National Pollutant Discharge Elimination System
Phase I & II
Municipal Separate Storm Sewer System
Permit No. 99-DP-3313 MD0068276
Permit Term October 2005 to October 2010

SHA State Highway Administration
Maryland Department of Transportation

Annual Report Update
October 21, 2015

Submitted to:
Water Management Administration
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, MD 21230

Submitted by:
Maryland State Highway Administration
Office Of Environmental Design
707 North Calvert Street, C-303
Baltimore, MD 21202

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

SHA State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

Date: October 21, 2015

Re: Annual NPDES MS4 Phase I and II Report Update
Permit No. 99-DP-3313 MD0068276 Continuation

Mr. Raymond Bahr
Sediment, Stormwater, and Dam Safety Program
Water Management Administration
Maryland Department of the Environment
1800 Washington Boulevard, Suite 440
Baltimore, Maryland 21230

Dear Mr. Bahr,

The Maryland State Highway Administration (SHA) is pleased to submit this final Annual Report Update addressing conditions under the expired permit issued for the SHA National Pollution Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) in 2005. The report covers compliance efforts from October 1, 2014 through September 30, 2015 and includes updates for both Phase I and Phase II jurisdictions. We submitted a re-application for the NPDES Phase I MS4 permit on October 21, 2009 and recently received a new permit, which took effect on October 9, 2015. Future annual reports will address conditions under the new permit.

SHA has fulfilled the requirements and purpose of the expired permit, and has expanded the program to comply with additional conditions of the new permit. This submission includes one hard copy and an electronic version of the report along with accompanying digital geodatabase files. Full geodatabase information was provided with the 2014 Annual Report Update on October 21, 2014 and the information provided herein only includes new data updates for this reporting period. The geodatabase information provided is prepared in compliance with the version of Attachment A included in the Draft MS4 Permit provided to SHA on December 26, 2012.

If you have any questions or need additional information regarding this delivery, please contact Ms. Karen Coffman at 410-545-8407 (or via email at kcoffman@sha.state.md.us) or me at 410-545-8644 (or via email at rshreeve@sha.state.md.us).

Sincerely,

Robert Shreeve, Deputy Director
Office of Environmental Design

Attachments
cc: Mr. Dave Coyne
Ms. Sonal Sanghavi
Mr. Doug Simmons

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Prepared by:
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SHA State Highway Administration

Executive Summary

This is the final annual report for the Maryland State Highway Administration (SHA) National Pollution Discharge Elimination System (NPDES) Phase I Municipal Separate Storm Sewer System (MS4) permit issued in October 2005 and Phase II MS4 Permit issued in November 2004 by the Maryland Department of the Environment (MDE) Water Management Administration (WMA). MDE issued SHA a new Phase I MS4 permit that is effective beginning October 9, 2015 through October 8, 2020 and the next annual report will discuss compliance under the new permit authority. SHA properties in Phase I and II jurisdictions are combined under this new permit.

This report covers the time period of October 1, 2014 to September 30, 2015. The following is a general overview and highlights significant achievements during the reporting period.

Source Identification

Impervious accounting and 25 project restoration requirements under the expired permit have been completed for the eleven Phase I and II counties and the three Phase II municipalities. The MDE document entitled *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* was issued in August 2014 and SHA has worked to adjust our accounting to meet these new guidelines.

GIS data for both the SHA storm drain systems and stormwater management facilities was completed under the expired permit term and regular schedules for updating asset data are included here. Restoration project data has been added to our overall GIS system as well in anticipation of increased restoration requirements with the new permit.

On March 19, 2015, MDE issued a new geodatabase design and User's Guide. SHA is working towards compliance with these new data reporting standards and they will be incorporated into the next annual report.

Discharge Characterization

SHA continues to investigate and research topics to maximize water quality in our construction methods, permanent stormwater runoff controls, decisions in design, and maintenance techniques. SHA is conducting additional research activities related to meeting the anticipated waste load allocations for designated watersheds with a Total Maximum Daily Load (TMDL). Current research studies include: Management of Nitrogen in Stormwater Runoff Using a Modified Conventional Sand Filter; Enhancements for N and P Removal from Stormwater Management Facilities for Multi-Modal Transportation Infrastructure in Maryland: Multi-Criteria Plant Selection for Vegetated Stormwater Control Measures; Evaluation of Compost Addition to Stormwater Control Measure Performance; NASA Satellite Imagery for Highway Runoff Stormwater Management Potential; Street Cleaning Research; Outfall Stabilization Sediment Reduction Credit Analysis; and Bioretention Soil Assessment.

Management Program

The SHA NPDES program continues to effectively incorporate all permit components. We have successfully integrated the stormwater environmental site design (ESD) regulations into roadway design and construction projects. SHA continues to measure and improve our performance in the areas of erosion and sediment control (ESC) during construction. Internal business goals to decrease pollutant discharges to the Chesapeake Bay and maximize the number of functionally adequate stormwater facilities statewide continue to be measured and reported.

SHA and MDE have entered into an agreement for delegated authority of SWM and ESC permitting. This agreement was implemented over the past year and required reporting is included here.

Watershed Assessment

SHA has incorporated watershed assessment efforts as described by the permit in the overall business process by continuing to evaluate highway drainage areas for stormwater management retrofit opportunities and coordinate with local jurisdictions on watershed restoration plans to maximize water quality benefits.

SHA exchanges the latest available geographic information system (GIS) highway data with permitted NPDES municipalities and provides the most recent spatial database of drainage assets and stormwater infrastructure to MDE. SHA completed the impervious surface accounting by the fourth annual report and continues systematically updating this dynamic layer. In preparation for increased restoration requirements under the new permit, SHA has been assessing areas that lack highway runoff control and treatment and implementing water quality improvement projects to maximize water quality benefits.

SHA also participates in a number of endeavors to expand and maximize watershed assessment initiatives and build partnerships with Federal, State, and local agencies.

Watershed Restoration

SHA continues to construct stormwater management retrofits to increase pollutant control associated with highway runoff. Requirements for this permit condition to implement twenty-five significant stormwater management retrofit projects to improve water quality of highway runoff has been met. Watershed restoration projects include functional enhancements and upgrades of stormwater facilities that do not meet current design standards as well as construction of additional stormwater BMPs to treat currently untreated impervious surfaces. Stream restoration and stabilization projects have also been implemented.

Assessment of Controls

The Long Draught Branch stream restoration project was designated early in the permit term as the watershed restoration project for assessing pre- and post- construction controls. Pre-construction monitoring has been completed. The original project design did not receive Wetland and Waterways approval and the project has been redesigned to address agency comments. SHA will proceed with the joint permit application and advertise for construction in February 2017, so the project can be constructed in 2017-2018. For the new permit requirement, SHA will develop a new watershed project for monitoring.

Program Funding

SHA's NPDES program remains fully funded, and is a priority. SHA and MDOT have begun funding Bay TMDL efforts and also supported procurement of NPDES engineering contracts.

Total Maximum Daily Loads

The SHA MS4 Phase I permit for this reporting period states that owners of storm drain systems that implement the requirements of the permit will be controlling stormwater pollution to the maximum extent practicable. However, the current mandate to restore the Chesapeake Bay by 2025 and the recently issued MS4 Phase I permit requirement for 20% impervious restoration by 2020 are significant efforts that SHA has anticipated. We have increased our funding, staffing and program initiatives in order to meet these deadlines.

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Part 1

Standard Permit Conditions and Responses

PART ONE

Standard Permit Conditions and Responses

1 Introduction

The Maryland State Highway Administration (SHA) is committed to continuing our National Pollutant Discharge Elimination System (NPDES) Program efforts, and is pleased to partner with the Maryland Department of the Environment (MDE), the Environmental Protection Agency (EPA) and other NPDES jurisdictions in order to achieve the program goals.

The original NPDES Phase I and II permit guided SHA through establishing our NPDES program. (The permit, MS-SH-99-011, was issued on January 8, 1999 and expired in 2004.) The next permit (99-DP-3313, MD0068276, issued October 21, 2005 and expired on October 21, 2010) focused on improving water quality benefits, developing an impervious accounting database and developing a watershed-based outlook for stormwater management and NPDES program elements. SHA submitted a re-application for the NPDES Phase I Municipal Separate Storm Sewer System (MS4) permit on October 21, 2009 and a new permit was recently issued to SHA on October 9, 2015. This report covers compliance with the expired permit that was issued in 2005.

This is the fifth and final annual update to the final annual report that was submitted October 21, 2010 for the expired permit. This report covers the period from October 1, 2014 through September 30, 2015, and combines reporting for both Phase I and II jurisdictions. Geographically, this report covers SHA compliance for storm drain systems, industrial shops and management programs within Anne Arundel, Baltimore, Carroll, Cecil, Charles, Frederick, Harford, Howard, Montgomery, Prince Georges and Washington Counties as well as Cumberland, Cambridge and Salisbury municipalities. (See Figure 1-1 on the following page)

Part One lists permit conditions and explains SHA activities over the last year to comply with each one. Wherever possible, future activities and schedules for completion are provided. Part Two of this report discusses the SHA Stormwater Management (SWM) Facility Program in depth. Appendices are included at the end of the report that contain information on data, research, and monitoring reports.

A CD is included that contains portable document format (PDF) files of the report, database tables and GIS spatial data. The SHA storm drain and stormwater management data included is an update only from last year's delivery. The entire geodatabase will be delivered next year when we have achieved compliance with the new MDE geodatabase design delivered to the MS4 jurisdictions on March 19, 2015.

A Administration of Permit

Administration coordinator for the NPDES Program is listed below and an organizational chart detailing personnel responsible for major program components is included on page 1-3 as Figure 1-2.

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The SHA coordinator for the MS4 permit is:

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Chief, Water Programs Division
Office of Environmental Design
(410) 545-8407
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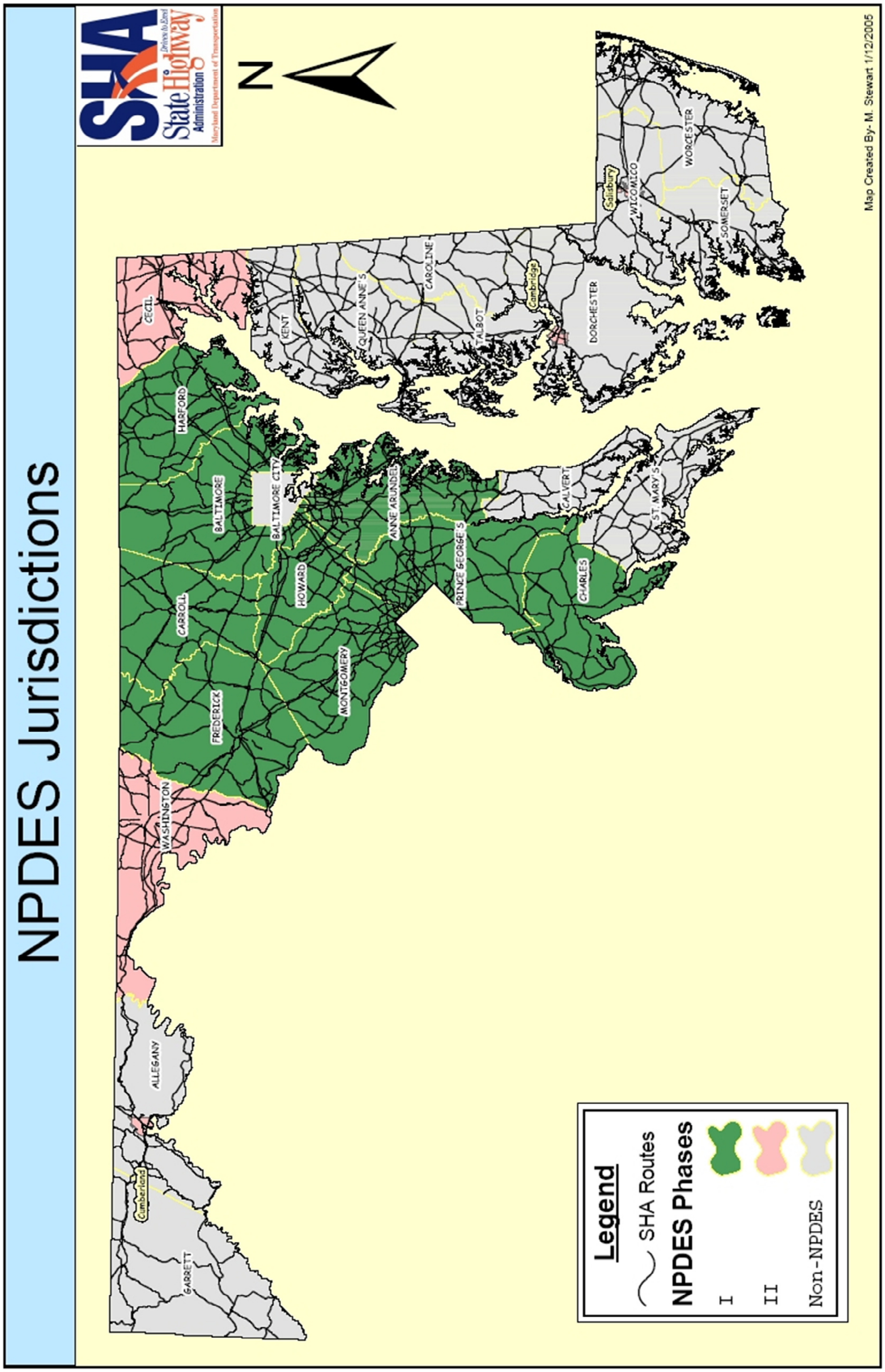

Figure 1-1: NPDES Municipal Separate Storm Sewer System (MS4) Jurisdictions

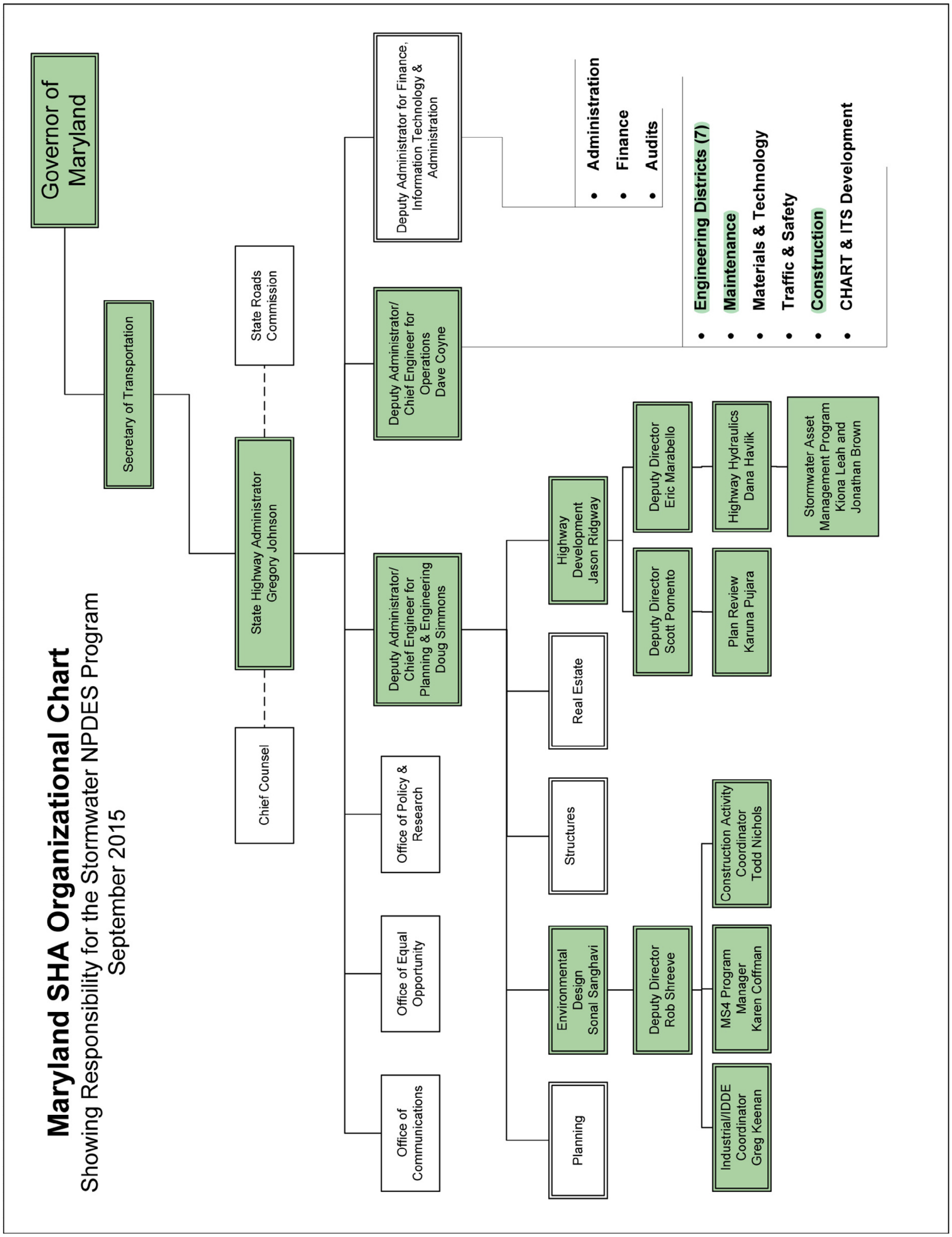

Figure 1-2: 2015 Organizational Chart for SHA NPDES MS4 Permit Administration

B Legal Authority

A description of the legal authority maintained by SHA was restated in the fourth annual report dated October 21, 2009 and remains unchanged.

C Source Identification

According to the permit language, source identification deals with identifying sources of pollutants and linking those sources to specific water quality impacts on a highway district basis. Source identification is also tied to impervious surfaces and land uses.

For this permit term, MDE has defined the source identification effort as completing the description of the SHA storm drain and BMP system, submitting BMP data to MDE, and creating an impervious surface account.

Maryland SHA has successfully completed the GIS development of SHA storm drain systems within the nine Phase I MS4 counties, two Phase II counties, and three Phase II municipalities. Maryland SHA has initiated identification of SHA storm drain systems outside of the permit areas. We are utilizing advances in technology and software improvements to more effectively and efficiently collect and maintain data sets. These process improvements will enhance communication between offices regarding the goals and needs for NPDES.

C.1 Describe Storm Drain System

Requirements under this condition include:

a) *Complete Source identification requirements by October 21, 2009;*

b) *Address source identification data compatibility issues with each jurisdiction where data are collected. Data shall be organized and stored in formats compatible for use by all governmental entities involved;*

c) *Continually update its source identification data for new projects and from data gathered during routine inspection and repair of its municipal separate storm sewer system; and*

d) *Submit an example of source identification for each jurisdiction where source identification is being* compiled.

C.1.a Complete Source Identification

SHA completed the identification and GIS development for our storm drain systems and stormwater management facilities in 2008, well before the October 21, 2009 deadline. Our focus has shifted to updating our source identification information for the Phase I and II MS4 jurisdictions. We have also added in a similar protocol for tracking the same information in eleven additional counties and only exclude Garrett County at this time from these efforts. We are also preparing to update our current data structure to integrate new data standards provided in the final version 1.0 of MDE MS4 Geodatabase and documentation requirements in the *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* guidance published by MDE in August 2014. Information on source identification updates and updates to the data structure are included under section C.1.c, Update Source Identification Data.

C.1.b Data Compatibility

SHA continues to share information with other MS4 jurisdictions and MDE, specifically providing and acquiring data to support planning, management, and monitoring activities. The storm drain and restoration project data generated by SHA is deployed using the Esri geodatabase format in an ArcSDE enterprise environment. It is either natively compatible with other jurisdictions, or can be exported to Esri shapefile format. The current SHA geodatabase and data dictionary can be reviewed in Appendix A and on the included CD.

SHA has supported MDE efforts to update their NPDES data and reporting requirements by coordinating with their consultant, Maryland Environmental Services (MES), and providing our TMDL data standards, NPDES Standard Procedures, and geodatabase structure to them. Since MDE has released the MS4 geodatabase v1.0, SHA is adopting this structure and is working to standardize our data to ensure compliance.

Geospatial Database Development

SHA has developed a geospatial database for our source identification and inspection data. This database will be expanded to include other components of the program as they are brought together and as we update our standard procedures and inspection manuals. All of the SHA MS4 data including source identification, SWM facility inspections, outfall screening, outfall inspections, and impervious area acre amounts are currently housed in the database.

A SHA-wide web-based application, known as Enterprise GIS (eGIS), was developed to display content themes for decision making purposes. Content themes allow the user to overlay datasets without extensive knowledge of the Esri tool sets. MS4 data has been included as a content theme in eGIS.

Google Earth is an alternative method to present and communicate storm drain asset information to parties outside of the SHA firewall. It provides a user-friendly framework for information to be communicated to SHA Districts and the consultant community through the distribution of KML and KMZ files that open directly in Google Earth (See Figure 1-3 below).

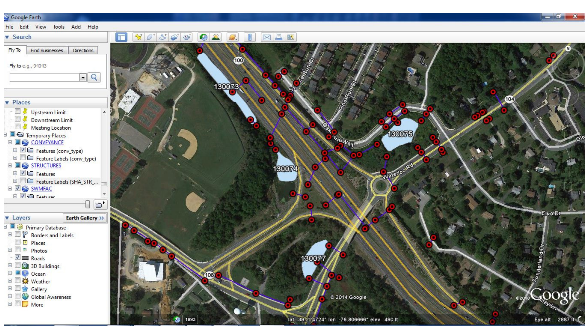

Figure 1-3: Google Earth Screenshot of SHA NPDES Data Uploaded as KML

Software Development

The 2010 Annual Report contains a description of the SHA GIS field software application developed for gathering data to populate the database. Software application updates are performed using available resources and employing new technological advances as needed. Table 1-1 represents the upgrade status.

Table 1-1: GIS Application Development

Phase of Development	% Complete
SWM Program Module	100
SWM Facility Numbering Module (eGIS)	100
eGIS Integration	100
eGIS IDDE Module	Initiated

SHA Data Development Procedures and Standards

SHA has available standard procedures for data development, asset inspections, illicit discharge investigations and stormwater facility remediation. These are combined into the *MD SHA Stormwater NPDES Program Standard Procedures Manual*. This manual will be updated to include new geodatabase requirements, restoration asset management and updates to illicit discharge compliance procedures. The current manual includes the following chapters:

1. Introduction
2. Source Identification and Inventory
3. BMP Inspections
4. Storm Drain Outfall Inspection Program
5. Illicit Discharge Detection and Elimination Procedures
6. BMP Assessment Guidelines for Maintenance and Remediation
7. Rapid Assessment Guidelines for Outfall Channels

A more recent addition to SHA standardized procedures for the NPDES program is the *Maryland SHA Stormwater NPDES Program Data Management and Editing Tools Manual.* This manual outlines the data management workflow, discusses office and field editing applications that are used to assist in data collection, and discusses the procedures and process for quality control of the stormwater database. SHA data managers and editors utilize the procedures outlined in the manual to manage data and GIS needs for the SHA MS4 stormwater program.

C.1.c Update Source Identification Data

Since the initial source identification has been completed for all the NPDES MS4 Phase I and II counties, the permit activity requirement for this condition now focuses on updating the storm drain asset data.

Source identification updates are performed with the goal to meet the required three-year inspection cycle and we have improved our processes in order to meet this timeframe. Future updates have been scheduled to meet this goal once the maintenance and remediation efforts have been completed for SHA assets in a particular county. The process for performing GIS data updating has been revised and will be performed in four phases for each county.

- SWM Features- This phase includes verification, inspection, and updating data attributes for existing SHA stormwater facilities
- IDDE Update – This phase includes the verification and inspection of all major and minor outfalls within SHA right-of-way to meet requirements of Illicit Discharge Detection and Elimination (IDDE).
- Data Quality - This additional step was recently added to the process due to the overall scale to the information. The phase includes quality control and assurance for the data set.
- New Feature Update- This phase includes the inputting, verification, and inspection of newly constructed SWM and drainage assets.

The schedule for initiation of these phases and future updates are specified in Table 1-2. The latest data collected is as follows:

Table 1-2: Source ID Schedule

Jurisdiction	SWM Feature	IDDE Update	Data Quality Update	New Feature Update
Anne Arundel County	July-16	August-14	November-14	December-14
Baltimore County	July-16	February-12	February-15	May-15
City of Cambridge	April-14	December-14	August-17	December-16
Carroll County	July-16	March-12	July-15	July-15
Cecil County	July-16	October-14	January-15	May-15
Charles County	July-16	March-12	July-15	September-15
City of Cumberland	September-14	January-15	September-17	May-17
Frederick County	July-16	September-15	May-18	August-17
Harford County	July-16	September-14	May-17	May-17
Howard County	July-16	February-12	March-15	June-15
Montgomery County	October-15	December-14	November-14	December-14
Prince George's County	July-14	October-14	November-14	December-14
City of Salisbury	April-14	December-14	August-17	December-16
Washington County	July-16	April-12	April-15	June-15

Phase I

Anne Arundel County – Updated identifications of the separate storm water system and outfall and BMP inspections were completed during this reporting period and are included in this report. Inspections within this county are underway and will be completed during spring 2016.

Baltimore County – Updated identifications of the separate storm water system and outfall and BMP inspections were completed in 2012.

Inspections within this county are kicking off and will be completed during spring 2016.

Carroll County – Updated identifications of the separate storm water system and outfall and BMP inspections were completed in 2012.

Charles County – Updated identifications of the separate storm water system and outfall and BMP inspections were completed in 2012. Inspections within this county are kicking off and will be completed during spring 2016.

Frederick County – Updated identifications of the separate storm water system and outfall and BMP inspections were completed and included in the 2011 Report. Inspections within this county are kicking off and will be completed during spring 2016.

Harford County – Updated identifications of the separate storm water system and outfall and BMP inspections were completed and included in the 2011 Report. Inspections within this county were started in September 2015 and will be completed during early 2016.

Howard County – Updated identifications of the separate storm water system and outfall and BMP inspections were completed in 2012. Inspections within this county are kicking off and will be completed during spring 2016.

Montgomery County – Updated identifications of the separate storm water system and outfall and BMP inspections were included in the 2011 Report. IDDE screenings were completed in December 2014. Inspections within this county are underway and will be completed in October 2015.

Prince George's County – Updated identifications of the separate storm water system and outfall and BMP inspections were completed during this reporting period and are included in this report. Inspections within this county were completed in October 2014.

Phase II

Cambridge, Cumberland and Salisbury Cities – This original inventory work was completed in 2014.

Cecil County – The GIS inventory of SHA storm drain, BMP and outfall information, and inspections in Cecil County was completed in 2008. Inspections within this county were completed in October 2014.

Washington County –The GIS inventory of SHA storm drain, BMP and outfall data and inspections in Washington County were completed in 2012.

C.2 Submit BMP Data

Database tables are included on the attached CD as noted in the Introduction.

C.3 Create Impervious Surface Account

This condition requires that SHA provide a detailed account of impervious surfaces owned by SHA and an account of those acres of impervious surface controlled by stormwater management, broken out by SHA engineering district. This account will be used to identify potential areas for implementing restoration activities.

We completed the impervious accounting requirement and the baseline accounting numbers were reflected in the 2010 report. Table 1-3 (on the following page) displays the baseline untreated impervious numbers for SHA by county and progress of the restoration based on the requirement for twenty-five restoration projects (permit condition G.1). Figure 1-4 (on the following page) provides a graphic illustration of the progress.

Our impervious accounting is currently being updated based on the August 2014 MDE NPDES Accounting Guidance. Restoration projects identified in this report as complying with the expired permit requirements will be placed in the baseline 'treated' accounting for the new permit term.

Table 1-3: SHA Impervious Restoration Accounting by County

County	Baseline Total Impervious	Baseline Untreated Impervious (AC)	Baseline Treated Impervious (AC)	Impervious Acres Restored by Permit Condition (AC)	Impervious Acres Restored by Permit Condition (%)	Adjusted Untreated Impervious (AC)	Total Impervious Treated (%)
Anne Arundel	3979	3096	883	67	2.2%	3029	23.9%
Baltimore	4140	3790	350	460	12.1%	3330	19.6%
Carroll	1312	1198	114	0	0%	1198	8.7%
Cecil	1189	1174	15	0	0%	1174	1.3%
Charles	1323	1156	167	2	0.2%	1154	12.8%
Frederick	2396	2091	305	2	0.1%	2089	12.8%
Harford	1665	1487	178	21	1.4%	1466	12.0%
Howard	2144	1729	415	15	0.9%	1714	20.1%
Montgomery	3686	3058	628	8	0.3%	3050	17.3%
Prince George's	4535	4001	534	26	0.6%	3975	12.3%
Washington	2168	2073	95	0	0%	2073	4.4%
Totals	**28,537**	**24,853**	**3,684**	**601**	**2%**	**24,252**	**15.0%**

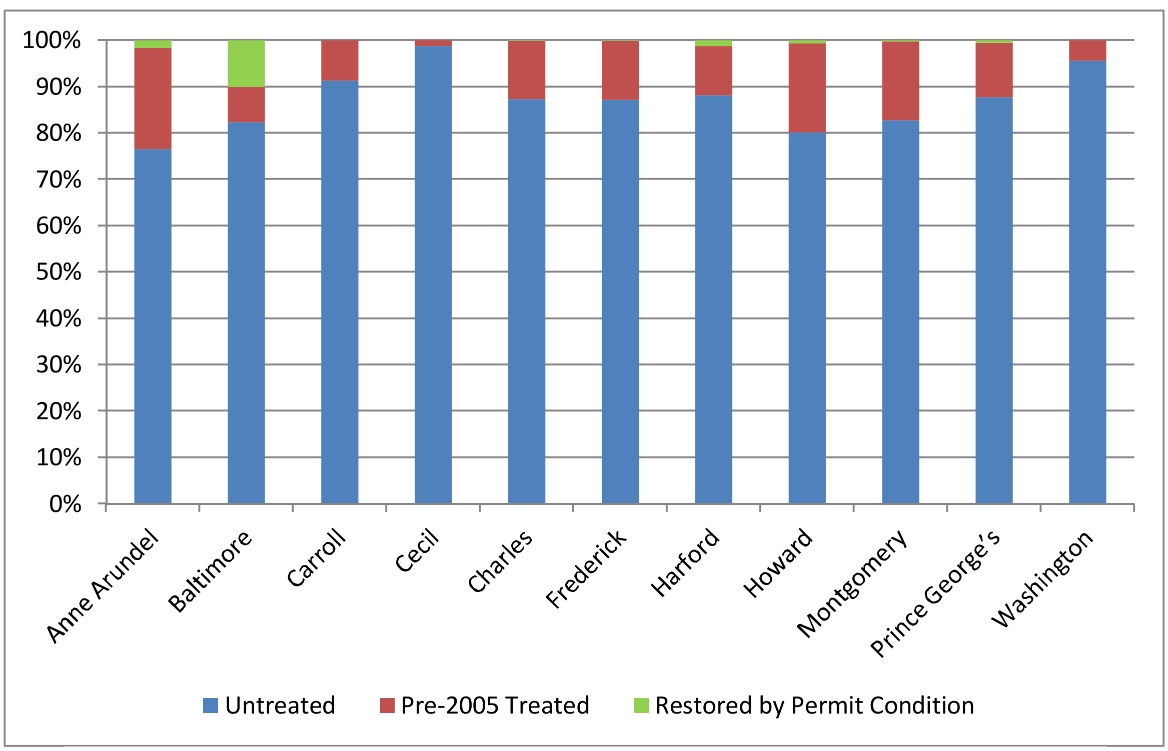

Figure 1-4: SHA Impervious Restoration Progress by County

Impervious Layer Updates

The GIS spatial layer delineating and quantifying impervious surfaces owned and treated by SHA has been updated during the past reporting cycle. Over the past year, a number of adjustments were made to the impervious data to improve both the spatial and reporting accuracy. These efforts will continue as we finalize our impervious accounting under the new permit and include:

- Research has been performed to verify that only SHA roads are included in the data and to identify SHA owned roads that were not originally collected. Also, roadways discovered not to be owned by SHA were removed.
- Howard County data was updated using 2011 orthophotos to be consistent with data developed for SHA properties in the other Phase I counties.
- SHA-owned stormwater management facility data and associated drainage areas were updated. This allowed for a more precise assessment of treated and untreated impervious surfaces. Updates for drainage areas in Howard, Montgomery, Prince Georges and Anne Arundel counties are under development.
- The data was reviewed and corrected for any additional anomalies and automated tools were used to eliminate data overlaps and slivers.

During this reporting period, SHA has initiated updates in Anne Arundel, Howard, Montgomery and Prince George's counties.

In accordance with the August 2014 MDE Accounting Guidance, SHA has initiated efforts to research documentation for existing stormwater facilities such as permits and stormwater reports. This information allows us to verify the impervious surfaces treated and quantify the amount and type of water quality treatment provided. The result will be updated numbers for pavement treated against which new baseline treatment requirements can be calculated for the next permit term.

Table 1-4 indicates the current status of impervious layer updates in each Phase I and II MS4 County.

Table 1-4: Impervious Layer Update Status

County	Impervious Layer Update Status
Anne Arundel	In Progress
Baltimore	Complete
Carroll	Complete
Cecil	Complete
Charles	Complete
Frederick	Complete
Harford	Complete
Howard	In Progress
Montgomery	In Progress
Prince George's	In Progress
Washington	Complete

D Discharge Characterization

SHA continues to research the impacts of various controls on highway stormwater runoff. Discharges to and from stormwater control measures (SCMs) and other treatment methods are measured and analyzed. Over the permit term, we have investigated several areas of concern including:

- Grass swales
- Thermal impacts
- Pollutant removal efficiencies
- Urban runoff
- Wet infiltration
- Bioretention soil
- Sand filters
- Outfall Stabilization

Typically, the pollutants measured include:

- pH
- Temperature
- Total suspended solids (TSS)
- Nutrients
  - Total phosphorus (TP)
  - Total Kjeldahl nitrogen (TKN)
  - Oxidized nitrogen
- Heavy metals (total)
  - Copper (Cu)
  - Lead (Pb)
  - Zinc (Zn)
- Chlorides

In some instances, other monitored parameters include oil, grease, petroleum, and other hydrocarbons; turbidity; and fecal coliforms.

To ensure consistency, test methods adhere to standards specified by Federal Regulations under CFR 136. Auto-samplers are used as much as possible since it is difficult to determine exactly when and where precipitation events will occur and to allow sufficient travel time to sampling locations..

The data from our research efforts and discharge characterization activities may be used towards new designs and evaluations of both existing and proposed SCMs. The information is also used to assess the effectiveness of current SWM asset function and can inform future implementation strategies and long-term decisions..

Characterization of SHA highway runoff was completed in the previous permit term (1999 to 2004) and results were reported in the following documents.

Annual Report: Pindell School Road Storm Sampling, KCI, March 7, 2000.

National Highway Runoff Study: Comparison to MSHA Sampling Results, KCI, December 2001.

Dulaney Valley Road I-695 Interchange Stream Monitoring at the Tributary to Hampton Branch, KCI, Annual Reports dating 2000 to 2003.

Research activities that were completed during this permit term (2005-2010/15) and reported in previous annual reports include the following.

First Annual Report (October 2006):

Low Impact Development Implementation Studies in Mt. Rainier, MD, University of Maryland, December 2005.

Grassed Swale Pollutant Removal Efficiency Studies (Part II – MDE/SHA Swale Comparison), University of Maryland, October 2006.

Mosquito Surveillance/Control Program for SWM Facilities in Baltimore, Howard, Montgomery and Prince Georges Counties (2003-2005), Millersville University, October 2006.

Second Annual Report (October 2007):

Grassed Swale Pollutant Removal Efficiency Studies (Part III – Grass Check Dams), University of Maryland, August 2007.

Literature Review: BMP Efficiencies for Highway and Urban Stormwater Runoff, Progress Report, University of Maryland, September 2007.

Underground SWM Thermal Mitigation Studies, Progress Report, University of Maryland, August 2007.

Prediction of Temperature at the Outlet of Stormwater Sand Filters, Progress Report, University of Maryland, August 26, 2007.

Third Annual Report (October 2008):

Grassed Swale Pollutant Removal Efficiency Studies: Field Evaluation of Hydrologic and Water Quality Benefits of Grass Swales with Check Dams for Managing Highway Runoff (Part III continuation), Progress Report, University of Maryland, October 2008.

Thermal Impact of Underground Stormwater Management Storage Facilities on Highway Stormwater Runoff, Progress Report, University of Maryland, October 2008.

Fourth Annual Report (October 2009):

Field Evaluation of Water Quality Benefits of Grass Swale for Managing Highway Runoff (Part III – Grass Check Dams), Progress Report, University of Maryland, July 2009.

Nutrient Removal Optimization of Bioretention Soil Media, Progress Report, University of Maryland, August 2009.

Field Evaluation of Wet Infiltration Basin Transitional Performance, Progress Report, University of Maryland, August 2009.

Fifth Annual Report (January 2010):

Field Evaluation of Water Quality Benefits of Grass Swale for Managing Highway Runoff, Progress Report, University of Maryland, July 2009.

Field Evaluation of Wet Infiltration Basin Transitional Performance, Progress Report, University of Maryland, August 2009.

Nutrient Removal Optimization of Bioretention Soil Media, Final Report, University of Maryland, September 2010.

Annual Report Update (October 2011):

Although there were no reports or findings that were included, new studies on enhancing nitrogen and phosphorus removal in existing and proposed SWM facilities were initiated and work on the field evaluation of wet infiltration basin transitional performance continued.

Annual Report Update (October 2012):

Field Evaluation of Wet Infiltration Basin Transitional Performance, Progress Report, University of Maryland, July 2012.

Management of Nitrogen in Stormwater Runoff Using a Modified Conventional Sand Filter, University of Maryland, August 2012.

Denitrification Optimization in Bioretention Using Woodchips as a Primary Organic Carbon Source, First Year Progress Report, University of Maryland, July 2012.

Annual Report Update (October 2013)

Final Report: Evaluation of Transitional Performance of an Infiltration Basin Managing Highway Runoff, University of Maryland, 2012

Final Report: Advanced Denitrification in Bioretention Systems Using Woodchips as an Organic Carbon Source, University of Maryland, 2013

Management of Nitrogen in Stormwater Runoff Using a Modified Conventional Sand Filter and *Enhancements for N and P Removal from Stormwater Management Facilities for Multi-Modal Transportation Infrastructure in Maryland,* University of Maryland, 2013

Multi-Criteria Plant Selection for Vegetated Stormwater Control Measures, University of Maryland, 2013

Annual Report Update (October 2014)

Final Report: Recommendations for the State Highway Administration on Stormwater Control Measures and Research Efforts for Multimodal

Transportation Infrastructure in Maryland that Promote More Effective and Sustainable Stormwater Runoff Management. University of Maryland, 2014

Final Report: Advanced Denitrification in Bioretention Systems using Woodchips as an Organic Carbon Source. University of Maryland, 2014

Ongoing Studies

Current research continues and progress is discussed below.

Management of Nitrogen in Stormwater Runoff Using a Modified Conventional Sand Filter

The surface sand filter is a common SWM facility type that was frequently used between 2003 and 2010. They continue to be a popular choice when conditions are appropriate for its use, such as the means of SWM for salt barn facilities. However, sand filters are not necessarily an optimal choice for reducing nutrient concentrations in stormwater runoff. Because of the number of sand filters in our asset inventory, and because we are interested in techniques to enhance existing facilities to increase nitrogen and phosphorus removal efficiencies, the University of Maryland has continued to examine ways in which nitrogen removal may be improved in sand filter facilities.

To reduce nitrogen loading, the proposed design divides the sand filter into three zones to promote ammonification, nitrification, and denitrification. Nitrification was observed to automatically occur during low nitrogen loadings and dry periods, without any modifications to sand filter design. However, to achieve adequate media contact time for key biological denitrification processes to occur, sorptive materials must be incorporated into the sand filter bed.

The first phase of the project focused on the selection of adsorbents to increase the uptake of ammonium. Clays, recycled materials, and sands were selected for study. The time necessary for sorption to reach equilibrium with these materials was found to be 24 hours. However, due to the low sorption capacity and instability in the structure of clay agglomerates, testing of Georgia attapulgite and brown montmorillonite soils were abandoned. Sorption tests continued with California aluminosilicate (CA), crushed brick (BR), red montmorillonite (MR), and clinoptilolite zeolite (ZT). The sorption capacity of ZT was found to be the greatest of all adsorbents, followed by MR.

The second phase focused on small scale column studies for the sorption of ammonium to provide more comprehensive determinations on adsorbent performance. Based on the results, the column studies were expanded for further study in the third phase to better examine nitrification and sorption simultaneously to quantify the rate of nitrification and determine the optimum media thickness.

In the third phase, it was found that zeolite added to sand results in greater nitrogen removal. However, the presence of road salts, often a result of winter deicing operations, significantly impairs and eliminates the enhanced nitrogen removal capacity of the zeolite. Even without the presence of road salts, the enhancement only appears to be viable for about 18 months.

In the fourth phase, it was found that the media mix, depending on the additive used, may last from 5 to 108 months. This estimated value also depends on roadway deicing operations and the amount of chlorides released. It may also be possible for the media to regenerate itself depending on the viability and health of denitrifying biota living in the soil. A fifth phase was recommended, but we were unable to obtain funding to continue this study.

Enhancements for N and P Removal from Stormwater Management Facilities for Multi-Modal Transportation Infrastructure in Maryland: Multi-Criteria Plant Selection for Vegetated Stormwater Control Measures

The University of Maryland continues to examine vegetation selection used in bioretention and similarly-related vegetated SCMs (swales, bioswales, rain gardens, and planter boxes). While current criteria for plant selection are primarily based on survival, aesthetics and context, there may be facility performance benefits associated with specific plant species that may be quantified.

In the relationship between plants and soils, vegetation is known to help maintain soil porosity through root building and decay, promote nutrient extraction, and host beneficial microbial consortia in the rizosphere. However, we have found that during construction activities, successful vegetation establishment has also been a challenge, and we are concerned that this may also affect facility performance as well as aesthetic appeal and sustainability.

In phase one of the study, a full literature synthesis and review was completed and several plant species were identified that appear to better remove nitrogen (and various forms thereof), phosphorus, hydrocarbons, and heavy metals. Vegetation appears to offer other benefits as well, such as providing habitats within SWM facilities along with shade, which may reduce thermal impacts to waterways. However, some vegetation may not meet expected aesthetic appeal. Specifically, it appears that *Eutrochium* (Joe Pye) species, *Iris versicolor*, *Juncus effusus*, and *Panicum virgatum* are very hardy and acceptable (see Figures 1-5 through 1-8.) *Juncus effusus* tends to appear messy and may not be suitable for high-visibility areas. *Panicum virgatum* may also get too tall and interfere with sight-distance. Species that appear to consistently fail to survive are *Ilex verticillata* (winterberry), *Ilex glabra 'shamrock'*, and *Onoclea sensibilis* (sensitive fern)

Figure 1-5: Eupatorim dubium (Joe Pye Weed)

Figure 1-7: Panicum virgatum (Switchgrass)

Figure 1-6: Iris versicolor (Blue Flag Iris)

Figure 1-8: Juncus effusus (Soft Rush)

The study continues its second phase, which was extended a few more months to complete the work. Examination of plant species will continue. The completion of a recommended plant list, and possibly a recommended plants-to-avoid list, is anticipated to be completed at the end of phase two.

Evaluation of Compost Addition to Stormwater Control Measure Performance

To simultaneously achieve the goals of greater incorporation of recycled materials into our projects as well as facilitate meeting new requirements established by recent legislative mandates, research continues with the University of Maryland to examine how compost may be used in SWM facilities.

Laboratory experiments to identify compost leachate composition and concentrations were performed, along with some initial experiments to determine how the infiltration rate through filter media may change with variable compost concentrations that replace portions of the shredded hardwood bark amounts. A final report detailing findings and future research and study needs will ultimately be generated. Preliminary results indicate leachate in the forms of nitrogen and phosphorus occurs, particularly in compost derived from biosolids and manure.

NASA Satellite Imagery for Highway Runoff Stormwater Management Potential

This Project utilizes geospatial technologies (GST) with emphasis on Remote Sensing (RS) to process and analyze images from the National Aeronautics and Space Agency (NASA) Public Domain databases to enhance stormwater management (SWM) system for Maryland's State Highway Administration (SHA). Through this Project, GST methodologies will be developed (a non-invasive technique) to optimize the effectiveness of Highway Runoff Stormwater Management Potential (HRSMP) systems thereby reducing the negative environmental impacts to properties and financial cost to SHA.

Geographic Information System (GIS) and Differential Global Positioning System (DGPS) datasets will complement the remotely sensed datasets in order to improve the accuracy and integrity of the GST Methodologies. The Environment for Visualizing Images (ENVI) will form the major RS image processing software (as shown in Figure 1-9), while ArcGIS will be the core GIS software for this Project. Trimble's Handheld DGPS will be used for field verification activities (ground truthing) and other related *in situ* activities. Landsat Multispectral Scanner (MSS), Thematic Mapper (TM), and Enhanced TM will be utilized in this Research because of their multispectral/multitemporal characteristics. Finally, this Project will enable SHA to realize substantial reductions in highway project delivery time and meet its obligations to both State and Federal agencies. The study is in the final stages, and a final report is expected to be complete within the next reporting period.

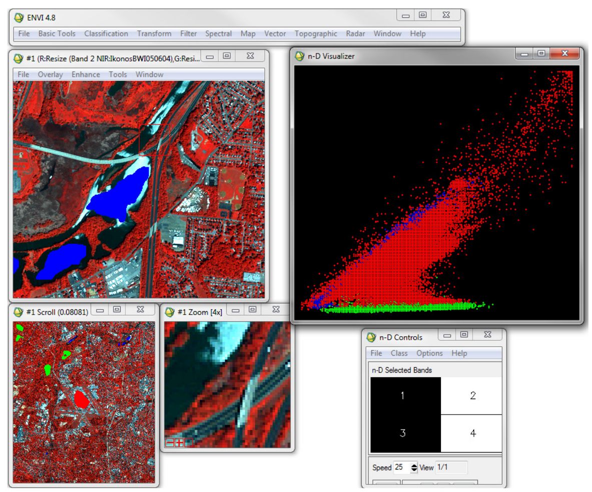

Figure 1-9: ENVI Software showing Visualizer Feature Extraction

New Studies

New studies have also been initiated, or are about to be initiated, and are as follows.

Street Cleaning Research

Both street sweeping and inlet cleaning operations are credited by MDE for NPDES and TMDL compliance as an alternative BMP. Street sweeping credits are well defined; however, inlet cleaning credit depends on an estimate of the load removed. SHA is undertaking an assessment of its operations to determine the appropriate level of credit from this practice and to collect information that could support enhancements to the existing credit allowed by MDE.

A prime challenge of meeting TMDL requirements is the mandate to quantify the pollutants captured and removed from inlets and road surface. Defining the composition of those captured solids is of major interest for SHA for compliance planning, implementation, and reporting. The results of this analysis will assess and recommend how SHA can optimize their inlet cleaning operations to maximize nutrient, sediment, and trash load reduction credits under MDE's current MS4 Guidelines.

Outfall Stabilization Sediment Reduction Credit Analysis

SHA is currently studying an alternative outfall credit protocol to more accurately predict TMDL credit for outfall restoration projects, and will be made available once complete. Outfall channels are first order channels with direct infrastructure interface. Previous studies found that a majority of material eroded from first order streams is not stored in the valley bottoms of second- to fifth-order streams. This indicates that the majority of sediment from outfall channels in the Chesapeake Bay watershed is transported into the Bay.

In order to quantify the amount of material that is available to erosion at an outfall site, methods provided in *Stream Restoration Design NRCS 2007* for finding equilibrium bank and bed slope are used in conjunction with field data for base level control and equilibrium bottom width. Together these data provide an approximate equilibrium condition that accounts for vertical and lateral erosion associated with outfall systems. Comparison between equilibrium and existing conditions provides a volume of material expected to be eroded and transported out of the outfall channel. This entire volume of material is adjusted by the bulk density and measured nutrient concentrations to determine the total reduction of pollutants provided by the outfall restoration project. In order to annualize the total reduction, two probable timeframes were evaluated based on engineering judgment of channel realignment.

As a case study the I-97 southbound Outfall Stabilization project is described, as seen in Figures 1-10 and 1-11 on the following page. This project is being designed by SHA-OED for TMDL crediting as part of their Capital Improvements projects. The I-97 outfall channel drains a 30 acre, 55% impervious watershed, and contains variable bank heights up to 21 ft consisting of primarily sand. Comparison between existing and equilibrium conditions indicates that 10,296 tons of material is expected to be eroded before the channel reaches equilibrium. Pollutant reductions using the alternative method are compared to the methods provided in CBP 2014 and the alternative method predicts eight times higher pollutant reduction on average than Protocol 1, assuming a 20 year timeframe. An imperious restoration equivalency that will allow the SHA to align outfall stabilization projects to the MS4 permit imperious restoration requirements is under development.

Figure 1-10: Outfall in need of Stabilization, I-97 in Anne Arundel County

Figure 1-11: Stabilized Outfall, I-97 in Anne Arundel County

Bioretention Soil Assessment

This research activity would use some of these less successful bioswale sites as test plots to research various elements of bioswale design, including soil mixes, vegetation, and design criteria. The goal of the proposed study is to identify improvements that could reduce maintenance and improve pollutant removal for future bioswale sites.

The solutions will take into account the practical requirements of installation and long-term maintenance. The research results will be needed in order to determine how to restore or rehabilitate failed installations

.

E Management Program

A management program is required to limit the discharge of stormwater pollutants to the maximum extent practicable. The idea is to eliminate pollutants before they enter the waterways. This program includes provisions for environmental design, erosion and sediment control, stormwater management, industrial facility maintenance, illicit connection detection and elimination, and personnel and citizen education concerning stormwater and pollutant minimization.

E.1 Environmental Design Practices

This permit condition requires that SHA take necessary steps to minimize adverse impacts to the environment through the roadway planning, design, and construction process. Engaging the public in these processes is also required.

The Maryland State Highway Administration has a strong environmental commitment that has only increased as the new Stormwater Management Act of 2007 was implemented in May 2010. Through this legislation, emphasis was placed on the use of environmental site design (ESD) techniques. We are actively working ESD measures into roadway projects.

SHA also continues to adhere to processes that ensure that environmental and cultural resources are evaluated in the planning, design, construction and maintenance of our roadway network. This includes providing opportunity for public involvement and incorporating context sensitive solutions. We also ensure that all environmental permitting requirements are met by providing training to our personnel (see E.6.b on page 1-38) and creating and utilizing software to track permitting needs on projects as they move through the design, advertisement and construction processes.

NEPA/MEPA Process

SHA's National Environmental Policy Act/ Maryland Environmental Policy Act (NEPA/MEPA) design and planning process, includes developing and obtaining approval on environmental documentation for any project proposed utilizing state or federal funding. SHA also assists local jurisdictions through the environmental documentation process so they remain eligible to receive state/federal funds, such as Transportation Alternatives Program funds. An early step in the process is to identify the natural, community, and cultural resources that exist in the project study area and determine the level of environmental documentation and stakeholder involvement needed. The final environmental document may be a Categorical Exclusion (CE) for minor impacts, Finding of No Significant Impact (FONSI) for more substantial impacts, or Environmental Impact Statement (EIS) and Record of Decision (ROD) for major impacts or when significant stakeholder controversy surrounds the project.

Increasingly, SHA is evaluating stormwater needs during the NEPA process to address Environmental Site Design requirements. This movement requires that stormwater concepts be developed during the planning process, and has affected the development process in several ways. Beginning the stormwater process earlier allows more realistic concepts to be presented during public meetings and allows more accurate assessments of right-of-way needs. The drawback to this approach, however, can be that assumptions made in terms of the stormwater requirements may not be the final approved requirements as plans change during the design process. This can have negative impacts on the permit approval process, public expectations, right-of-way acquisitions, and design schedules. SHA encourages the stormwater regulatory reviewers to participate in the planning process by attending interagency meetings, reviewing concept plans, and providing valid comments and concept approvals at the planning stage of design.

It should be noted, however, that the planning process for major projects and the project development timeline can be greater than cycles of regulatory changes for water quality. This further introduces complexity in decision making and public perception of accuracies of SHA projects and processes.

Effort is made to avoid or minimize environmental impacts. If impacts are unavoidable, however, mitigation is provided and monitored per regulatory requirements.

E.2 Erosion and Sediment Control

Requirements under this condition include:

a) *Use of MDE's 2011 Standards and Specifications for Soil Erosion and Sediment Control, or any subsequent revisions, evaluate new products for erosion and sediment control, and assist MDE in developing new standards; and*

b) *Perform responsible personnel certification ('Green Card') classes to educate highway construction contractors regarding erosion and sediment control requirements and practices. Program activity shall be recorded on MDE's "green card" database and submitted as required in Part IV of this permit.*

E.2.a MDE ESC Standards

SHA continues to comply with Maryland State and Federal laws and regulations for erosion and sediment control (ESC) as well as MDE requirements for permitting. We maintain compliance with the NPDES Stormwater Construction Activity permit for projects that disturb one acre or more of land.

We continue compliance with the Maryland Erosion & Sediment Control Guidelines for State and Federal Projects published in January 1990 and revised in January 2004. In December 2011, MDE published the 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control. Projects are designed and constructed in compliance with the new specifications. SHA updated their Erosion and Sediment control field guide to support the 2011 MDE specifications. The laminated book version is used as a field tool where users have the option of writing (dry erase) notes in the book.

SHA has implemented changes to construction inspection practices to maintain compliance with the NPDES Construction Activity Permit by drafting a new evaluation form (QA-2) to measure NPDES and Stormwater Management (SWM) requirements. We continue to submit applications for coverage under this general permit for all qualifying roadway projects.

SHA ESC Quality Assurance Ratings

SHA continues to use our improved Quality Assurance rating system for ESC on all roadway projects. This effort is designed to improve field implementation of ESC measures through a rating system (by issuing grades A – F) and by including incentive payments to the contractor for excellent ESC performance. Under this system, the contractor incurs liquidated damages for poor ESC performance.

SHA tracks quality assurance inspections and ratings for reporting to our business plan and StateStat. Increased numbers of inspections and better documentation have improved the overall performance of our ESC program. Incentive payments are made when the contractor receives an ESC rating score of 85% or greater over the course of each rating quarter (three months). A final incentive payment is also made for projects with an overall (average) rating of 85% or better.

On SHA design-build projects compensation for erosion and sediment response action related to severe weather is addressed by specification. This compensation is in addition to the incentive for excellent performance as stated above.

Liquidated damages are imposed on the contractor if the project receives a 'D' or 'F' rating. If two ratings of 'F' are received on a project, the ESC certification issued by SHA will be revoked from the contractor project superintendent and the ESC manager for a period of six months and upon successful completion of the certification training. This system of rewarding good performance and penalizing poor performance has shown to improve contractor responsibility for ESC practices. It has also improved water quality associated with earth disturbing and construction activities.

In FY 2015, a record number of inspections (4233) on a record number of projects (342) reviewed, yielded an overall compliance of 99.6 percent (See Figures 1-12 and 1-13).

In the past year, SHA prepared a revised standard form (OOC61/QA-1) – Independent Quality Assurance Erosion and Sediment Control Field Investigation Report used for ESC and NPDES construction tracking in an effort to increase compliance with both State and Federal ESC regulations. This form is currently being used statewide.

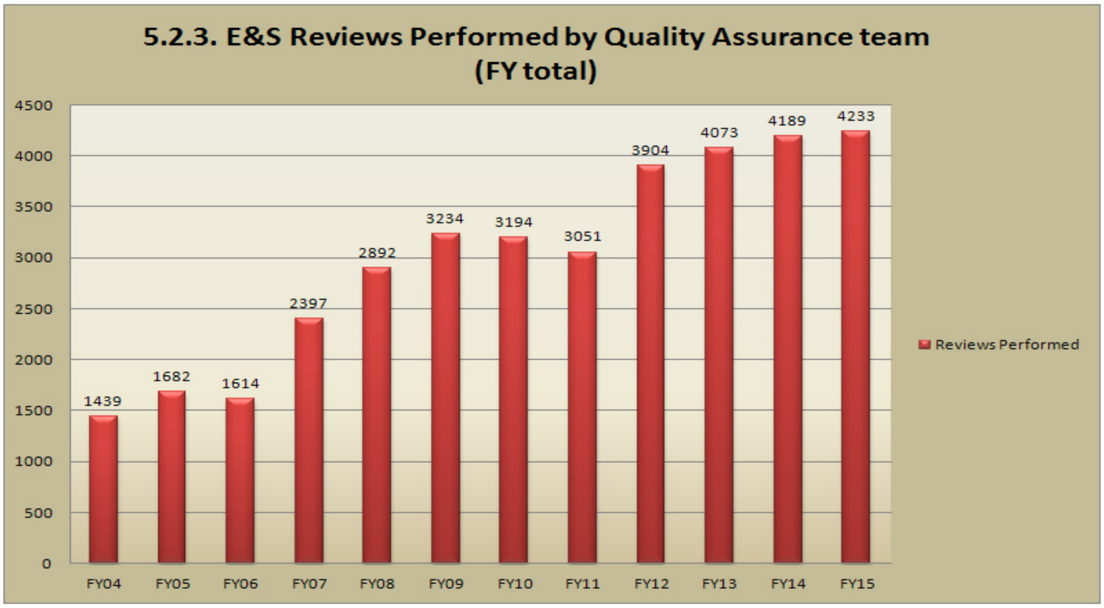

Figure 1-12: Erosion and Sediment Control Reviews Performed for FY2015

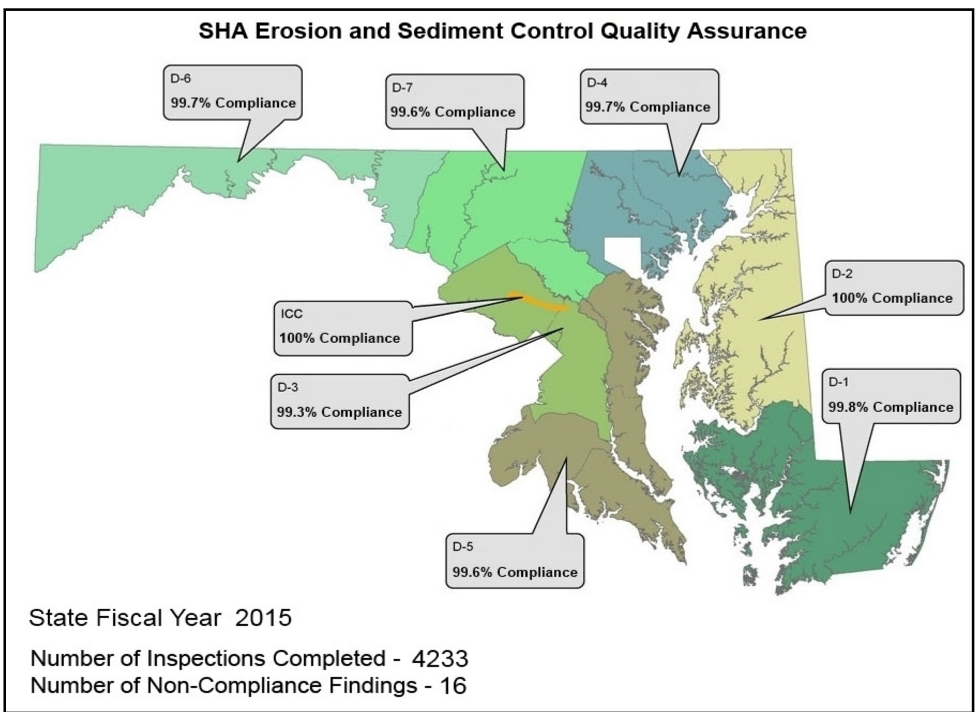

Figure 1-13: Erosion and Sediment Control Quality Assurance for FY2015

E.2.b Responsible Personnel Training for Erosion and Sediment Control (Green Card Certification)

MDE has developed a new training which is only available as an on line application.

SHA Basic Erosion and Sediment Control Training (Yellow Card Certification)

SHA continues to present updated Erosion and Sediment Control training initiated in 2004. This Level I training is recommended for contractors and field personnel. It covers key requirements of the NPDES construction activity permit. Also covered are resources and personnel for construction projects, ESC specifications and inspections, process for ESC modifications during construction, stabilization, SWM and ESC/SWM plan review and approval Delegated Authority. This certification expires three years from the date of issuance. In FY2015, SHA updated and provided on-line training for Yellow Card (YC) and YC re-certification. Table 1-5 below details the number of personnel certified for each of the training levels for the reporting period.

Table 1-5: SHA ESC Training

Type of Training	Number Certified
Responsible Personnel (Green Card)	0
Level I (Yellow Card)	516
Level I (Yellow Card Recertification)	249

E.2.c Delegated Authority and the Quality Assurance Toolkit

In February 2015, MDE approved delegation of ESC and SWM plan review and approval authority to SHA which includes inspection and compliance. In regards to compliance the SHA Quality Assurance Program (QAP) will perform inspections. The SHA QA toolkit was enhanced to track, sort and store ESC and SWM compliance issues. A new revised OOC62/QA-3 form will require all modifications to ESC to be done electronically through the QA toolkit. With this standardization, increased compliance is expected. Quarterly Reports document SHA projects and compliance, and the most recent Quarterly Report is included in Appendix B.

E.3 Stormwater Management

The continuance of an effective stormwater management program is the emphasis of this permit condition. Requirements under this condition include:

a) Implement the stormwater management design principles, methods, and practices found in the 2000 Maryland Stormwater Design Manual, the 2009 update, and COMAR;

b) Implement a BMP inspection and maintenance program to inspect all stormwater management facilities at least once every three years and perform all routine maintenance (e.g., mowing, trash removal, tarring risers, etc.) within one year of the inspection; and

c) Document BMPs in need of significant maintenance work and prioritize these facilities for repair. The SHA shall provide in its annual reports detailed schedules for performing all significant BMP repair work.

E.3.a Implement SWM Design Manual and Regulations

SHA continues to comply with Maryland State and Federal laws and regulations for stormwater management (SWM) as well as MDE requirements for permitting. We also continue to implement the practices found in the *2000 Maryland Stormwater Design Manual* and the *Maryland Stormwater Management and Erosion & Sediment Control Guidelines for State and Federal Projects, February 2015* for all projects. We have also implemented the requirements in the revised Chapter 5 of the 2000 Manual for Environmental Site Design (ESD) and the Stormwater Management Act of 2007 for all new projects. In the past year, SHA has been granted Delegated Authority for ESC and SWM plan review and approval, as discussed in Section E.2.c. To satisfy the requirements of SHA's delegated review and approval authority, SHA submitted its First Quarterly Report to MDE covering the period February 24, 2015 through May 1, 2015 and is included in Appendix B.

E.3.b Implement BMP Inspection & Maintenance Program

Our continuing Stormwater and Drainage Asset Program inspects, evaluates, maintains, remediates and enhances SHA BMP assets to maintain and improve water quality and protect sensitive water resources. Inspections are conducted on a cyclical basis as part of the NPDES source identification and update effort (see Section C, above). Maintenance and remediation efforts are accomplished after the inspection data has been evaluated and ranked according to SHA rating criteria.

Details of the Stormwater and Drainage Asset Program are included as Part 2 of this document. Discussion of inspection results and maintenance, remediation, retrofit and enhancement efforts undertaken over the past year is included in that section.

Stormwater As-Built Certification Process

SHA continues to improve the SWM facility as-built certification process in order to comply with the SWM approval and COMAR. This process assures verification of proper construction of SWM facilities to meet the design intent. Throughout the construction process, the design engineer coordinates with the Office of Construction and the contractor to perform required inspections during construction and to document the information in the MDE approved as-built tabulations. The contactor's engineer certifies the SWM facility was constructed according to the approved design plans and within allowed tolerances as stated in the SHA issued Special Provision included in the contract documents. SHA has made the delivery of this certification a separate pay/bid item in the construction estimate.

The SHA project engineer coordinates with MDE on the review and approval of the as-built certified plan. The construction project cannot be closed and accepted for maintenance until the as-built plans have been accepted by MDE. Copies of the final approved as-built certifications are retained by SHA and integrated into the storm drain and BMP GIS/database. This information is then used as source identification updates.

E.3.c Document Significant BMP Maintenance

See Part 2 for Stormwater and Drainage Asset Program updates on major maintenance, remediation and BMP retrofits.

E.4 Highway Maintenance

Requirements under this condition include:

a) *Clean inlets and sweep streets;*
b) *Reduce the use of pesticides, herbicides, and fertilizers through the use of integrated pest management (IPM);*
c) *Manage winter weather deicing operations through continual improvement of materials and effective decision making;*
d) *Ensure that all SHA facilities identified by the Clean Water Act (CWA) as being industrial activities have NPDES industrial general permit coverage; and*
e) *Develop a "Statewide Shop Improvement Plan" for SHA vehicle maintenance facilities to address pollution prevention and treatment requirements.*

E.4.a Inlet Cleaning and Street Sweeping

Mechanical sweeping of the roadway is essential in the collection and disposal of loose material, debris, and litter into approved landfills. This material, such as dirt and sand, collects along curbs and gutters, bridge parapets/curbs, inlets, and outlet pipes.

Sweeping prevents buildup along sections of roadway and allows for the free flow of water from the highway, to enter into the highway drainage system. See Figure 1-14 below for an example of SHA's street sweeping activity.

Figure 1-14: Street Sweeping often takes place at night due to high traffic volumes in urbanized counties

The SHA desired maintenance condition is 95% of the traveled roadway clear of loose material or debris. In addition, 95% of closed section roadways (curb and gutter) should have less than 1 inch depth of loose material, debris, or excessive vegetation that can capture debris, in the curb and gutter.

In addition to street sweeping, SHA owns and operates four vacuum pump trucks that routinely clean storm drain inlets along roadways. Sediment and trash make up the majority of the material that is removed. The vacuum trucks operate in central Maryland, spanning the following counties: Anne Arundel, Baltimore, Calvert, Carroll, Charles, Frederick, Harford, Howard, Montgomery, Prince Georges and St. Mary's. This practice ensures safer roadways through maintaining proper drainage and improves water quality in Maryland streams by removing captured sediment and trash before they enter adjacent waterways.

See Figures 1-15 (below) and 1-16 (following page) for examples of street vacuuming and inlet cleaning.

Figure 1-15: SHA Shop Personnel Operating Vacuum Truck to Clean Roadside Debris

Figure 1-16: Inlet Before and After Vacuuming

Pollutant Reductions for Inlet Cleaning and Street Sweeping

Sweeping and inlet cleaning are recognized as valid pollutant source reduction BMPs, however the means for crediting reductions is not well defined at this point. We are evaluating appropriate load reductions that can be claimed by SHA in meeting local and Bay TMDLs. This accounting will be added to reports for the next permit term.

The SHA Water Programs Division (WPD) is working with the SHA Office of Maintenance (OOM) to document current routes, to extend these activities to watershed-based, priority roadways and to characterize and quantify material and debris removed as a result of these activities. The result will be the development of procedures to optimize reporting of reductions associated with each of these activities and to better understand pollutant loads gathered from highways. It is hoped that this understanding will result in additional impervious surfaces treatment.

E.4.b Reduction of Pesticides, Herbicides and Fertilizers

SHA has standards for maintaining the highway system and one of these standards is the *SHA Integrated Vegetation Management Manual for Maryland Highways, October 2003* (IVMM). This manual incorporates the major activities involved in the management of roadside vegetation including application of herbicides, mowing and the management of woody vegetation. In order to maximize the efficiency of funds and to protect the roadside environment, an integration of these activities is employed.

Herbicide Application

The majority of SHA's vegetation management is accomplished mechanically, through the use of mowers and brush axes. However, in areas where mechanical control is not practical or feasible, SHA manages vegetation through the use of targeted applications of herbicide. Vegetation controlled by SHA includes noxious weeds, invasive weeds and plant material that is a safety hazard.

SHA promotes the safe and responsible use of herbicide for the control of vegetation. All SHA employees and contractors who apply herbicide on SHA rights-of-way must be registered with the Maryland Department of Agriculture (MDA) and operate under the supervision of a MDA-certified pesticide applicator.

Environmental stewardship is a primary focus of SHA's business plan, and SHA uses selective herbicides when available and targeted application, rather than broad application of non-selective herbicides. SHA uses the lowest pressure and largest droplet size for each application. Along with the addition of anti-drift agents these measures reduce the potential for drift, runoff and non-point source contamination. The selection of herbicide is based on the plant species that is being targeted. This ensures the effects on other plants are minimized and soil residual activity is limited. Application rates are based on the label minimum amount required to control the targeted plant species, which further reduces the potential for runoff and non-point source contamination.

Herbicide application equipment is routinely inspected and calibrated to ensure that applications are accurately applied in accordance to the IVMM, Maryland State law, and the herbicide label.

Nutrient Management Plans

The Maryland Lawn Fertilizer Law limits the total amount and restricts the timing of fertilizer applications associated with turfgrass establishment and maintenance. SHA uses slow-release nitrogen fertilizers when establishing turf, meadows, and other vegetation. Topsoil is sampled and tested for major and minor plant nutrients, pH, organic matter, and soluble salts. The test results are used to develop a nutrient management plan (NMP) to ensure optimal nutrient levels and growing conditions, and to avoid the application of excess fertilizer.

Mowing Reduction & Native Vegetation Establishment

A major initiative at the SHA is to reduce the extent of mowed areas within our right-of-way. SHA's Turfgrass Management Policy has been revised to provide consistent guidance to decrease the size of mowed areas and the number of mowing cycles per year.

Several projects have been completed throughout the state to install and maintain reforestation and native meadow areas. Reforestation and native meadow areas require no mowing, preserve native vegetation, and enhance erosion control and nutrient uptake.

E.4.c Winter Deicing Operations

SHA continues to test and evaluate new winter materials, equipment and strategies in an on-going effort to improve the level of service provided to motorists during winter storms while at the same time minimizing the impact of its operations on the environment.

One method employed to decrease the overall application of deicing materials is to increase application of deicing materials prior to and in the early stages of a winter storm (anti-icing). This prevents snow and ice from bonding to the surface of roads and bridges and ultimately leads to lower material usage at the conclusion of storm events, thus lessening the overall usage of deicers.

SHA is also piloting Liquid Only Snow Routes at one of its facilities. This operation is a designated snow route that only uses a critically measured salt brine solution to prevent the snow and ice from bonding to the pavement. Unlike anti-icing, which takes place prior to the event, this operation continues for the duration of the event and has proven to be quite effective. Data has shown that at an average application rate of 120 lbs / lane mile / inch exceeded not only our level of service metric by 17 percent but also help reduce that facility's usage rate by 61 percent this past season.

In addition, SHA is continuing its 'sensible salting' training of State and hired equipment operators in an on-going effort to decrease the use of deicing materials without jeopardizing the safety and mobility of motorists during and after winter storms. Table 1-6 on the following page lists materials used by SHA in winter deicing operations.

Table 1-6: SHA Deicing Materials

Material	Characteristics
Sodium Chloride (Rock and Solar Salt)	The principle winter material used by SHA. Effective down to 20° F and is relatively inexpensive.
Abrasives	These include sand and crushed stone and are used to increase traction for motorists during storms. Abrasives have no snow melting capability.
Calcium Chloride	A solid (flake) winter material used during extremely cold winter storms. SHA uses limited amounts of calcium chloride.
GEOMELT 55	A de-sugared sugar beet molasses may be blended with the brine. Also known as "beet juice," this organic material lowers the freezing point of the brine to –30º F. The light brown material is environmentally safe and does not stain roadway surfaces
Salt Brine	Liquid sodium chloride or liquefied salt is a solution that can be used as an anti-icer on highways prior to the onset of storms, or as a deicer on highways during a storm. Used extensively by SHA. Freeze point of -6° F.
Magnesium Chloride (Mag)	A liquid winter material used by SHA for deicing operations in its northern and western counties. It has a freeze point of -26° F and has proven cost effective in colder regions.

New Road Salt Management

On May 20, 2010 the Governor approved Senate Bill 775, requiring SHA, in consultation with the Maryland Department of the Environment (MDE), to develop a best practices road salt management guidance document by October 2011. This document is necessary to reduce the adverse environmental impacts of road salt storage, application and disposal on Maryland's water and land resources.

SHA posted the Statewide Salt Management Plan on its website in October 2011. The plan was subsequently updated on October 1, 2012. The plan provides guidance on snow and ice control operations with an emphasis on lessening the impact of salt on the environment. The plan covers all aspects of winter operations including:

- Safety and mobility of motorists during and after winter storms,
- Defining levels of service provided during winter storms,
- Establishing long-term goals to lessen the usage of salt, and reduce its impact on the environment,
- Salt and other winter materials,
- Material storage and handling,
- Winter storm fighting equipment,
- Training initiatives,
- Winter storm management from pre-storm preparations through post-storm operations,
- Post-storm material and equipment cleanup,
- Post-storm and post-season data analysis,
- Public education and outreach, and
- Testing and evaluation of new materials, equipment, and strategies for continual improvement.

Winter Operations Training

SHA Annual Snow College – This training is offered every fall for new maintenance shop hires as well as 20% of veteran shop forces. The goal is to train all maintenance personnel over a five year period and repeat the process. This ensures that all maintenance personnel are exposed to current trends and technologies. The training presentations are included in the Statewide Salt Management Plan, Appendices II and III and topics covered include all aspects of winter operations with an emphasis on sensible salting. See Table 1-7 for number of participants trained during this reporting period.

Table 1-7: SHA Snow College Training

SHA District (Shops)	Number of Participants
1 (DO, WI, WO, SO)	43
2 (CE, KE, QA, CO, TA)	22
3 (MG, MF, PL, PM)	20
4 (BG, BH, BO, HA)	29
5 (AA, AG, CV, CA, CH, SM)	16
6 (GA, AL, WA)	36
7 (FR, CL, HO)	20
1 (DO, WI, WO, SO)	186

Annual Maintenance Shop Winter Meetings – Abbreviated salt management training is provided to all SHA maintenance forces annually at winter shop meetings. No data was available for the current reporting period on numbers trained.

Hired Equipment Operator Training – This training is provided to hired equipment contractors and operators every fall. The training presentations are included in the Statewide Salt Management Plan, and topics covered include effective plowing, sensible salting and adhering to all pertinent SHA policies and procedures. This training has also been made available in a bilingual format aiding in information decimation. No data was available for the current reporting period on numbers trained.

E.4.d Industrial Permit Coverage

As discussed in previous Annual Reports, SHA has implemented an Environmental Management System (EMS) to ensure multi-media compliance at maintenance facilities statewide. The EMS covers procedures for management of environmental compliance issues, including those related to Industrial NPDES at maintenance facilities, such as spill response, material storage and vehicle washing. It includes the implementation of Standard Operating Procedures (SOPs), routine compliance inspections and environmental training covering a variety of media areas including stormwater management and spill prevention and response.

The EMS has been implemented in a phased approach, and as of June 2015 it covers 162 SHA facilities under a program of scheduled routine multimedia compliance assessments that include recommendations for stormwater improvements and pollution prevention. As shown in Table 1-8 on the following page, certain facilities are currently covered under the General Discharge Permit (12-SW). Actions taken to meet 12-SW requirements include:

- Updated Storm Water Pollution Prevention Plans (SWPPP) and maps
- Roll-out of standard operation procedures for Quarterly Visual Monitoring
- Updated internal self assessment compliance checklists for routine and annual inspections
- Trained shop personnel on pollution prevention requirements and incorporated updates in annual environmental awareness training provided to all SHA maintenance staff
- Established a specific training program for pollution prevention team members performing stormwater inspections and quarterly visual monitoring assessments
- Evaluated all permitted facilities for the presence of non-stormwater sources
- Completed annual comprehensive site compliance evaluations

SHA maintenance facility staff is continuing to perform monthly inspections and the SHA Environmental Compliance Division (ECD) is continuing to perform quarterly inspections at all SHA facilities through its District Environmental Coordinators (DEC) to ensure stormwater pollution prevention BMPs are implemented and the 12-SW permitting requirements are being met. The DEC and facility staff are responsible for ensuring compliance with all applicable permits, plans and regulations at facilities in their region.

Table 1-8: Industrial NPDES Permit Status

District	Maintenance Facility	Permit Type
1	Berlin	General
	Cambridge	General
	Princess Anne	General
	Salisbury	General
	Snow Hill	General
2	Centreville	Individual – SW
	Chestertown	General
	Denton	General
	Easton	General
	Elkton	General
3	Fairland	General
	Gaithersburg	General
	Laurel	General
	Marlboro	General
4	Churchville	Individual – SW
	Golden Ring	General
	Hereford	General
	Owings Mills	General
5	Annapolis	General
	Glen Burnie	General
	La Plata	General
	Leonardtown	General
	Prince Frederick	General
	Hanover Auto Shop	General
6	Hagerstown	General
	Keyser's Ridge	Individual – GW
	La Vale	General
	Oakland	General
7	Dayton	General
	Frederick	General
	Thurmont	General
	Westminster	General
Notes: SW = Surface Water, GW = Groundwater		

The SHA ECD also continues to encourage maintenance facilities to present funding requests for stormwater related improvements such as erosion stabilization, material storage improvements, and spill prevention/containment devices.

E.4.e Statewide Shop Improvement Plans

As described above, SHA continues to maintain an effective Industrial Stormwater NPDES Program through ECD to ensure pollution prevention and permit requirements are being met at SHA maintenance facilities. Annually, and as change dictates, SHA updates it's combined Storm Water Pollution Prevention Plans (SWPPP)/ Spill Prevention, Control, and Countermeasure (SPCC) Plans. As a continuing best management practice SHA has developed SWPPPs for facilities not required to have one (e.g. salt storage facilities). Throughout the reporting year, SHA continued to address potential stormwater pollution issues by implementing Best Management Practices (BMPs) and designing/constructing capital improvements. BMPs were identified during pollution prevention plan updates and routine facilities inspections. The status of BMP implementation for maintenance facilities is tracked by each District Environmental Coordinator during routine inspections. Potential capital improvements are prioritized based on risk to human health and the environment and funding availability. The following list details the major pollution prevention efforts and maintenance facility improvements since the last annual report.

Completed Projects:

- 12-SW quarterly visual monitoring and annual comprehensive site compliance evaluations
- Update of all associated SWPPPs
- Standard Operating Procedure creation and updates to ensure compliance with 12-SW permit
- Updating existing and creation of a new training program to ensure compliance with 12-SW permit
- Petroleum storage tank system upgrades at various SHA maintenance facilities
- Vacuum Truck Dewatering Station (VTDS) construction at La Plata shop and Mt. Airy Salt Storage Facility
- OWS Upgrades at Princess Anne and Thurmont facilities

Ongoing Projects / Efforts:

- Statewide stockpile management assessment, planning, and design for new structural controls, including covered/roofed storage structures for erodible material
- Statewide brine secondary containment assessment
- Design and construction of new wash bays to ensure indoor vehicle washing
- Salt barn repair plan and development of on-call repair contracts
- Initial assessment reports and preliminary design completed for erosion issues noted at various facilities statewide
- Statewide discharge sampling and reporting program for facilities with Individual Discharge Permits
- Routine compliance inspections at all SHA facilities
- Annual multimedia compliance training provided to maintenance shop personnel

Table 1-9: Capital Expenditures for Pollution Prevention BMPs

Fiscal Year	Expenditure
2005	$ 613,210 - actual
2006	$ 592,873 - actual
2007	$ 450,608 - actual
2008	$ 590,704 - actual
2009	$ 478,889 – actual
2010	$ 613,766 - actual
2011	$ 595,984 - actual
2012	$ 664,577 - actual
2013	$ 917,902 - actual
2014	$641,512 - actual
2015	$2,339,971 - actual
2016	$2,338,000 - projected

Table 1-9 above shows the SHA capital expenditures towards industrial pollution prevention BMPs from the current and past 11 fiscal years. Projected expenditures for Fiscal Year 16 are also included.

E.5 Illicit Discharge Detection and Elimination

Requirements under this condition include:

a) Conduct visual inspections of stormwater outfalls as part of its source identification and BMP inspection protocols

b) Document each outfall's structural, environmental and functional attributes;

c) Investigate outfalls suspected of having illicit connections by using storm drain maps, chemical screening, dye testing, and other viable means;

d) Use appropriate enforcement procedures for eliminating illicit connections or refer violators to MDE for enforcement and permitting.

e) Coordinate with surrounding jurisdictions when illicit connections originate from beyond SHA's rights-of-way; and

f) *Annually report illicit discharge detection and elimination activities as specified in Part IV of this permit. Annual reports shall include any requests and accompanying justifications for proposed modifications to the detection and elimination program.*

E.5.a Visual Inspections and Remediation of Outfalls

The SHA Storm Drain and Outfall Inspection and Remediation Program (SOIRP) has seen an expansion from the original focus on the physical conditions and structural functionality of NPDES defined major outfalls (which were documented using Chapter 4 of the *SHA NPDES Standard Procedures*) to performing comprehensive inspections of all SHA pipe outfalls. This expansion was initiated in an effort to locate and eliminate significant sources of pollution within the SHA highway drainage systems as well as address issues with degraded drainage infrastructure. In addition to assessing the current structural condition of the pipe and outfall structure, the inspections also identify eroded downstream channels that are contributing to the pollution of Maryland's waterways and the Bay, with the intent to restore these sites to reduce the pollutant loads.

The outfall channel assessment criteria has been incorporated into the SOIRP through programmatic outfall inspections and assessment protocols and included in Chapter 8, *Rapid Assessment Guidelines for Outfall Channels*. This approach has been developed to assess outfall stability through various highway corridors, to identify and prioritize restoration and stabilization projects as well as locate opportunities for water quality improvement projects. This protocol describes the standard data collection and documentation required for performing outfall channel assessments and is used in conjunction with Chapter 4 by targeting unstable outfalls with poor ratings for further assessment for remediation.

SHA incorporated the outfall assessment protocol into county-wide MS4 inspections and will continue assessment of outfalls and outfall channels in the cyclical inspections statewide. In addition, corridor wide pipe video inspection will be added to the assessments to collect additional information required for comprehensive performance assessment and project prioritization. The record management system is currently under development with the intent to include the collected data within the structure of the SHA NPDES Geodatabase.

Outfall channel inspections have been completed along twenty four SHA road corridors within the following MS4 Phase I and II Permit counties:

Anne Arundel County (6 corridors)
MD 2, MD 3, MD 4, I097, MD 32, MD 10

Baltimore County (4 corridors)
I-83, MD 151, I-70, US 40

Cecil County (1 corridor)
US 40

Harford County (1 corridor)
MD 24

Howard County (3 corridors)
MD 32, US 40, MD 100

Montgomery County (2 corridors)
MD 119, MD 97

Prince Georges County (7 corridors)
I-495, MD 210, US 301, MD 5, MD 4, MD 214, MD 202

SHA is taking a proactive approach to address failing infrastructure issues to prevent emergency repair situations. The results of these investigations and assessments have been evaluated, outfall stabilization needs have been systematically prioritized and design projects initiated. SHA has procured design of twenty-five outfalls that are currently under construction or have been completed and continues designing and permitting an additional seventy-four outfalls as listed on the following page in Table 1-10 starting on the following page.

Table 1-10: Current SHA Outfall Stabilization Projects

Project Number	Road	County	Location Description	No. of outfalls	Project Status
AA757	MD 2	AA	Between I-695 and US 50	5	Under design
MO637	US 29	MO	At SWM Facility 150173	1	Construction completed 2015
PG092	MD 216	PG	NB at Patuxet River Bridge	1	Construction competed 2015
HO408	MD 100	HO	Behind noisewall between MD 104 and Long Gate Parkway	1	Construction completed 2012
BA712	I-695	BA	Minebank Run at Cromwell Bridge Road	5	Under design to be advertised in 2017
BA487	I-83	BA	Gunpowder Falls	2	Construction completed 2012
BA487	MD 147 I-695	BA	Various locations (Phase 2)	4	Construction Completed 2014
AW730	I-83	BA	Near Cold Bottom Road	4	Under Design
PG554	MD 4	PG	At MP 2.6	1	Construction completed 2012
PG712	I-495	PG	400 ft N of Ramp 2 MD 450 WB to I 95 NB	1	Under Design
CH374	US 301	CH	From MD 6 to Glen Albin Road	2	Emergency repair completed 2012
BA144	I-795	BA	Near Red Run Boulevard	2	Construction completed 2012
HA365	US 1	HA	Conowingo Road Slope and Outfall Stabilization	1	Construction completed 2012
AA169	I-97	AA	North of Benfield Blvd	1	Under construction
BA487	Various	BA	5 sites within BA County	5	Construction completed in 2015
PG070	Various	PG	Various locations	35	Under design to be advertised in 2016
M0160	I-270	MO	At Montrose Road	1	Under design to be advertised in 2016
AX158	MD 202	PG	Near Campus Way	1	Construction Completed 2012
XY138	MD185	MO	At Rock Creek	1	Construction Completed 2013
AT812	I-495	PG	At MD 450 near Metro Yard	2	Construction completed 2014
AT812	MD 210	PG	Between MD 373 and Jenifer Drive	1	Construction completed 2014
AW730	MD 450	AA	Near War Memorial	1	Under design to be advertised in 2015
AT688	US 301	AA, CH	Various locations	9	Under design to be advertised in 2016

Project Number	Road	County	Location Description	No. of outfalls	Project Status
CE403	MD 272	CE	N. of Rogues Harbor Road	1	Under design to be advertised in 2016
AA757	MD 2	AA	Between I-695 and US 50	5	Under design
MO637	US 29	MO	At SWM Facility 150173	1	Construction completed 2015
PG092	MD 216	PG	NB at Patuxet River Bridge	1	Construction competed 2015
HO408	MD 100	HO	Behind noisewall between MD 104 and Long Gate Parkway	1	Construction completed 2012
BA712	I-695	BA	Minebank Run at Cromwell Bridge Road	5	Under design to be advertised in 2017
BA487	I-83	BA	Gunpowder Falls	2	Construction completed 2012
BA487	MD 147 I-695	BA	Various locations (Phase 2)	4	Construction Completed 2014
AW730	I-83	BA	Near Cold Bottom Road	4	Under Design
PG554	MD 4	PG	At MP 2.6	1	Construction completed 2012
PG712	I-495	PG	400 ft N of Ramp 2 MD 450 WB to I 95 NB	1	Under Design
CH374	US 301	CH	From MD 6 to Glen Albin Road	2	Emergency repair completed 2012
BA144	I-795	BA	Near Red Run Boulevard	2	Construction completed 2012
HA365	US 1	HA	Conowingo Road Slope and Outfall Stabilization	1	Construction completed 2012
AA169	I-97	AA	North of Benfield Blvd	1	Under construction
BA487	Various	BA	5 sites within BA County	5	Construction completed in 2015
PG070	Various	PG	Various locations	35	Under design to be advertised in 2016
M0160	I-270	MO	At Montrose Road	1	Under design to be advertised in 2016
AX158	MD 202	PG	Near Campus Way	1	Construction Completed 2012
XY138	MD185	MO	At Rock Creek	1	Construction Completed 2013

Project Number	Road	County	Location Description	No. of outfalls	Project Status
AT812	I-495	PG	At MD 450 near Metro Yard	2	Construction completed 2014
AT812	MD 210	PG	Between MD 373 and Jenifer Drive	1	Construction completed 2014
AW730	MD 450	AA	Near War Memorial	1	Under design to be advertised in 2015
AT688	US 301	AA, CH	Various locations	9	Under design to be advertised in 2016
CE403	MD 272	CE	N. of Rogues Harbor Road	1	Under design to be advertised in 2016
HA356	AW	HA	Various locations	11	Under design to be constructed in 2016

SHA continues to undertake projects related to outfall channel stabilization with drainage system improvements. The goal of these improvements is to protect receiving streams, improve the water quality within the watershed, restore failing drainage infrastructure and extend the drainage asset's service life. Less complex or urgent sites are addressed with open end construction contracts after the design plan is developed and permits have been obtained. This is one of the innovative contracting mechanisms that allow SHA to efficiently deliver projects of an urgent nature such as emergency repairs. SHA typically manages three or four area wide contracts for drainage and stormwater asset remediation with annual expenditures of $5-$7 million. Examples projects constructed using these contracts are outfalls at I-270 in Montgomery County and Swan Creek stream stabilization in Harford County as shown in Figures 1-17 below and 1-18 on the following page.

Figure 1-17: Outfall Remediation at I-270 in Montgomery County

Figure 1-18: Swan Creek Stabilization in Harford County

E.5.b Document each Outfall's Attributes

SOIRP outfall inspections have been completed in Charles, Calvert, and St. Mary's Counties. Inspections are conducted using the SHA SOIRP pipe and outfall inspection protocol. Based on the inspection results, those with the poorest ratings are assessed for repair or remediation using the Outfall Channel Rapid Assessment Guidelines. Details of each protocol and current work for the report period are discussed below.

Pipe and Outfall Inspections (Chapter 4)

The first step in the expanded SOIRP process is to perform a visual evaluation of pipe and outfall conditions. Some pipes connect to headwalls or endwalls, some terminate at end sections or projecting pipes and some connect directly to culverts. Pipes are rated on a scale of 0 to 5 to identify the overall condition of the pipe and outfall.

The inspection results are based on issues visually identified by the inspection crew. Often it is difficult to evaluate an entire pipe length, so the inspection is based only on what the inspection crew can visually identify. If the upstream end of the pipe is in worse condition than the downstream end, the inspection team assigns the worst rating (5). Photographs are taken for ratings of 3, 4, or 5, which are poor ratings, or as deemed necessary. These pipes and outfalls are then subjected to a second assessment (based on Chapter 8 discussed below) to determine the form and level of remediation necessary.

Rapid Assessment Guidelines for Outfall Channels (Chapter 8)

Use of this protocol is the second step in the SOIRP process and assesses each targeted outfall that was rated 3-5 in step one for remediation potential and urgency. The outfalls may be contributing to channel erosion, thus resulting in sediment transport to downstream receiving channels. SHA has two overall goals for these second level assessments. The first goal is to develop data collection to augment our efforts in inspecting and maintaining SHA infrastructure. This includes GPS-locating of channels located downstream from SHA outfall structures, and completing standard inspection forms that are linked with the spatial outfall features in the SHA NPDES geodatabase. The second goal is to use the data to prioritize the repair of SHA storm drain infrastructure

E.5.c Discharge Investigations

SHA's Environmental Compliance Division (ECD) manages the Illicit Discharge Detection and Elimination (IDDE) program. ECD is continually reviewing the IDDE management program and process to determine areas that can be streamlined or updated. ECD will continue to coordinate with MDE, surrounding jurisdictions and property owners to eliminate illicit discharges.

Over the past annual reporting period, October 1, 2014 through September 30, 2015, discharge screenings were completed in Anne Arundel, Harford, Baltimore, and Montgomery counties. As illicit discharges are found through the field screening process, SHA sends out a team to collect samples for more accurate laboratory analysis. If laboratory analysis indicates the discharge to be illicit, the inspection reports are delivered to local NPDES coordinators and MDE.

SHA has focused on follow up for existing illicit discharges that have been reported in previous annual reports, as well as illicit discharges that were discovered during this reporting period. Maryland Environmental Service (MES) is contracted to revisit both previously identified and recently reported illicit discharges to confirm an illicit discharge is still occurring and collect a sample for laboratory analysis. Those discharges determined to be illicit will then follow the elimination process.

During this reporting period, it was determined that out of the 133 outfalls screened, 42 had a discernible dry-weather flow and were sampled. One new identified illicit discharge required additional follow-up to be eliminated. Table 1-11 below summarizes past and present illicit discharges.

In addition, MES also performs on-call inspections of potential illicit discharges that are reported by SHA field staff or the public. SHA continues to remain committed to detecting and eliminating illicit discharges throughout our system.

Table 1-11: Discharges Investigated from February 2001 to Date

County	Discharges Field Sampled	Illicit Discharges requiring follow-up
Anne Arundel	6	0
Baltimore	13	0
Carroll	22	0
Cecil	7	0
Charles	7	0
Frederick	16	0
Howard	19	0
Montgomery	107	0
Harford	6	1
Totals	**203**	**1**

E.5.d Use Appropriate Enforcement Procedures

Currently, SHA notifies MDE and the appropriate county NPDES coordinator, or their IDDE designee, when illicit discharges to SHA storm drain system are discovered. In order to achieve better elimination results and increase public awareness of the issue, SHA has implemented a process to notify property owners that are determined to be the origin of the illicit discharge as discussed in the previous Annual Report. Educational materials on non-stormwater discharges and MS4 permits are included with the initial notification. SHA continues to work with local jurisdictions and MDE to eliminate illicit discharges. If attempts to eliminate the discharge fail after working with the local jurisdiction and MDE/WMA, then MDE has the option of coordinating with the State Office of Attorney General (OAG) Environmental Crimes Unit (ECU) to resolve the illicit discharge.

E.5.f Annually Report Illicit Discharge Detection and Elimination Activities

Over the reporting period, outfalls were screened in four Phase I counties for illicit discharges including Montgomery, Harford; Baltimore; and Anne Arundel. The geodatabase containing this data is included on the attached CD. During the reporting year, a total of twelve discharges were closed out. Two discharges were determined to not have dry weather flow; five discharges were sent for laboratory analysis and identifying parameters were within acceptable limits; four discharges were eliminated by property owners, and one discharge was determined not to be in SHA right-of-way.

Table 1-12 below shows information for the one remaining illicit discharge requiring follow-up. SHA is currently coordinating with MDE to address the open illicit discharge.

Table 1-12: Illicit Discharge Requiring Follow-up

Number	County	SHA-Structure #	Date Identified	Potential Pollutant
1	Harford	1202700.001	04/22/2014	Detergents

E.6 Environmental Stewardship

Requirements under this condition include:

a) *Environmental Stewardship by Motorists*

   i) *Provide stream, river, lake, and estuary name signs and environmental stewardship messages where appropriate and safe,*

   ii) *Create opportunities for volunteer roadside litter control and native tree plantings; and*

   iii) *Promote combined vehicle trips, ozone alerts, fueling after dark, mass transit and other pollution reduction actions for motorist participation.*

b) *Environmental Stewardship by Employees*

   i) *Provide classes regarding stormwater management and erosion and sediment control;*

   ii) *Participate in field trips that demonstrate links between highway runoff and stream, river, and Chesapeake Bay health;*

   iii) *Provide an environmental awareness training module for all areas of SHA;*

   iv) *Provide pollution prevention training for vehicle maintenance shop personnel;*

   v) *Ensure Integrated Pest Management instruction and certification by the Maryland Department of Agriculture for personnel responsible for roadside vegetation maintenance; and*

   vi) *Promote pollution prevention by SHA employees by encouraging combined vehicle trips, carpooling, mass transit, and compressed work weeks.*

E.6.a Environmental Stewardship by Motorists

SHA continues many initiatives that encourage or target public involvement and participation in water quality programs. These initiatives cover the areas of litter control, watershed partnerships, community planting efforts and public education.

SHA public involvement and participation initiatives for the past year include:

Annual Earth Day Celebration – To commemorate this year's Annual Earth Day celebration, the SHA Earth Day Team sponsored two Lunch and Learn sessions to promote environmental awareness and stewardship. The Learning Sessions were held at SHA Headquarters in May 2015. A presentation was given by a DNR biologist on a rare freshwater mussel in Deer Creek in Rocks State Park. The mussels were relocated upstream to avoid impacts from a stream bank stabilization project. See Figure 1-19 below.

Figure 1-19 - Tagged rare freshwater mussels during relocation in Harford County

Also, a session titled "Landscape 411" provided an opportunity for employees to ask one-on-one design and plant guidance questions from landscape architects, biologists, and foresters from the Office of Environmental Design. This was very popular, and will likely be repeated in the future. As in previous years, a service project to enhance the plantings at the entrances to the SHA Headquarters drew many volunteers. For some who had not participated before, it was a learning experience, and it was enjoyable for all who contributed their time to improve the environment. See Figure 1-20 on the following page for a view of finished landscaped areas.

Figure 1-20 – Example of Volunteer Landscaping Results at SHA Headquarters

Adopt-a-Highway Program

The Adopt-a-Highway (AAH) program encourages volunteer groups (family, business, school, or civic organizations) to pick up litter along one to three mile stretches of non-interstate roadways four times a year for a two year period as a community service. Table 1-13 identifies the participation for the AAH program over the current reporting period, and Figure 1-21 below shows a volunteer group working in Baltimore County along MD 45.

Table 1-13: Adopt-a-Highway Program

Jurisdiction	Groups	# Bags	Miles Adopted
Anne Arundel	8	161	7.12
Baltimore	53	697	57.71
Carroll	15	93	16.14
Cecil	24	342	26.16
Charles	17	168	18.09
Frederick	15	146	15.65
Harford	18	213	18.61
Howard	0	0	0
Montgomery	6	43	6.15
Prince George's	0	0	0
Washington	20	198	22.01
Cumberland, Cambridge, Salisbury	0	0	0
Totals	176	2061	186.74
Data extracted from the Adopt-A-Highway database for the period 9/11/2014 to 8/12/2015			

Figure 1-21: Adopt-A-Highway Volunteers along MD 45 in Baltimore County

Sponsor-a-Highway Program

SHA also has a program that allows corporate sponsors to sponsor one-mile sections of Maryland roadways. Table 1-14 shows the miles currently being sponsored. The Sponsor enters into an agreement with a maintenance provider for litter removal from the sponsored highway segment.

Table 1-14: Sponsor-a-Highway Program

Jurisdiction	Available Miles	Miles Sponsored
Anne Arundel	62.23	68.58
Baltimore	11.53	92.40
Carroll	0	0
Cecil	0	0
Charles	21.64	3.80
Frederick	12.19	9.99
Harford	6.99	2.43
Howard	19.02	30.96
Montgomery	6.94	43.75
Prince George's	50.66	58.09
Washington	12.91	4.05
Cumberland, Cambridge, Salisbury	0	0
Totals	204.11	314.05
Data extracted from the Sponsor-A-Highway database for the period 9/11/2014 to 08/12/2015.		

Partnership Planting Program

SHA develops partnerships with local governments, community organizations, and garden clubs for the purpose of beautifying highways and improving the environment. Community gateway plantings, reforestation plantings, streetscapes, and highway beautification plantings are examples of the types of projects that have been completed within the Partnership Planting Program. Table 1-15 lists the number of plants, counties, and numbers of volunteers for the last reporting period. See Figure 1-22 for an example.

Figure 1-22: Cecil County Partnership Planting Project at MD 213

Table 1-15: Partnership Planting Program

NPDES County or Municipality	Number of Plants	Number of Volunteers
Anne Arundel		
Baltimore		
Cambridge		
Carroll		
Cecil	154 Shrubs and Perennials	25
Charles		
Cumberland		
Frederick	25 shrubs	12
Harford		
Howard	50 Trees, 50 Shrubs and 3300 Bulbs	16
Montgomery		
Prince George's		
Salisbury		
Washington		
Data extracted from the Partnership Planting Program database for the period 10/01/2014 to 09/30/2015		

Maryland Quality Initiative (MdQI) 2015 Conference: 'Continuous Quality Improvement by Maryland's Transportation Industry'

The mission of MdQI is to provide the Maryland transportation industry a forum that fosters coordinated and continuous quality improvement in order to ensure safe, efficient, and environmentally sensitive transportation networks to meet the needs of all transportation stakeholders. This industry conference is held annually each winter and brings together public and private design and construction industry professionals in a forum of workshops, round table discussions, exhibits, and networking. The 22nd Annual Conference was held February 4 and 5, 2015 at the Baltimore Convention Center. SHA presented a session focused on NPDES related issues titled *Changes in SHA Environmental Business*: This session reviewed SHA's new programs for the TMDL Program, delegated permit review authority, and stormwater management and erosion and sediment control reviews.

Storm Drain Stenciling

SHA supported the Howard County Watershed Stewards Academy (WSA) who initiated a storm drain stenciling program in collaboration with local Boy Scout organizations. The goal of the project was to educate middle school-aged students about sources of stormwater pollution, provide them with information to help solve stormwater pollution problems, and reduce polluted runoff into the Chesapeake Bay. The first storm drain stenciling occurred at the Scaggsville Park and Ride off of MD 216 in Howard County. The stencil designs were developed by local Boy Scout Troops for competition with SHA staff serving as one of the judges. The winning designs were applied to the storm drains at the the Park and Ride to help raise awareness of the general public about water quality issues within our communities, the adverse impacts of urban pollutions to the water resources and potential stewardship measures. Figures 1-23 and 1-24 show stenciled inlets painted by local Boy Scout volunteers.

Figure 1-23: Volunteer Boy Scouts Stenciling Storm Drains and Rain Barrels

Figure 1-24: Finished Stencil Design on Storm Drain

E.6.b Environmental Stewardship by Employees

SHA continues to provide environmental awareness training to its personnel and is committed to continuing these efforts in the future. We have provided updated data for these efforts through the following training and awareness programs listed below:

District Coordination Meetings

In the past year, representatives from SHA's Water Programs Division reached out to various District Offices across the State to discuss watershed restoration initiatives. These meetings occurred from January through April in district offices responsible for efforts within MS4 counties, including Districts 3, 4, 5, 6, and 7. The purpose of these meetings were to introduce the newly established Water Programs Division, provide a review of the Chesapeake Bay TMDL and MS4 regulatory requirements, discuss trash reduction strategies, review watershed restoration goals, and discuss local watershed restoration projects. These meetings also served as a venue to discuss project issues and increase collaboration between the districts and Water Programs Division. This is particularly important as projects move forward to ensure districts are aware of the program goals, assist with site selection efforts, review project submissions, and respond to public inquiries related to SHA's watershed restoration efforts. See Figure 1-25 for an excerpt of the presentation to review local compliance and watershed restoration projects with District staff.

Figure 1-25: Excerpt from District Coordination Presentation about Local Projects for MS4 Compliance

SHA Recycles Campaign

In support of the SHA Business Plan, the Environmental Compliance and Stewardship Key Performance Area launched the SHA Recycles Campaign on April 22, 2008 to raise awareness and encourage change in consumer culture throughout the organization. The goal of this campaign is to reduce waste and litter by making conservation a priority, reusing what we previously discarded, and recycling as much as possible.

The SHA Recycles Campaign is working to build a consortium of stakeholders across the entire SHA organization towards this collective goal. The campaign encourages all employees to give feedback on what can be done to save energy and fuel, reduce or eliminate waste, improve current recycling efforts, or change business practices to conserve resources. It provides education and outreach through displays and presentations at SHA events such as the Annual Earth Day Celebration, and office-wide training and recognition days.

A statewide Recycling Task Force has also been formed at SHA to examine key issues in recycling and identify ways to improve the SHA Statewide Recycling Program.

Environmental Awareness Training (Chesapeake Bay Field Trips)

This training is provided to all new employees and other employees seeking to improve their environmental awareness. This field trip demonstrates the link between highway runoff and its impacts on streams, rivers, and on the health of the Chesapeake Bay. The field trip includes visits to important environmental sites including wetlands, streams, forests, and a boat trip on the Bay. Three trips were taken this reporting period on October 22, 2014, April 29 and April 30, 2015 with approximately 75 participants attending in all. See Figure 1-26 for an image from training in October, 2014.

Figure 1-26: SHA Chesapeake Bay Field Trip and Environmental Awareness Training in October, 2014

Office of Highway Development (OHD) University

Our Office of Highway Development continues its OHD-University training program for employees. Although primarily developed for engineers within OHD, others throughout the organization are invited to participate. The annual technical training sessions provide staff with the latest policy and design updates, including any changes to permitting requirements that affect policies and procedures. A myriad of key topics associated with the planning, design, construction, and maintenance phases of roadway network development are discussed, including SWM, ESC, permits, specific NPDES concerns, and TMDLs. During the current reporting period, the relevant trainings were not offered, but presentations for 2016 classes are under development.

Statewide Pesticide/Vegetation Management Training

There are several types of internal training sessions for pesticide management that SHA provides annually. They include registration, re-certification, right-of-way pre-certification preparation, aquatic pre-certification preparation, and herbicide updates. The number of participants at each of these training sessions is listed below in Tables 1-16 (below), 1-17, and 1-18 (following page). There was no Vegetation Management Conference or Aquatic Pesticide Certification Preparation training held in 2015. There were 7 Re-certification classes (ENV200), 2 Pesticide Core and Right-of-Way certification preparation classes (ENV210), and 3 Pesticide registration classes (ENV100) held in 2015.

Table 1-16: Pesticide Applicator Registration (ENV100)

SHA District	Number Trained
District 1 (DO,WI,WO,SO)	18
District 2 (TA,CO,QA,KE,CE)	0
District 3 (MO,PG)	0
District 4 (BA,HA)	8
District 5 (AA,CA,SM,CH)	0
District 7 (HO,CL,FR)	17
OFSD-Headquarters	0
OM-FMD	0
Other	0
Total	43

Table 1-17: Maryland Pesticide Recertification (ENV200)

SHA District	Number Trained
District 1 (DO,WI,WO,SO)	8
District 2 (TA,CO,QA,KE,CE)	20
District 3 (MO,PG)	6
District 4 (BA,HA)	15
District 5 (AA,CA,SM,CH)	5
District 6 (WA,AL,GA)	7
District 7 (HO,CL,FR)	17
Total	83

Table 1-18: Pesticide Core and Right-of-Way Certification Preparation (ENV210)

SHA District	Number Trained
District 1 (DO,WI,WO,SO)	2
District 2 (TA,CO,QA,KE,CE)	
District 3 (MO,PG)	
District 4 (BA,HA)	
District 5 (AA,CA,SM,CH)	1
District 6 (WA,AL,GA)	
District 7 (HO,CL,FR)	
Total	3

Maryland Department of Transportation (MDOT) Water Quality Policies and Water Quality Clearing House Web Page

This is a continuing effort that provides information on department-wide water quality policies and other regulations applicable to transportation projects. This webpage is periodically updated with regulatory/policy changes and can be accessed at www.mdot.maryland.gov and clicking on the 'Environment' link at the top of the page. The tabs at the top of the page lead to information on state and environmental self-audit program; regulations for transportation facility operations such as storage tanks and spill prevention and response; environmental resources such as Smart, Green & Growing, MDE, MDNR and EPA; MDOT's environmental management system (EMS), environmental stewardship and sustainability efforts, and environmental planning initiatives.

SHA Environment and Community Web Page

SHA has developed an environmental awareness web page that is located on the SHA website (www.marylandroads.com). SHA continues to update this site with up to date information about various NPDES related topics, including:

Chesapeake Bay and Local Waterway Restoration

- Bay Restoration Viewer Interactive Map (See Figure 1-27)
- Bay Restoration Strategies (See Figure 1-28 for a photo example from the website)
- Frequently Asked Questions
- Documents and Reports

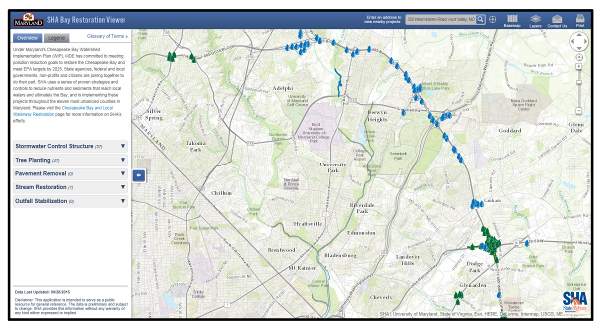

Figure 1-27: Screen Capture of the SHA Bay Restoration Viewer Interactive Map

Figure 1-28: SHA Sand Filter BMP Example used on the Website

Environmental Stewardship and Mitigation

- Reforestation and Planting Programs
- Invasive Plant Control
- Wetlands and Waterways

Initiatives

- Recycling
- Litter Education

Maintenance

- Winter Operations
- Mowing Reduction
- Idling Policy
- Vehicle and Equipment Fleet
- Road Sweeping
- Ditch/Culvert Cleanings
- Litter Removal

Employee Commuter Reduction Incentives

SHA offers several incentives to reduce the number of drivers and/or number of commuter days/miles per week by Administration employees. Fewer commuter days and miles mean less vehicle pollutants entering the watershed.

Alternate work schedules include flexible work hours allowing employees to work compressed workweeks reducing the total number of commuting days and miles.

Teleworking allows employees to work from a remote location (presumably at or close to home) and also reduces the number of commuting days and miles per week. Each office has or is developing a teleworking policy.

Car-pooling has been encouraged at SHA for many years and reduces the number of commuters on the road. SHA car-pooling incentives include prioritizing parking space allocation to those in a designated car pool and Administration assistance in locating a carpool within the employee's residential area.

Bicycle commuting is also encouraged with SHA's support to promote bicycle safety laws, implementing new bike facilities throughout the state. SHA also participated in a number of bicycle safety events and campaigns across the state year round. See Figure 1-29 for an image from Bike to Work Day.

Figure 1-29: SHA Promoted Bike to Work Day on May 15, 2015

Finally, employee ID badges allow state employees to acquire a free State Transit Employee Pass (STEP) that allows free access to MTA mass transit including the Baltimore area subway, light rail, and buses. This encourages the use of mass transit by SHA employees who live within the Baltimore area.

SHA Vehicle and Equipment Idling Policy

On September 22, 2009, the SHA issued a policy regarding reduction in idling of engines for state equipment and vehicles. The purpose is to reduce fuel consumption by state forces, and if adhered to, will result in pollutant load reduction as well.

F Watershed Assessment

Requirements under this condition include:

1. *Continue providing available geographic information system (GIS) highway data to permitted NPDES municipalities and MDE;*
2. *By the fourth annual report, complete SHA's Impervious Surface Account as described in Part III.C. (Source Identification);*
3. *Select for retrofitting impervious areas with poor or no runoff control infrastructure. These projects shall be implemented where water quality improvements can be achieved; and*
4. *Work with Maryland's NPDES municipalities to maximize water quality improvements in areas of local concern*

SHA has incorporated watershed assessment effort as described by the permit in the overall business process by contiguous evaluation of highway drainage areas for stormwater management retrofit opportunities and coordinating with local jurisdictions on their watershed restoration plans to maximize water quality benefits.

SHA exchanges the latest available geographic information system (GIS) highway data with permitted NPDES municipalities and provides the most recent spatial database of drainage assets and stormwater infrastructure to MDE. SHA completed the impervious surface accounting by the fourth annual report and continues to systematically update this data. SHA is assessing the areas that lack highway runoff control and treatment and implementing water quality improvement projects in cooperation with the Maryland NPDES jurisdictions to maximize water quality benefits in areas of local concern.

F.1 GIS Highway Data to NPDES Jurisdictions and MDE

SHA makes the GIS database of drainage and stormwater assets available to NPDES jurisdictions, and provides the most recent updates when the data is requested. SHA annually submits the latest version of the NPDES Geodatabase to MDE to incorporate into the statewide database for the Chesapeake Bay and local TMDL modeling. In addition, SHA provided the NPDES Geodatabase datasets to MDE for the required Historical BMP Cleanup deliverable on May 29, 2015.

F.2 Complete Impervious Accounting by Fourth Annual Report

SHA completed the impervious accounting requirement for all of the Phase I counties, by the fourth annual report, October 2009.

The issue of treatment credit accounting for impervious surfaces treated by entities other than the jurisdiction that has ownership of the surfaces is still not resolved between MDE and the MS4 jurisdictions. SHA has currently taken credit only for SHA-owned surfaces and not included in the accounting of any non-SHA impervious surfaces to date. Although it is anticipated that this additional treatment credit will be applied to SHA in the future, thus increasing treatment currently provided.

The impervious accounting has been expanded to include Phase II counties (Washington and Cecil) and three municipalities (Cambridge, Cumberland, and Salisbury), and the results are included in this report under Section C.3.

F.3 Impervious Area Retrofits

SHA developed a protocol for site searches to identify most suitable location for stormwater management facilities that would directly treat the highway impervious surfaces runoff, preferably within existing SHA controlled right of way. SHA has also implemented alternative BMPs such as Tree Planting, Stream Restoration, Outfall Stabilization, and Pavement Removal as part of our Chesapeake Bay TMDL implementation plan discussed in Section J.

F.4 Maximize Water Quality Improvements in Areas of Local Concern

SHA is a transportation agency focusing on providing and maintaining a highway system that supports local and statewide economic development, but also focuses on ensuring that highway projects meet all necessary SWM and water quality regulations. In addition, as part of the terms of the permit conditions, SHA adheres to the watershed restoration goals and priorities that have been established by local NPDES jurisdictions.

Past achievements to maximize water quality improvements within areas of local concern have been discussed in detail in annual reports of previous reporting periods. Past activities have included the following.

- Documenting watershed goals and priorities.
- Piloting a watershed-based SWM assessment on US 301 in partnership with Prince George's and Charles counties during the evaluation of transportation improvements within the corridor.
- Commencing work on a draft framework for implementing a watershed-based approach for SWM using a grant from the Environmental Protection Agency (EPA) and as part of the Green Highways Partnership (GHP) between SHA, the EPA, and the Federal Highway Administration (FHWA).
- Completion of watershed assessment and a retrofit study of the Indian Creek watershed in partnership with Prince George's County.
- Conducting watershed wide water quality site searches to maintain a positive balance in the SHA Water Quality bank.
- Incorporating stormwater management practices into SHA major highway projects to maximize the water quality treatment of highway runoff; implementing environment site design and other innovative practices to maximum extent practicable
- Implementing an outfall inspection protocol and rating system, to systematically prioritize outfall channels stabilization projects in conjunction with stream restoration projects
- Initiating outfall restoration projects and drainage improvements projects to preserve and restore SHA stormwater and drainage infrastructure and eliminate potential pollution sources
- Preparing for TMDL milestones and allocation reduction strategies.

Updates for on-going or recently-reported endeavors are as follows:

Water Quality Bank

The Water Quality (WQ) Bank was established in 1992 as part of a Memorandum of Agreement (MOA) between SHA and MDE with the intent to facilitate construction of smaller roadway improvements where hardship in meeting the full water quality requirements can be demonstrated and allowing debiting an established bank to meet water quality requirements if credit exists in the 6-digit watershed account. Proposed updates to terms and conditions for WQ bank are under review. Credit is achieved by over managing water quality on other projects. The bank tracks, on a project basis, the amount of impervious area required to be treated and how much is actually treated. For any project in which WQ treatment cannot be provided, in part or in full, a debit may be incurred. For projects that provide WQ treatment in excess of what is required, credits may be earned. Credits provide the means for debits to be possible. This flexibility not only allows SHA to deliver projects more efficiently, but also ensures that WQ management of SHA impervious areas is ultimately provided within each 6-digit watershed within the state. In addition, the tracking of watershed credits allows SHA the opportunity to consistently exceed the regulatory requirements and provide additional WQ treatment to regularly increase the percentage of the amount of impervious surfaces managed.

Credits and debits are tracked by acres of impervious surface and includes parking lots, roadways, sidewalks, and any other impervious surfaces within designated watersheds.

A strict set of rules of how credits and debits may be applied are well-defined in the MOA:

- For impervious areas to be considered treated for WQ, stormwater runoff must be managed for the first inch of rainfall.
- If the existing impervious surface amount within limits of disturbance (LOD) of a project is greater than 40%, 50% of the existing impervious surfaces and 100% of net change (new) in impervious surfaces must be managed for WQ.
- If the existing impervious surface amount is less than 40%, 100% of impervious areas within LOD must be managed for WQ, regardless of whether or not the impervious surface is existing or new.
- Based on the current SWM requirements, all potential opportunities to implement Environmental Site Design (ESD) to the Maximum Extent Practicable (MEP) must be exhausted and it must be demonstrated that structural and non-structural SWM facilities are not practicable to install before debits may be incurred from the WQ Bank.
- When the amount of impervious surfaces managed for WQ exceed the requirements of a project, the excess may be applied as a credit to the WQ Bank only if ESD practices are implemented resulting in excess treatment.
- Credits to the WQ Bank are applied as follows: 100% for management of SHA-owned impervious surfaces and 50% for management of non-SHA-owned impervious surfaces.

As an additional effort to ensure enough credits are available in the WQ Bank should the need for debits arise, SHA initiates projects to specifically identify locations of unmanaged impervious surfaces in various locations throughout the 6-digit watersheds and implements retrofit projects to install SWM facilities to manage impervious surfaces for WQ. This allows SHA to provide more meaningful and effective management of WQ improvements within watershed areas in which WQ balances are low. This concept is parallels a working framework for watershed-based stormwater management.

SHA submitted its accounting for balances to MDE as part of its quarterly report according to Delegated Authority MOU and is waiting for reconciliation conformation from MDE. SHA expects major credit record in SHA statewide bank.

County Coordination

SHA has been regularly meeting with permitted MS4 jurisdictions to discuss watershed needs, current assessments, and potential partnering projects. SHA has also been invited by local groups to discuss the Chesapeake Bay restoration program and SHA's plan to meet pollution reduction goals established by MDE. This outreach has helped SHA identify local needs for watershed restoration efforts, and has been very instrumental as SHA develops the TMDL program, as discussed in Section J. Below is a list of meetings attended this reporting period. Table 1-19 on the following page summarizes the meetings held in the past year. More details about partnering projects are further discussed in Section G.

Table 1-19: Summary of SHA and County Coordination Efforts

Jurisdiction/Group	Meeting Date(s)	Main Topics and Comments
Anne Arundel County	11/18/14, 2/27/15, 5/13/15, 8/19/15, 9/16/15	SHA and Anne Arundel County DPW regularly meet and discuss project opportunities and implementation. Broad Creek stream restoration is one partnering project.
Anne Arundel County, Jabez Watershed Assessment Stakeholder Group	4/30/15, 9/29/15	Anne Arundel County and SHA are collaborating on a watershed assessment and restoration plan for the Jabez Branch 3.
Baltimore County	1/29/15, 7/7/15	SHA and Baltimore County have met several times. SHA gave a presentation of their grass swale assessment procedures and credit determination.
Town of Hancock	6/30/15	Met with Town Manager to discuss stream restoration partnering project at Kirkwood Park in Washington County.
Harford County's Environmental Advisory Board	11/18/14	Presentation of SHA's Chesapeake Bay Restoration program.
Mount Saint Mary's University	2/24/15	SHA and Mount Saint Mary's University are partnering to plant several acres of trees on the campus in Frederick County.
M-NCPPC Montgomery County Parks	6/7/15	SHA and M-NCPPC discussed project opportunities on parkland.
Prince George's County	5/7/15	Discussed restoration and mitigation opportunities and collaboration.
Washington County	5/12/15	Discussed stream restoration opportunities in Washington County.
Town of Woodsboro	3/20/15	Discussed a stream restoration opportunity in Woodsboro Park, Frederick County.
Maryland Association of Counties	8/31/15 & 9/24/15	Discuss permit Streamlining for TMDL and MS4 restoration projects

Green Highways Partnership

A Green Highways Partnership has been established between EPA and the Federal Highway Administration (FHWA). The partnership creates a voluntary public/private network focusing on effective green transportation partnering, innovation, and collaboration between the environmental and transportation communities. SHA, as a leading partner in the Green Highways Partnership, has become involved in a number of demonstration projects promoting innovative stormwater management practices, including low impact development strategies and water quality banking. In addition to the SHA transportation mission, SHA has incorporated this significant component in the business process in all aspects of project development including planning, design, and permitting.

Watershed Resources Registry

The Watershed Resources Registry (WRR) is a national pilot to integrate land-use planning, regulatory, and non-regulatory decision making using the watershed approach. SHA, through the Green Highways Partnership, developed a GIS-based pilot Registry in close collaboration with all regulatory agencies including DNR, MDE, ACOE, USFWS, and EPA, along with FHWA, Charles County, Prince George's County, and Maryland Environmental Service (MES).

The WRR is a GIS based targeting tool that was developed to analyze watersheds and identify the best opportunities for the protection of high quality resources, restoration of impaired resources, resource conservation and environmental resource planning, and improvement of stormwater management. The WRR is intended to integrate the Clean Water Act (CWA) authorities by facilitating implementation of CWA Sections 319, 401, 402, and 404, TMDL implementation practices, and multiple state programs.

WRR is a comprehensive web based mapping tool and replicable framework with a user friendly interface that:

- Integrates regulatory and non-regulatory programs
- Guides resource planners
- Conserves program resources
- Highlights for multiple environmental benefits
- Maximizes watershed benefits
- Is transparent and predictable

The objective of the Registry is to map natural resource areas that are a priority for preservation and to identify sites best-suited for ecosystem preservation and restoration. A major effort of the WRR process is a set of suitability analyses developed with sound science and the best professional judgment of regional experts, which will be used as a screening tool to target opportunity sites for the protection of high quality resources, restoration of impaired resources, and improvement of water resources. The analyses will specifically identify for:

- Upland Preservation, Upland Restoration
- Wetland Preservation, Wetland Restoration
- Riparian Preservation, Riparian Restoration
- Natural Stormwater Infrastructure Preservation
- Compromised Stormwater Infrastructure Restoration

By having both regulatory and non-regulatory agencies base decisions from a WRR, integration and the use of the watershed approach will become implicit and "stovepipe" processes in decision making will become obsolete. The results will streamline the regulatory and non-regulatory processes and ensure maximum environmental results. The benefits of WWR in greater detail include the following:

- Helps agencies identify watershed restoration and protection opportunities to target improvements and evaluate results.
- Helps "connect the dots" between agencies, fostering shared vision and stronger relationships that produce better government and improved services to customers.
- Provides a wide variety of labor and cost efficiencies associated with streamlined processes, collaboration and shared resources.
- Helps provide a consistent evaluation framework that each state can establish based on stakeholder consensus (a data-driven "star" rating) through which watershed/geography/context sensitive decisions can be made.
- Helps agencies avoid or minimize negative environmental and natural resource impacts and informs decision-making.
- Fosters continuous improvement in the quality of data outputs through opportunities for collective intelligence and feedback (with appropriate controls).
- Significantly streamlines regulatory review processes and workflow for a variety of stakeholders, including state agency departments of natural resources, environmental protection, and planning, as well as federal organizations such as the Federal Highway Administration, US Army Corps of Engineers, Environmental Protection Agency, Natural Resources Conservation Service, and US Fish and Wildlife Service.
- Also significantly streamlines the evaluation of projects by users, including conservation groups, permit applicants, and others, since it provides valuable information on existing resources and realities.
- Improves collaboration and coordination between agencies occurs because everyone is using the same data and tool. This promotes

an upfront understanding of all of the issues by all of the stakeholders and reduces surprises along the way.

- Helps transportation planners identify potential impacts to resources early in the process.
- The transparency and collaboration central to WRR helps promote optimal watershed actions.
- Helps significantly streamline, integrate and enhance a variety of regulatory permitting processes and requirements
- Helps agencies identify and address data gaps, which improves data integrity and quality over time.
- The Registry's flexible data layers permit highly customizable outputs depending upon business user needs, providing a highly dynamic evaluation approach.
- Supplies a transferrable framework that can be used by states across the nation

In the past year, the members of the WRR Technical Committee have been working on the nationwide promotion of this new technology through the AASHTO Innovation Initiative (AII). This program, formerly known as Technology Implementation Group (TIG), provided funding for the first national WRR Workshop that was held in Baltimore on October 16 and 17, 2014 (See Figure 1-30). The more than 70 attendees at the workshop included resource, regulatory, and transportation agency staff from both State and federal agencies. In addition to the workshop, the WRR will hold a webinar in October 2015 to reach out to the intended targeted audience for adoption of this technology, including: Federal and State Transportation Agencies.

- State Natural Resource & Environmental Quality Agencies
- State Regulatory Agencies
- Local Government Agencies and Authorities (cities/counties/toll road authorities)
- Private Sector Stakeholders (Architectural Engineering Firms, Mitigation Banks, Environmental Services Firms, Utility Companies, Developers, etc.)

SHA adopted the WRR in spring 2012. The WRR application has been valuable for gathering environmental inventory information, assessing watershed needs, identifying potential mitigation sites, and avoidance and minimization efforts. The future use of this tool is for suitable stormwater management site searches to meet regulatory requirements and for TMDL projects implementation.

Figure 1-30: SHA Representatives Presenting at the National WRR Workshop

Framework to Implement a Watershed-Based Approach for Managing Stormwater

The watershed approach framework for managing stormwater represents coordination and environmental management that focuses public and private sector efforts to address the highest priority problems within hydrologically-defined geographic areas.

SHA has recognized the need for integrated environmental management through watershed – based approach for treatment of highways as well as off-site runoff to effectively reduce pollutant loads delivered to downstream reaches lakes, rivers, wetlands, estuaries, coastal waters, and ground water. Successful stormwater management can be achieved primarily by controlling point sources of pollution in many case outside of SHA controlled Right-of-Way, therefore close coordination and cooperation with all stakeholders in the watershed is unavoidable. SHA has developed a framework for implementing a watershed-based approach with recommendations how to cultivate partnerships, assess specific watershed needs, establish accountability, optimize budget spending, and promote sustainable systems within the transportation network and local communities.

SHA has been a leading supporter of watershed based stormwater management and has defined this vision as of stormwater management concept to recognize that highways coexist with other land uses in watersheds. SHA adopted this collaborative approach as it provides opportunity to plan and deliver the most effective protection and improvements to the watersheds. In support of this concept, SHA has taken significant steps towards creating GIS database of more than 3300 stormwater facilities and associated drainage infrastructure that allows systematic evaluation of the effectiveness of stormwater controls on a watershed scale.

Close and frequent coordination with various local Programs and their watershed implementation plans results in better environmental benefits, positive socioeconomic impacts, and more accurate financial planning. Data sharing and joint review can help program managers from all levels of government and regulatory agencies to better understand the cumulative impacts of land development, highway construction, and other human impacts. This helps to determine the most critical problems within each watershed related to protection, pollution control, fish and wildlife habitat, and other aquatic resource programs. Using this information to set priorities for action allows public and private managers from all levels to allocate appropriate funding and human resources to address the most critical needs. Part of the action is establishing environmental indicators to select appropriate activities to prioritize and address high priority issues as well as measure the success through implementation of appropriate and effective improvements rather than simply fulfilling programmatic requirements. SHA is committed to continue working within this framework as it has been in close coordination with local jurisdictions, regulatory agencies, local watershed groups, and the public throughout all phases of project development process to effectively address stormwater issues that result in significant and measurable environmental benefits.

The watershed based approach results in significant cost savings by leveraging and building upon the financial resources and the willingness of the stakeholders with interests in the water quality improvements to take action. Through improved communication and coordination, the watershed approach can reduce costly duplication of efforts and conflicting actions. Implementation of water quality banking, wetland mitigation, and stream restoration, as well as establishment of trading mechanism among various sectors, results in significant environmental benefits, a streamlined permitting process, more efficient and timely delivery of projects, cost saving of public funds, and reduction of potential adverse impacts.

Finally, SHA recognizes that the watershed approach strengthens teamwork between the public and private sectors at the federal, state, and local levels to achieve the greatest environmental improvements with the resources available. The watershed approach builds a sense of community, reduces conflicts, increases commitment to the actions necessary to meet societal goals, and improves the likelihood of sustaining long-term environmental improvements.

Green Asset Management System

Maryland State Highway Administration (SHA) Office of Planning and Preliminary Engineering (OPPE) Program Development Division Asset Management Section has developed and deployed an asset management data warehouse for data integration and storage. It provides both editing and viewing capabilities as a component to SHA's current Enterprise GIS (eGIS) application. The ADW Asset Editor Widget provides an enterprise, centralized suite of tools and functionality integrated within the eGIS framework to streamline the maintenance of SHA-owned assets. The eligible assets that may be managed using an enterprise asset management approach include bridges / structures, pipes and small culverts, standard roadway and mowable areas, guardrails, and dynamic message signs, and traffic control mechanisms.

The Asset Editor Widget is a flexible, easy-to-use widget that provides functionality to add, move, and update location details and delete asset information. Currently, the Asset Editor Widget has been implemented for managing Lighting Assets (such as poles, panels, and structures), Signage Assets (such as sign installations, and sign panels), Traffic Barrier Assets, Rumble Strip Assets, and Line Striping (Pavement Marking) Assets, Park and Ride and Raised Pavement Markings (RPM). Future consideration will be given for opportunities to implement the Asset Editor Widget for additional applicable SHA asset maintenance programs

The existing eGIS widget suite includes the Green Asset Management System (GAMS). The GAMS widget allows the desktop user to manage green assets (such as invasive species) along SHA owned right of ways. After that widget had been developed, a supplemental feature was added to facilitate the collection of data about green assets using a mobile device, such as a tablet or smartphone. A user guide was developed to focus on the mobile field editor and eGIS widget functionality to checkout, search, add, update, delete, and check-in GAMS assets.

Recycled Materials Task Force

The Office of Materials and Technology created a task force to review, analyze, and implement greater use of recycled materials in transportation projects. Pertinent design offices actively participate in quarterly meetings. Design expertise includes materials, hydrology, environmental regulations, habitats and ecosystems, and highways. Members of regulatory agencies, industry manufacturers, and material suppliers also participate. As a result of these meetings, SHA has continued to increase opportunities to use recycled and reclaimed materials in transportation projects. SHA has identified multiple recyclable materials that can be incorporated into highway projects.

Local 8-Digit Impairments and TMDLs

With the TMDL requirements anticipated for the next permit term, which is expected to focus on treatment of untreated impervious surfaces and waste load reductions for urban stormwater runoff, SHA will be shifting efforts to prioritize key segments of the Chesapeake Bay watershed along with local TMDL watersheds in which SHA is named as a contributor to the waste load allocation (WLA). Establishment of the 2-year milestones has begun and SHA has been making progress towards meeting set goals to achieving Bay TMDL requirements while demonstrating compliance with local TMDLs and treating impervious surfaces. SHA is programming and developing policies to coincide with the anticipated load reduction goals, which are further discussed in Section J. Additional endeavors in which SHA is currently involved are covered in Section G.

G Watershed Restoration

Requirements under this condition include:

1. *Construct or fund 25 significant stormwater management retrofit projects during the course of this permit for impervious areas with poor or no runoff control infrastructure. These projects shall be implemented where water quality improvements can be achieved and shall not include typical stormwater management maintenance. Innovative alternatives to conventional stormwater management methods will be considered by MDE. Alternative practices shall be submitted to MDE for approval prior to implementation;*

2. *Contribute to local watershed restoration activities by constructing or funding stormwater management retrofits in watersheds targeted by local NPDES municipalities when feasible; and*

3. *Submit annual reports containing pertinent information on its watershed restoration activities such as stormwater management retrofit proposals, costs, schedules, implementation status, and impervious acres proposed for management.*

SHA continues to construct stormwater management retrofits to increase pollutant control associated with highway runoff, although requirements for this permit condition to implement 25 significant stormwater management retrofit projects has been met. In addition, SHA continues to partner with local jurisdictions on various watershed restoration initiatives and activities. The watershed restoration projects mostly include functional enhancements and upgrades of outdated stormwater facilities that are currently not meeting the latest design standards, as well as construction of additional stormwater BMPs to treat currently untreated impervious surfaces. The watershed restoration projects include innovative approaches to conventional stormwater management methods such as stream restoration projects. Projects also include drainage outfall stabilization to restore degrading channels, prevent sediment and other pollutants transport to the downstream reaches, and provide significant water quality benefits.

SHA continues to support local watershed activities by constructing and funding water quality projects such as stormwater retrofits and stream restoration projects within targeted watersheds. To comply with the permit conditions, SHA annually reports on watershed restoration activities, progress, costs, schedules, implementation status, and impervious acres proposed to be treated.

G.1 Implement 25 Significant SWM Retrofit Projects

SHA has met the goal to complete the required 25 significant SWM Retrofit projects within this expired permit term, and has been reported in the past annual reports. However, SHA has been continuing efforts to maximize treatment of untreated impervious surfaces in anticipation of the increased restoration requirements under the new permit.

Stormwater Facility Functional Upgrades, Enhancements, Retrofits, and Restoration Projects.

These projects are not developed to meet stormwater management requirements of major highway projects, but they were specifically initiated to upgrade stormwater BMPs to meet current regulations and provide maximum water quality treatment, or to construct new SWM facilities for additional impervious surface treatment. SHA continues design and permitting activities for a SWM retrofit project at I-695 and Cromwell Bridge Interchange to treat over 80 acres of impervious surface and off site runoff from highly urbanized watershed. This water quality improvement project is designed in conjunction of four outfall stabilizations at tributaries to Minebank Run, as well as main channel restoration. The project is scheduled to advertise in the spring of 2017.

Several functional enhancement projects were initiated in Harford County to improve water quality of existing SWM facilities and provide maximum treatment of SHA highway runoff. The design is in final stages and the projects will be completed with areawide construction contracts.

In addition to SWM retrofit and enhancement projects, stream restoration and drainage outfall channel stabilization projects were initiated to address adverse impacts of urbanization to further reduce pollutant loads and improve water quality within targeted watersheds.

All restoration projects initiated or completed to meet the 25 project requirement are listed in Table 1-20. A total of 124 water quality improvement projects were designed to treat approximately 1089.79 acres of impervious surface (not including the Chester River Area projects, which are in Queen Anne's County).

SHA continues design and construction activities within medians of divided highways to address water quality of legacy pavement– the pre-1985 impervious surfaces. The detailed progress will be reported in the next reporting period after construction completion when as-built information is available to assure full functionality. Our current level of treatment by stormwater controls completed is 420 acres at 1.7% (See Table 1-3 in Section C). Design efforts are underway to increase restoration to 1089.79 acres at 4%.

Table 1-20: Watershed Restoration Projects

Projects by Watershed	Retrofit Type	Status	Restored Impervious Acres
Lower Susquehanna River – 02-12-02			
BMP 120076	SWM Retrofit	Complete	2.82
		Total Treated:	**2.82**
Bush River Area – 02-13-07			
BMP 120069	SWM Retrofit	Complete	4.16
BMP 120072	SWM Retrofit	Complete	4.68
BMP 120073	SWM Retrofit	Complete	3.99
BMP 120075	SWM Retrofit	Complete	1.77
BMP 120081	SWM Retrofit	Complete	2.39
BMP 120082	SWM Retrofit	Complete	1.00
		Total Treated:	**17.99**
Gunpowder River – 02-13-08			
I-83 Outfall Stabilization of Tribs. to Gunpowder Falls	Stream stabilization	Complete	7.85
Minebank Run Restoration, & WQ Improvements	Stream restoration, outfall stabilization, SWM retrofit***	Design	236.8
BMP 030389	SWM Retrofit	Complete	2.43
		Total Treated:	**247.08**
Patapsco River – 02-13-09			
BMP 020120	SWM Retrofit	Complete	17.73
BMP 020121	SWM Retrofit	Complete	0.96
BMP 020122	SWM Retrofit	Complete	0.92
BMP 020625	SWM Retrofit	Design	2.46
BMP 030281	SWM Retrofit	Complete	8.35
MD 139 Tributary to	Stream Stabilization	Complete	260.30

Projects by Watershed	Retrofit Type	Status	Restored Impervious Acres
Towson Run Stabilization			
BMP 020111	SWM Retrofit	Complete	6.04
BMP 020112	SWM Retrofit	Complete	0.56
BMP 020098	SWM Retrofit	Complete	0.68
BMP 020099	SWM Retrofit	Complete	0.75
BMP 020476	SWM Retrofit	Complete	3.79
BMP 020477	SWM Retrofit	Complete	Combined with 020476
BMP 130197	SWM Retrofit	Complete	0.44
BMP 130207	SWM Retrofit	Complete	1.57
BMP 130221	SWM Retrofit	Complete	0.17
BMP 130210	SWM Retrofit	Complete	0.24
BMP 130217	SWM Retrofit	Complete	0.10
I-695 Tributary to Steamers Run	Stream Stabilization	Complete	182.00
		Total Treated:	**487.06**
West Chesapeake Bay – 02-13-10			
BMP 020019	SWM Retrofit	Complete	1.22
BMP 020022	SWM Retrofit	Complete	1.06
BMP 020027	SWM Retrofit	Complete	1.59
BMP 020029	SWM Retrofit	Complete	0.88
BMP 020031	SWM Retrofit	Complete	2.29
BMP 020088	SWM Retrofit	Complete	3.53
BMP 020481	SWM Retrofit	Complete	2.09
BMP 020522	SWM Retrofit	Complete	1.70
BMP 020273	SWM Retrofit	Complete	1.18
BMP 020491	SWM Retrofit	Complete	1.79
BMP 020185	SWM Retrofit	Complete	0.48
BMP 020198	SWM Retrofit	Complete	0.68
BMP 020201	SWM Retrofit	Complete	1.01
BMP 020205	SWM Retrofit	Complete	1.16
BMP 020206	SWM Retrofit	Complete	0.49
BMP 020210	SWM Retrofit	Complete	0.36
BMP 020220	SWM Retrofit	Complete	0.72
BMP 020258	SWM Retrofit	Design	3.27
BMP 020260	SWM Retrofit	Design	1.41
BMP 020268	SWM Retrofit	Design	7.08
BMP 020393	SWM Retrofit	Design	4.35
BMP 020394	SWM Retrofit	Design	3.27
BMP 020014	SWM Retrofit	Construction	1.9
BMP 020015	SWM Retrofit	Construction	0.73
BMP 020016	SWM Retrofit	Construction	0.72
BMP 020017	SWM Retrofit	Construction	0.16
BMP 020018	SWM Retrofit	Construction	0.65
		Total Treated:	**45.5**
Patuxent River – 02-13-11			
BMP 160059	SWM Retrofit	Complete	3.2
BMP 020488	SWM Retrofit	Complete	5.56

Projects by Watershed	Retrofit Type	Status	Restored Impervious Acres
BMP 160217	SWM Retrofit	Complete	0.64
BMP 160219	SWM Retrofit	Complete	0.91
BMP 160380	SWM Retrofit	Complete	3.42
BMP 020301	SWM Retrofit	Complete	2.30
BMP 020311	SWM Retrofit	Complete	0.28
BMP 020437	SWM Retrofit	Complete	4.13
BMP 020299	SWM Retrofit	Complete	1.09
BMP 130149	SWM Retrofit	Complete	0.48
BMP 130150	SWM Retrofit	Complete	1.02
BMP 130154	SWM Retrofit	Complete	0.47
BMP 130159	SWM Retrofit	Complete	0.02
BMP 130160	SWM Retrofit	Complete	0.52
BMP 130162	SWM Retrofit	Complete	0.66
BMP 130179	SWM Retrofit	Complete	2.10
BMP 130180	SWM Retrofit	Complete	0.43
BMP 130187	SWM Retrofit	Complete	0.13
BMP 130188	SWM Retrofit	Complete	0.12
BMP 130189	SWM Retrofit	Complete	0.03
BMP 130190	SWM Retrofit	Complete	0.03
BMP 130191	SWM Retrofit	Complete	0.05
BMP 130192	SWM Retrofit	Complete	0.05
BMP 130193	SWM Retrofit	Complete	0.10
BMP 130194	SWM Retrofit	Complete	0.22
BMP 130232	SWM Retrofit	Complete	0.03
BMP 130242	SWM Retrofit	Complete	0.72
BMP 130243	SWM Retrofit	Complete	3.49
BMP 150228	SWM Retrofit	Complete	0.13
BMP 150331	SWM Retrofit	Complete	0.23
BMP 130047	SWM Retrofit	Complete	1.39
		Total Treated:	**24.77**
Lower Potomac River – 02-14-01			
BMP 160456	SWM Retrofit	Complete	1.70
BMP 080014	SWM Retrofit	Complete	0.24
BMP 080039	SWM Retrofit	Complete	0.10
BMP 080040	SWM Retrofit	Complete	0.10
BMP 080041	SWM Retrofit	Complete	0.12
BMP 080042	SWM Retrofit	Complete	0.11
BMP 080043	SWM Retrofit	Complete	0.28
BMP 080044	SWM Retrofit	Complete	0.20
BMP 080083	SWM Retrofit	Complete	0.06
BMP 080095	SWM Retrofit	Complete	0.48
		Total Treated:	**3.39**
Washington Metropolitan – 02-14-02			
BMP 160607	SWM Retrofit	Complete	0.41
BMP 160609	SWM Retrofit	Complete	Combined with 160607
BMP 160653	SWM Retrofit	Complete	15.80

Projects by Watershed	Retrofit Type	Status	Restored Impervious Acres
Long Draught Branch Restoration	Stream Stabilization	Design	228
BMP 150002	SWM Retrofit	Complete	0.31
BMP 150003	SWM Retrofit	Complete	1.69
BMP 150004	SWM Retrofit	Complete	Combined with 150003
BMP 150005	SWM Retrofit	Complete	Combined with 150003
BMP 150172	SWM Retrofit	Design	1.25
BMP 150173	SWM Retrofit	Complete	1.18
BMP 150301	SWM Retrofit	Complete	0.28
BMP 150362	SWM Retrofit	Complete	1.03
BMP 150380	SWM Retrofit	Complete	1.05
BMP 150550	SWM Retrofit	Complete	1.26
BMP 150076	SWM Retrofit	Complete	1.25
BMP 150059	SWM Retrofit	Design**	0
BMP 150556	SWM Retrofit	Design	5.65
		Total Treated:	**259.16**
Middle Potomac River – 02-14-03			
Tributary to Tuscarora Creek Stabilization at US 340 and US 15	Stream Stabilization	Complete	1.94
BMP 150270	SWM Retrofit	Complete	0.08
		Total Treated:	**2.02**
		TOTAL	**1089.79**

*Projects added since last report.
** Retrofit will be included in major highway projects

Pavement Retrofit Projects

SHA has been working with MDE to finalize Bay TMDL requirements for SHA in order to establish funding and resource needs for the future retrofit and implementation projects. SHA continues development and implementation of enhancement projects of existing SWM facilities as well as continues site search for water quality improvement projects. Funding has been allocated for design and construction of SWM retrofit projects to meet both the future waste load reductions and impervious treatment requirement. Future projects include conversion of older SWM facilities originally designed to manage water quantity into water quality sites. In addition, SHA is actively working on implementation of water quality treatment of legacy pavement through median bioswales designed within the open section roadway medians in Phase I and Phase II jurisdictions.

Stream Project Assessments

SHA has been designing stream restoration and stabilization projects as part of larger highway projects for fulfilling mitigation requirements, to ensure safe roadside areas for travelling public, and to ensure new bridge opening is in sync with the geomorphology and have long term stability. Other times these projects are implemented to provide stable conveyances from roadway outfalls or to minimize sediment transport beyond stream's natural rate such that these projects result in water quality improvements. These projects addressing mostly physical degradation issues of natural stream channels have been often perceived as additional impacts to aquatic resources even though some of the projects are remediating unintended past human impacts and the new impacts may be intended to result in some improvement to either physical, biological or both indexes. Additionally, actual environmental benefits are challenging to implement, prove, or quantify without monitoring data and scientific analysis. Therefore, SHA initiated assessment and monitoring study of completed and proposed stream restoration projects to make recommendations for design or construction changes as well as potential improvements to restoration strategies and methods. The data has been collected since 1998 at a total of 14 sites for benthic, macro invertebrates, fishes and physical habitat. The stream assessments have been performed by Dr. R. P. Morgan and his students from the University of Maryland Frostburg, Center for Environmental Service.

The study in FY 2015 focused on biological monitoring and assessment of two selected streams that have been already restored to evaluate the effectiveness of restoration in terms of revitalization of the physical and biological habitat. In addition, three streams that will be restored in the future have been assessed in order to determine the pre-restoration baseline that will be used to assess post-restoration functional rehabilitation and habitat quality improvement.

Assessment of benthic macroinvertebrates followed MBSS protocols in order to qualitatively describe the community composition and relative abundance in favorable habitats. Baseflow water quality samples were taken at each SHA site for the determination of water quality parameters following the standard analyses performed for the MBSS.

Stream physical habitat data is an essential component of any biological assessment program. Habitat data is normally used to assess trends in water quality and to investigate the influence of land use practices that may affect stream water quality. A number of variables were assessed qualitatively at each site. These include the following with scores assigned for each metric:

- In stream habitat
- epifaunal substrate
- velocity/depth diversity
- pool/glide/eddy quality
- riffle quality
- channel alteration
- bank stability
- embeddedness
- channel flow status, and
- shading

Observations of the surrounding area were used to evaluate aesthetic value (based on amounts of human refuse) and remoteness (based on ease of access and presence of human activity). The presence, or absence, of other stream habitat features (i.e., morphological characteristics, stream channelization, woody debris, and land uses visible from each site) was also recorded for each site. In the field, physical habitat assessments were integrated across controls and across the stream restoration area.

The overall project objective is to assess and monitor completed and proposed SHA stream restoration projects and to make recommendations for future monitoring needs and restoration strategy, as well as for the improvement and revitalization of current restoration projects. The full monitoring report is included in Appendix C. The following five sites were monitored in 2015:

- Montgomery County - MD117 Long Draught Branch: Pre construction monitoring
- Harford County - Plumtree Run from east of Ring Factory Rd. to north of MD 24: Post-construction monitoring
- Montgomery County – Tributary to Seneca Creek at Watkins Mill Boulevard: Pre-construction monitoring
- Howard County – Upper Little Patuxent River: Pre and Post Construction Monitoring

- Prince George's County – Tributary at Marbury Drive: pre-construction monitoring

Restoration Project Database Delivery

Data related to the retrofit projects was submitted with previous reports and can be made available upon request.

G.2 Contribute to Local NPDES Watershed Restoration Activities

SHA actively participates in local water quality improvement projects and supports watershed interest groups and local jurisdictions in their watershed restoration activities. SHA has participated directly or indirectly in developing watershed plans as well as provided funding.

Additionally, SHA oversees the Federal Transportation Alternatives Program (TAP) within the state, and encourages the use of these funds by local jurisdictions and interest groups to fund water quality projects to mitigate the adverse impacts of roadway runoff. This program was formerly known as the Transportation Enhancements Program (TEP). Under the MAP-21 legislation enacted in 2012, TAP does not fund MDOT or SHA projects anymore. The TAP funding is dedicated entirely to locally sponsored projects. However, the TAP funding can be used towards water quality initiatives when sponsored by a local jurisdiction. This year, TAP funded seven water quality initiatives including:

- Cowhide Branch Stream Restoration and Fish Passage – Anne Arundel County $1,000,000
- Elderwood SWM Basin #2 and Oklahoma Phase IV SWM Facility – Carroll County $1,047,466
- Finksburg Industrial Park Stormwater Management Facility – Carroll County $760,708
- Hwy 301 Stream Restoration – Cecil County $440,000
- MD 2/4 SWM Facilities Functional Upgrades – Calvert County $482,887
- Rutland Road Fish Passage – Anne Arundel County $747,924
- Westminster Community Pond Stormwater Management Facility – Carroll County $933,125

The following is a summary of watershed activities undertaken by SHA during the report period:

I-695 at Minebank Run Stream Restoration, Drainage and Water Quality Improvements

Design activities continue for this project addressing multi outfall stabilization, stream restoration and SWM retrofits. Minebank Run is within the Gunpowder River Watershed that is targeted by Baltimore County for restoration. This reach is located between two stream restoration projects lead by Baltimore County, therefore SHA has been coordinating with Baltimore County on the restoration effort as well as relocation of sanitary sewer that is currently greatly impacted by the degrading channel. The final design plans will be developed in 2016. The project is scheduled for construction in 2017-18. This project will result in significant pollutant load reductions for the Gunpowder River Watershed as well as improve local drainage infrastructure issues and adverse impacts of the upstream urbanization through upland SWM water quality retrofit within I-695 interchange, providing stable conveyance of the surface drainage, stabilizing 4 degraded outfall channels and restoration of the main channel to address the stream degradation. See Figures 1-31 through 1-33 on the following page.

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Figure 1-31: Existing Conditions at Minebank Run

Figure 1-32: Stormwater Retrofit Site at Minebank Run

Figure 1-33: Biological Monitoring Efforts at Minebank Run

Westminster SWM Regional Pond

This project has been developed by Carroll County and the construction is completed. SHA's function was to provide a technical guidance through the procurement process and funding through Transportation Alternatives Program (TAP). The project is a SWM retrofit of a regional pond originally designed for flood control to treat currently untreated impervious surfaces within a 250 acre watershed. A total of 25 acres of SHA owned impervious surface will receive treatment when the project is completed. See Figure 1-34 below.

Figure 1-34: Westminster Pond Stormwater Retrofit

Finksburg Industrial Park Regional SWM Facility

This project is a retrofit of a regional SWM facility proposed by Carroll County at MD 91 and MD 140 in the Liberty Reservoir Watershed. The project was initiated to improve water quality treatment capacity to meet local pollutant reduction goals. SHA functions as a project sponsor providing portion of the funding through Transportation Alternatives Program

(TAP) funding. The proposed facility will treat 22 acres of impervious surfaces within a 152 acre drainage area out of which 4 acres are SHA owned impervious surfaces at MD 91 and MD140. The project design is complete and should be constructed in 2015-2016.

South River Federation

SHA and South River Federation have partnered to restore the headwaters of Broad Creek, a significant source of sediment to downstream waterways including the Chesapeake Bay. See Figure 1-35 for a view of existing conditions of a steeply cut bank along Broad Creek.

Figure 1-35: Existing Conditions of Broad Creek

South River Federation is providing funds for design through Department of Natural Resources Chesapeake & Atlantic Coastal Bays Trust Funds. SHA will fund and manage construction and have collaborated with South River Federation's consultant designers to provide geotechnical, permitting, right-of-way, and technical assistance. The project will reduce sediment and nutrient delivery by restoring stream and wetland functions through the promotion of stream and floodplain connectivity and increasing density of native vegetation. A failed dam will also be removed. Advertisement for construction is anticipated in January 2015. Sediment and nutrient reductions will be calculated and reported once design is finalized.

SHA is currently managing the construction contract with Diversified Site Works, LLC of Odenton MD. Approximately 2,700 LF of stream channel is being restored at a cost of approximately $1.4 million. SHA and South River Federation continue to collaborate on design during construction. SHA is also coordinating with MVA for access and Anne Arundel County on overall water quality/Bay Restoration initiatives. The project should be completed by spring 2016, weather permitting.

Jabez Branch 3 Watershed Study

SHA is conducting a watershed assessment of Branch 3 of Jabez Creek to identify restoration opportunities. SHA is funding the study, which includes an existing conditions evaluation for the entire watershed, assessment of stream conditions to identify stability issues, prioritization of restoration areas, identify retrofit opportunities, and community outreach. The initial assessment was completed in April 2015. Then, SHA will collaborate with Anne Arundel County and the Severn River Watershed Association to identify and prioritize potential restoration projects based on the assessment, and determine partnership opportunities for SHA and Anne Arundel County to collaborate on BMP implementation.

SHA has completed the watershed assessment and restoration plan. We are working with the county to implement projects and will meet with the stakeholder group in late September to inform the groups of progress and opportunities for watershed group participation. The meeting is a continuation of ongoing dialogue and a March 2015 meeting where the watershed assessment was presented. SHA will be pursuing several projects and monitoring of downstream reaches. See Figure 1-36 for a photo of existing conditions.

Figure 1-36: Degraded Stream Banks along Jabez Creek

Mount Saint Mary's University Tree Planting

SHA has partnered with Mount Saint Mary's University and The Journey Through Hallowed Ground (JTHG) to plant trees along the college campus. The JTHG is a non-profit organization who is orchestrating the planting of 620,000 trees for each fallen soldier of the Civil War. The JTHG will not be part of a formal partnership; they served as a medium to connect SHA and Mount Saint Mary's University. The non-profit will hold a dedication ceremony when the tree planting is complete and geotag the trees for their website. Each tree planted will have a clickable datapoint on JTHG website whereby each tree is dedicated to a particular fallen soldier. The campus is adjacent to US 15 in Frederick County. The University identified suitable areas for plantings and SHA will develop a design that meets the University's needs and goals.

The plantings will be designed and installed by SHA and maintained by SHA during the 2 year establishment period. Upon completion of the 2-year establishment period in the planting contract, the sites will be included in a series of three 3-year establishment contracts by SHA that will include maintenance such as mowing, invasive species control, mulching, and other activities to ensure successful establishment of the tree planting sites. The establishment contracts will include replanting if the density of trees drops below 100 trees per acre. SHA will retain perpetual access privileges to the plantings as the health of the trees will be evaluated every 3 years after the establishment period. SHA will perform maintenance in perpetuity.

Stream Restoration of Israel Creek in Woodsboro Park

A stream restoration of Israel Creek in Frederick County will extend into Woodsboro Park. SHA will partner with the Town of Woodsboro to repair and stabilize the reach within the park. SHA will begin design in late 2015 and construction will begin in 2019. See Figure 1-37.

Figure 1-37: Existing Conditions at Israel Creek in Frederick County

Stream Restoration of Little Tonoloway Creek in Kirkwood Park

Little Tonoloway Creek in Kirkwood Park is actively eroding threatening park facilities. SHA will partner with the Town of Hancock to stabilize the stream. SHA will begin design in early January 2016 and construction will begin 2018. See Figure 1-38 below.

Figure 1-38: Existing Conditions at Little Tonoloway Creek in Washington County

G.3 Report and Submit Annually

SHA had completed and submitted information on the twenty-five required watershed restoration projects and other activities to meet the permit requirement in the past reports. This included retrofit proposals, costs, schedules, implementation status, and impervious acres receiving treatment through project implementation. Documentation in the form of construction plans, cost estimates, and schedules for additional projects can be provided to MDE upon request. SHA continues planning, design, and construction activities to address various drainage, stormwater management, and water quality issues throughout the watersheds within the 11 NPDES MS4 counties and watersheds statewide.

SHA also continues to reach out to the local agencies, watershed groups, and jurisdictions to partner on a variety of environmental mitigation and water quality improvement projects. SHA participates in local watershed steering committees and attends field meetings with watershed groups to discuss opportunities for stream restoration and stormwater retrofits to address stream degradation and reduce sediment transport in highly urbanized and sensitive watersheds. SHA continues evaluating opportunities to implement watershed restoration projects in cooperation with local jurisdictions as well as address citizens' concerns regarding drainage issues, flooding, erosion, sediment, highway runoff, stormwater management, TMDL compliance, and other environmental issues.

H Assessment of Controls

Requirements under this condition include:

1. *Continue providing available geographic information system (GIS) highway data to permitted NPDES municipalities and MDE;*

2. *By the fourth annual report, complete SHA's Impervious Surface Account as described in Part III.C. (Source Identification);*

3. *Select for retrofitting impervious areas with poor or no runoff control infrastructure. These projects shall be implemented where water quality improvements can be achieved; and*

4. *Work with Maryland's NPDES municipalities to maximize water quality improvements in areas of local concern.*

This permit condition requires SHA to assess the effectiveness of the NPDES stormwater program and progress towards improving water quality. SHA was required to develop and receive approval for a monitoring plan that should include chemical, biological, and physical monitoring according to parameters specified in the permit and to submit data annually.

H.1 Restoration Site Approved by October 21, 2006

SHA developed a proposal and received approval for a watershed restoration project by October 21, 2006 for Long Draught Branch restoration. This project has been fully designed and prepared for advertisement, but it has undergone difficulties in obtaining the joint permit approval for construction and therefore has never been implemented. The monitoring plan for chemical, biological, and physical data has been developed and pre-construction monitoring has been completed. The biological monitoring has continued, while chemical and physical monitoring has been put on hold until the project design is restarted and funded again for construction. The new concept design has been developed in 2014 to address the concerns of multiple agencies and obtain the required permits. SHA will proceed with the joint permit application and advertise for construction in February 2017, so the project can be constructed in 2017-2018. Post construction monitoring data will be collected after the project completion for several consecutive years in accordance with the permit requirements and the previous delivered monitoring plan (See SHA First Annual Report, 2006, Appendix K). Meanwhile, biological monitoring continues, as mentioned in the Section G and Section D of this report.

H.2 Monitoring Requirements

Based on the previous approval of the Long Draught Branch project by MDE-WMA, significant pre-construction monitoring (physical, chemical and biological) was performed (See Figure 1-39). The final report for the pre-construction monitoring data was included in the SHA Third Annual Report, 2008, Appendix I. Since the project has been delayed, the post-construction monitoring data will not be available until after the construction is completed.

Figure 1-39: Biological Monitoring Efforts

In the interim, SHA performed monitoring of a failed infiltration basin at MD 175 in Howard County to assess pollutant removal efficiency of a technically deficient SWM BMP. The study has been concluded and is summarized in the 2012 and the final report with monitoring results was included in Appendix A of the 2012 Annual Report.

As noted earlier in Section D, SHA initiated bioswale monitoring study as well to evaluate effectiveness of this widely used BMP and its pollutant removal efficiency. The study site is located along US 40, west of I-81 in Washington County, at BMP 210197, 210198, and 210199. Monitoring equipment has been installed and the samplers are logging data. The research team has also completed the soil infiltration capacity measurements at all three sites. In the laboratory, the team has completed the digestion on the soil samples provided and measured the basic soil parameters. Testing for heavy metals in the samples is currently underway. Soil samples will be sieved and classified. A draft report was received in December 2014. See Figure 1-40 below for an image of the US 40 Bioswale monitoring equipment.

Figure 1-40: Bioswale Monitoring Equipment

H.3 Annual Data Submittal

Monitoring data for Long Draught Branch pre-construction monitoring was included with previous reports. The 2014 biological monitoring data is included in the Appendix C of this report. The new monitoring data will be delivered to MDE according to permit database format requirements, as it becomes available.

I Program Funding

This condition requires that a fiscal analysis of capital, operation and maintenance expenditures necessary to comply with the conditions of this permit be submitted, and that adequate program funding be made available to ensure compliance.

This report represents end of fiscal responsibility for this permit term. SHA has been able to fund its obligations for the all past years with some adjustments. Fiscal analysis is therefore not needed until a new permit is issued. SHA has seen requirements presented for the Bay TMDL as part of WIP process and also has reviewed MS4 permits issued to others. In the near future, SHA will perform funding needs as the next SHA permit is finalized.

In 2006, SHA had procured open-end consultant contracts in the amount of $9 million in order to accomplish both the Phase I and Phase II NPDES permits. SHA has procured open-ended consultant contracts for NPDES services in the amount of $48 million for the next six years to continue our engineering efforts for the future. Contracts totaling $48 million for environmental design services may also be utilized for NPDES related efforts over the next six years.

SHA utilizes Capital Funds (Fund 74 – Drainage and Fund 82 - TMDL) for engineering and construction related activities associated with the NPDES MS4 Permit. In addition to the funding commitment from these two funds, SHA seeks additional funding from a variety of sources such as the Chesapeake Bay Trust fund, State Planning and Research funds (SPR), and SHA Operations and Maintenance funds in completing NPDES requirements. SHA no longer uses TEP for state project funding. Under the new MAP-21 legislation enacted in 2012, TEP was modified into TAP, and TAP funding is dedicated for locally sponsored projects only. However, SHA serves as a partner in administering these funds and encouraging their use for water quality initiatives.

Currently, SHA tracks only capital fund spending for the NPDES program as a whole. According to our current records, the total spent for the MS4 NPDES, the Stormwater Facility Program and the Industrial NPDES are listed in Table 1-21 below, and Fund 82 projections are shown in Table 1-22.

Table 1-21: SHA Capital Expenditures for NPDES (State Fiscal Years)

Fiscal Year	Expenditure (Millions)*
2005	$ 3.40
2006	$ 7.26
2007	$ 5.74
2008	$ 5.73
2009	$ 6.42
2010	$ 8.68
2011	$ 11.62
2012	$ 19.20
2013	$ 28.54
2014	$33.73
2015	$54.57

** Includes Fund 74, 82, Industrial, and SPR Funds. TEP Funds were included through 2012.*

Table 1-22: Fund 82 Programmed Funding by Fiscal Year

Fiscal Year	2014*	2015*	2016	2017	2018	2019
GO Bond	--	$41.4 M	$3.6 M	$0 M	$100 M	$100 M
TTF	$25.8 M	$0M	$59.4 M	$74.0 M	$23.2M	$9.7 M
Total Dollars Allocated	$25.8 M	$41.4M	$63.0 M	$74.0 M	$123.2 M	$109.7. M

***Actual Expenditures**

J Total Maximum Daily Loads (TMDLs)

The SHA NPDES Phase I permit covering this reporting period states that MDE has determined that owners of storm drain systems that implement the requirements of the permit will be controlling stormwater pollution to the maximum extent practicable. However, the current mandate is to restore the Chesapeake Bay by 2025, and the recently issued MS4 Phase I permit requires that SHA meet assigned waste load allocations (WLAs) for local watershed TMDLs. Therefore, SHA has taken many steps in order to position ourselves to meet these requirements. SHA is developing funding and activities, and updates on SHA's watershed restoration efforts will be included in future milestone progress reports, data submissions, and annual reports. Expenditures reflected in Table 1-21 on the previous page reflects this increased activity.

Impervious Accounting

Although the SHA permit covering this reporting period does not include a 10% restoration requirement, as was included with other jurisdictions, SHA has been building momentum to address the anticipated requirements in the permit recently issued on October 9, 2015. The target required by SHA's recently issued permit is to treat 20% of all untreated surfaces within the five year permit term.

In the past year, SHA initiated developing the Impervious Baseline in anticipation for the requirement to submit an impervious surface area assessment. SHA is setting the baseline of October 21, 2010 to coincide with the permit term. Currently, SHA is developing the impervious surfaces and drainage area data layers. The team is also conducting field reviews and reviewing stormwater computations and maintenance records to determine treatment. This effort has been used to develop a preliminary accounting for use in programming project funds for upcoming watershed restoration projects.

The impervious accounting effort has also included:

- Researching redevelopment credits from the water quality bank
- Ensuring all BMPs are inspected as part of the three year inspection and remediation schedule
- Assessing the protocol for grass swale pavement disconnection (See Figure 1-41 below for example of a Grass Swale Pavement Disconnection)
- Coordinating with Counties to split impervious treatment credits

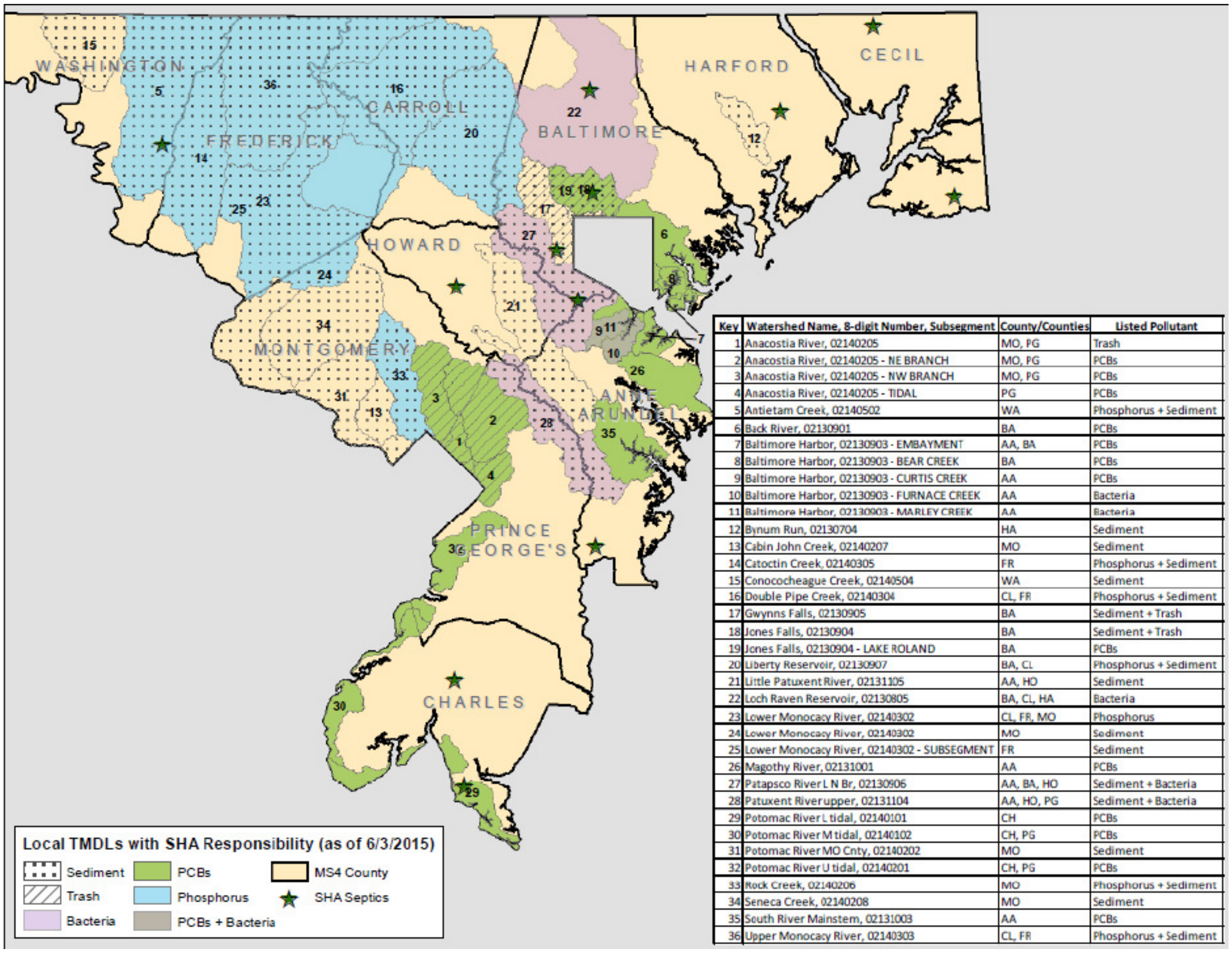
Figure 1-41: Grass Swale Pavement Disconnection

Restoration Plan Development

SHA has implemented a coordinated effort to meet the anticipated requirement to treat 20% of untreated surfaces as well as the TMDL WLAs. BMPs are being targeted in watersheds with pollutant load reduction needs and to treat impervious surfaces to gain efficiency with both requirements. Furthermore, SHA is actively coordinating with other MS4 jurisdictions to conduct watershed assessments, collaborate on projects, and split credits.

BMP protocols are being developed to allow SHA greater flexibility in cost effective BMP selection. A new protocol is being developed for an Outfall Stabilization BMP, and a revised protocol is being developed for the Tree Planting BMP to better address the restrictions of SHA right-of-way. An automated modeling protocol and calculation tool are also under development to improve data management.

See Figure 1-42 below for a map of current TMDL watersheds with an SHA pollution reduction requirement.



Key	Watershed Name, 8-digit Number, Subsegment	County/Counties	Listed Pollutant
1	Anacostia River, 02140205	MO, PG	Trash
2	Anacostia River, 02140205 - NE BRANCH	MO, PG	PCBs
3	Anacostia River, 02140205 - NW BRANCH	MO, PG	PCBs
4	Anacostia River, 02140205 - TIDAL	PG	PCBs
5	Antietam Creek, 02140502	WA	Phosphorus + Sediment
6	Back River, 02130901	BA	PCBs
7	Baltimore Harbor, 02130903 - EMBAYMENT	AA, BA	PCBs
8	Baltimore Harbor, 02130903 - BEAR CREEK	BA	PCBs
9	Baltimore Harbor, 02130903 - CURTIS CREEK	AA	PCBs
10	Baltimore Harbor, 02130903 - FURNACE CREEK	AA	Bacteria
11	Baltimore Harbor, 02130903 - MARLEY CREEK	AA	Bacteria
12	Bynum Run, 02130704	HA	Sediment
13	Cabin John Creek, 02140207	MO	Sediment
14	Catoctin Creek, 02140305	FR	Phosphorus + Sediment
15	Conococheague Creek, 02140504	WA	Sediment
16	Double Pipe Creek, 02140304	CL, FR	Phosphorus + Sediment
17	Gwynns Falls, 02130905	BA	Sediment + Trash
18	Jones Falls, 02130904	BA	Sediment + Trash
19	Jones Falls, 02130904 - LAKE ROLAND	BA	PCBs
20	Liberty Reservoir, 02130907	BA, CL	Phosphorus + Sediment
21	Little Patuxent River, 02131105	AA, HO	Sediment
22	Loch Raven Reservoir, 02130805	BA, CL, HA	Bacteria
23	Lower Monocacy River, 02140302	CL, FR, MO	Phosphorus
24	Lower Monocacy River, 02140302	MO	Sediment
25	Lower Monocacy River, 02140302 - SUBSEGMENT	FR	Sediment
26	Magothy River, 02131001	AA	PCBs
27	Patapsco River L N Br, 02130906	AA, BA, HO	Sediment + Bacteria
28	Patuxent River upper, 02131104	AA, HO, PG	Sediment + Bacteria
29	Potomac River L tidal, 02140101	CH	PCBs
30	Potomac River M tidal, 02140102	CH, PG	PCBs
31	Potomac River MO Cnty, 02140202	MO	Sediment
32	Potomac River U tidal, 02140201	CH, PG	PCBs
33	Rock Creek, 02140206	MO	Phosphorus + Sediment
34	Seneca Creek, 02140208	MO	Sediment
35	South River Mainstem, 02131003	AA	PCBs
36	Upper Monocacy River, 02140303	CL, FR	Phosphorus + Sediment

Figure 1-42: Local TMDLs within MS4 Jurisdictions with an SHA Responsibility

Part 2

Stormwater Facilities Program

PART TWO

Stormwater and Drainage Asset Program

Introduction

Maryland State Highway Administration (SHA) owns, operates, and maintains an extensive roadway network with a significant drainage and stormwater system. The Stormwater and Drainage Asset Management Program is established to operate and remediate permanent drainage and stormwater assets that convey and treat highway runoff. The program goal is to provide preventive and remedial solutions for the drainage and stormwater infrastructure within the right-of-way. As of 2015, SHA owns and maintains approximately 3638 permanent stormwater management facilities, 180,000 hydraulic structures, and over 100,000 conveyances statewide. Since 1999, SHA has had a comprehensive asset management program to locate, inspect, evaluate, and remediate these assets to sustain their functionality, improve water quality and stability, protect sensitive water resources, and provide an aesthetic and safe transportation system. SHA has developed a detailed inspection and rating system to prioritize and plan remedial activities and preventive maintenance to extend the life expectancy of each asset.

Functionality criteria and business plan objectives have been established for the program. These criteria and objectives provide feedback and allow for result oriented actions and adoptable managing techniques. The business objective of the program is to have 90% of the assets functioning as originally intended.

The Program's primary goal, which is directly tied to the SHA Business Plan goal of providing a positive contribution to the water quality of the Chesapeake Bay, is to ensure that SHA's SWM facilities are fully functional and perform as intended. In addition, the Program has a secondary goal of strategically enhancing the overall function of existing facilities to meet or exceed the latest SWM standards. During 2015 a rather significant shift in the enforcement of the SWM Standards took place which will have an impact on facility design and retrofitting activities in the future.

The Program, represented in Figure 2-1, is divided into four major components. These are, planning, design, construction, and operations.

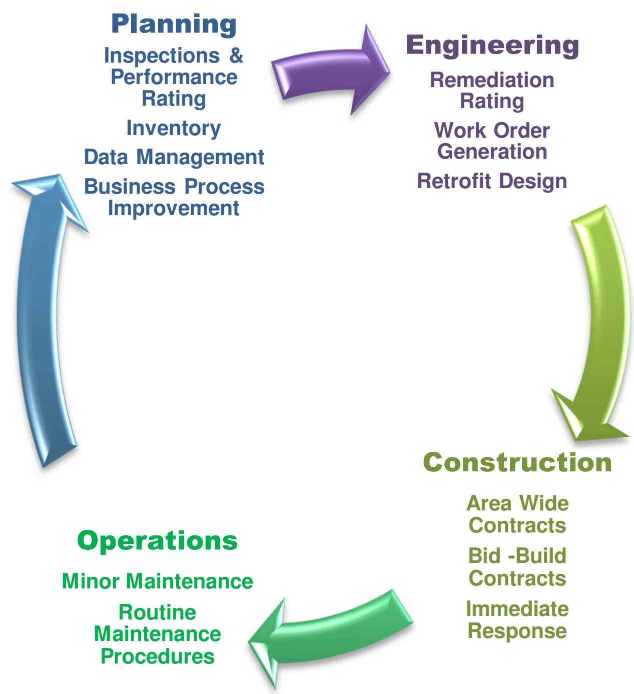


Figure 2-1 - Stormwater Asset Management Program

A. Planning

The SHA Highway Hydraulics Division inspects hydraulic assets (pipes, channels, inlets, and manholes) and stormwater facilities for functionality. The overall goal is to have an up to date inventory, conduct inspections and perform rating assessments based on the *MD SHA Stormwater NPDES Program Standard Procedures Manual.* This enables SHA to prioritize the repair, remediation, and retrofit of SHA-owned SWM facilities and infrastructure.

Assets receive a performance rating that is related to its asset type. For example, pipes and outfalls are rated based on the structural integrity.

The NPDES Municipal Separate Storm Sewer System (MS4) permit requires SHA to identify all storm drainage conveyance infrastructure that captures, treats, and conveys stormwater runoff from SHA properties in certain areas of the State. SHA is strategically expanding its program to cover all areas of the State within its right-of-way. In 2015 we were able to make strides in this effort with the completion of SWM inventory inspections in all counties outside the NPDES permit area with the exception of Garrett County. The properties associated with this drainage infrastructure include roadways, welcome centers, SHA shops, parking lots, and park and rides. Data includes identification and inspection of hydraulic structures, pipe conveyances, stormwater management facilities, and outfalls. In particular, inspections address:

- Visual, functional, and environmental enhancement, upgrade, and retrofit of SWM facilities, including upgrades related to safety.
- Site and SWM facility monitoring, research, and innovative technology tool development.

A.1. Inspection and Performance Ratings

Initial SWM facility field inspections and inventories have been completed for all counties, both MS4 and non-MS4 counties. The information is used to verify existing data in the SHA database as well as determine the SWM facilities functional rating and provide any necessary remedial action recommendations. The statewide inventory is continuously updated on a county-by-county basis.

The inspection protocol is documented in Chapter 3 of *"Maryland State Highway Administration Stormwater NPDES Program, Standard Procedures – Performance Rating."*

During initial field assessments, individual parameters of each SWM facility are scored (on a scale 1 to 5). Scores are used to establish an overall SWM facility performance rating as follows:

A **No Issues.** The SWM facility is functioning as designed with no adverse conditions identified. There are no signs of impending deterioration.

B **Minor Problems.** The SWM facility functions as designed, but minor issues are observed that may worsen to the next rating level if not repaired in a reasonable timeframe.

C **Moderate Problems.** The SWM facility functions as designed, but efficiency, performance and function have been significantly compromised and may worsen to the next rating level if not repaired in a reasonable timeframe.

D **Major Problems.** The SWM facility no longer functions as designed and efficiency has been compromised. Repair or remediation should be performed.

E **Severe Problems.** The SWM facility no longer functions as designed and efficiency as well as several critical parameters have been compromised. The SWM facility shows signs of deterioration and/or failure, requiring immediate remedial action.

Major effort for NPDES database and SWM inspections updates have been underway in 2015 in order to maintain the most current status of the SWM assets inventory functionality. SHA initiated re-inspection in most NPDES Counties, including Baltimore, Harford, Howard, Anne Arundel and Montgomery Counties. All updates should be completed by October 2016.

The inventory inspections are used to develop action ratings and prioritization for remediation. The remedial inspection protocol describing field assessment methodologies used for determining the observed functionality of a SWM facility and providing guidance for remedial actions is included in Chapter 7 of the *"Maryland State Highway Administration Stormwater NPDES Program Standard Procedures."* The assessments and recommended action ratings provide consistency that enables SHA to adequately allocate sufficient timing and funding that ensures an appropriate schedule of remediation activities.

A.2. Inventory

SHA's SWM facility inventory database is frequently updated as new facilities are brought online. Updates occur statewide for SHA's entire highway and facility infrastructure in each Maryland county, including all Phase I and II MS4 locations as well as those locations not presently covered under the Phase I or II permits. Inventoried SWM facilities include those owned and maintained by SHA. SHA also inventories facilities owned and maintained by other jurisdictions, municipalities, or other entities if they receive and manage stormwater runoff from SHA right-of-way. Table 2-1 summarizes the total number of SWM facilities that intercept and manage stormwater runoff from the SHA highway network and highway-related assets; the information is grouped by county.

Compared to the previous reporting period, several counties show an increase in the total number of SWM facilities managing runoff from SHA roadway networks and assets. Increases may occur for several reasons, including but not limited to, new developments adjacent to SHA roadways, improvements to the SHA roadway network, and construction of new SWM facilities in areas of the roadway network previously not serviced by adequate SWM facilities.

Table 2-1 – Stormwater Asset Management Program in MS4 Counties

County	No Action	Routine	Major Remedial	Retrofit Design	% Funct.	Total Invent.
Anne Arundel	195	281	91	23	80.7%	590
Baltimore	118	92	44	3	81.7%	257
Carroll	84	18	3	0	97.1%	105
Cecil	3	12	6	0	71.4%	21
Charles	179	10	0	0	100.0%	193
Frederick	174	19	0	0	100.0%	193
Harford	100	61	0	6	96.4%	167
Howard	459	84	32	3	93.9%	578
Montgomery	111	214	23	4	92.3%	352
Prince George's	209	167	75	1	83.2%	452
Washington	181	15	5	2	96.6%	203
Totals	**1813**	**973**	**279**	**42**	**89.7%**	**3107**

SHA conducts Stormwater Asset Management Statewide, however, the information in this table represents MS4 Phase I and II jurisdictions only.

A.3. Data Management

SHA has performed an inventory of all SWM drainage infrastructure in each NPDES MS4 county, and performs SWM facility inspections in all twenty-three counties statewide. A new data collection effort has begun in non MS4 counties. The statewide SWM facility inventory database was finalized in 2011. SHA continues the re-inspection effort, which involves continuous updates of GIS data for source identification and database records of inspection and remediation activities.

SHA has finalized the structure of the ESRI geodatabase and detailed schema that allows for the establishment and enforcement of topologic and/or network rules and unique data entry. Domain rules are updated as needed. The database format has resulted in improved data intelligence and integrity. SHA integrates the geodatabase with other organizational initiatives such as eGIS and iMAP (discussed below) to improve communication between offices. This is an ongoing process that continues to improve.

SHA uses two custom software programs to collect and store geospatial information: the Office Tool and the Field Tool. The Office Tool is used to input data as well as perform quality assurance (QA) reviews. The Field Tool is used with GPS coordinate units to collect and edit field data.

Along with the database format, the customized data viewer tool known as the *NPDES Viewer,* has been recently enhanced. The tool allows a user to view spatial information as well as digital images associated with each SWM facility, including as-built plans, photographs, inspection reports and other pertinent documents. *NPDES Viewer* is used to view data at various focus levels, such as highway corridors, SHA districts, counties, or watersheds.

A new component for SWM facility maintenance tracking, called the *Remediation Tool*, has been added to the *NPDES Viewer*. The application allows the tracking of routine upkeep and major repair activities, associated costs, retrofit project progress, and current functionality of SWM facilities. It can also output data reports that can be shared with managers and administrators.

A.4. Business Process Improvement

The program is undergoing a strategic planning effort to improve business processes, better serve our customers and efficiently use available resources. The planning effort will be completed in four phases

- Review of existing business processes and technical documents
- Review of new industry technologies and similar business processes for asset management
- Develop revised business processes and technical documents
- Implement business processes and new technology

B. Engineering

Assets with major deficiencies that entail more than minor maintenance require a detailed Remedial Assessment to determine specific causes of deficiencies and to develop a remedial action plan. Procedures have been developed that assist with decisions on maintenance, repair, and remediation of drainage and SWM assets. These assessment guidelines document the methodologies to be used in the field for assessing and determining remedial actions necessary for restoring stability and functionality. Also, the procedures provide information on field preparation, data management of collected information, as well as development of remedial assessment reports and work orders for maintenance crews.

B.1. Remediation Rating System

Response actions are divided into various categories of activities: no action, minor or routine upkeep and preventative maintenance, major repair, and retrofit or enhancement. The following outlines the official ratings that help determine the next steps in the process.

. **I No Response Required -** The asset is functioning as designed. Re-schedule for the next multi-year inspection assessment period.

Figure 2-2: Infiltration Sand Filter Rated I

II Minor Maintenance - The asset is functioning as designed, but routine and preventative action should be performed to sustain effective performance.

Figure 2-3: Infiltration Trench Rated II requiring vegetation and trash removal

III Major Maintenance or Repair - The asset is no longer functioning as originally designed and significant repair is necessary to restore original functionality. The facility is repaired to remain within the existing facility footprint.

Figure 2-4: Infiltration Basin Rated III (Infiltration is hampered and flooding beginning)

IV Retrofit Design - The asset is no longer functioning as designed and cannot be restored to the original function as designed without a complete re-design and construction of a facility with a larger footprint.

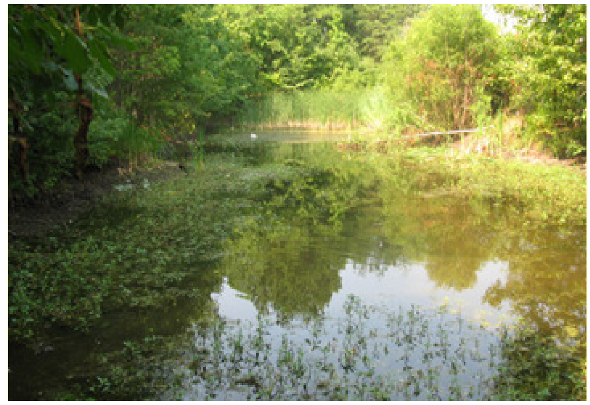


Figure 2-5 Infiltration Basin Rated IV (significant flooding and water not able to be retained in the original footprint.)

V Immediate Response - The SWM facility has catastrophically failed and public safety hazards exist that require immediate corrective action.

VI Abandonment - The SWM facility is unsustainable and no longer provides sufficient benefit to warrant remedial design.

B.2. Work Order Generation

This section summarizes the status of SHA repair and remediation activities in response to identified deficiencies of SWM facilities. Since SHA has a goal to ensure complete functionality and efficiency of all SHA owned and maintained SWM facilities, deficiencies are corrected in a timely manner through development of remedial work orders for arewide contracts

SWM facilities that require major or remedial repair are assigned a "III" rating by SHA and prioritized by urgency and location. Based on this rating, construction activities are defined in prescriptive workorders and marked on the plans for the contractor to address all issues. The work typically falls under the General Approval for Erosion & Sediment Control (ESC), but some sites might require individual ESC approval.

In 2015 nearly 200 remedial work orders have been developed and SHA expended approximately $1.7 million to perform inventory inspections and remedial assessments and to develop remediation action plans.

Figure 2-6: Major maintenance performed on BMP 030181 in Baltimore County

B.3. Retrofit Design for Visual and Functional Enhancement Projects

Design engineers determine remedial actions that need to be completed for the targeted SWM facilities to return to the designed intention and restore the treatment levels. This means that for facilities that are currently not functioning as originally intended, engineering solutions need to be developed to return the facilities to their original state. These facilities need to be retrofitted which often requires a SWM facility type change and new environmental permits. The project will involve detailed engineering design and coordination. Pipe assets deemed to need major remediation must also be addressed.

SHA continuously plans, designs and constructs functional enhancements and retrofits for SWM facilities. Projects are funded using state and federal funds. Site selection for enhancement projects are evaluated using several factors, including feasibility, permitting process complexity, and benefit analysis. SHA often seeks opportunities to improve the efficiencies of older SWM facilities that currently provide only minimum water quality treatment to achieve greater reduction of pollutant loads from highway runoff. SHA also seeks opportunities to manage greater amounts of untreated impervious areas in the existing SWM facilities to maximize the pollution removal potential.

As a part of SHA's greater improvement efforts and gaining increased benefit at smaller costs, projects to improve water quality involve treatment of additional impervious areas as well as provide replacement or upgrade to the existing drainage infrastructure. Projects also include rehabilitation of degraded outfalls, channel restoration, and slope stabilization. In addition to improvements of exiting SWM and drainage assets, SHA continues to initiate SWM retrofits and functional upgrades to provide more efficient water quality treatment of highway runoff. Retrofit projects may include reconstruction of a facility to restore function based on the most recent design criteria, or to replace the older facility with modern SWM BMP. For example, a non-functional infiltration trench may be retrofitted to a bioretention facility with an enhanced filter to increase pollutant removal efficiency. Figures 2-7 and 2-8 show a SWM facility during construction and after construction completion.

Figure 2-7 – SWM Facility 160883 Under Retrofit Construction

Figure 2-8 – SWM Facility 160800 After Construction

C. Construction

Major repair activities are performed to address significant deficiencies of SWM facilities. Activity schedules are based on local needs. In addition, geospatial data is also used to help combine activities together so they can be performed on multiple facilities in proximity to one another. This allows work to be completed with greater efficiency and lower costs. Entire roadway corridors can often be completed within a few weeks. The purpose of the construction activities is to restore the performance of the asset as well as prevent failure of specific functional elements. Actions may include dredging, sediment removal, and obstruction removal within pipes. Work also may include removal of sediment from facilities to maintain the required water volume. Often larger scale activities include total reconstruction to upgrade a facility in an attempt to enhance function and increase treatment capacity.

C.1. Area Wide Contracts

Many drainage systems and stormwater facilities remediation activities are performed through open-end construction contracts. Typically SHA administers concurrently 2-4 areawide contracts in value of $3-$4 million each to address deficiencies of stormwater facilities, drainage system repairs or outfall channel stabilization. Over the years, this construction mechanism has been proven to be the most efficient and effective construction method to timely address urgent drainage and stormwater needs. The annual expenditures of the AW contracts vary from $5 to $7 million. SHA procured 2 new AW contracts in 2015 to keep up with the rapidly increasing demand of growing SWM inventory and the SWM facilities functionality, therefore an additional contract is under development for 2016 advertisement.

In the past year, SHA performed major remediation of 73 stormwater management facilities in Anne Arundel, Prince George's Baltimore, Howard and Montgomery Counties. The total construction cost of SWM major remediation under arewide contracts was $2.7 million.

C.2. Immediate Response

In the event of an emergency, SHA immediately performs work to ensure public safety. SHA responds to any outfall or SWM facility that requires immediate repair and remediation. Roadways are closed as necessary and detour routes are implemented as needed. Site assessment and investigation occurs at the subject location within hours by a multi-disciplinary team. On-call contractors are mobilized and plans for repairs are initiated within 24-hours.

C.3. Bid -Build Contracts

Most of the SWM major retrofit projects have been implemented through traditional bid-build contracts. Currently 10 SWM facility retrofits are under construction along MD 32 in Anne County, and one project at US 29 has been recently completed. Four additional projects are under design in Anne Arundel and Saint Mary's County and will be advertised in 2016 to restore the facilities' functionality.

SHA continues to search for potential SWM sites to provide treatment of currently untreated impervious surface and maintain positive balance in the SHA Water Quality Bank. Several suitable sites have been identified, retrofit projects are in planning stage and the design will be initiated in the upcoming years.

D. Operations

District operations are key in preventive maintenance of the SWM facilities as a whole to assure long term sustainability. By developing a systematic approach over time, costs have been saved, planning for better spending is ramped up and the overall approach shifts from a reactive approach to drainage complaints to a proactive approach to asset management.

D.1. Minor Maintenance

SWM facilities requiring minor upkeep are assigned "II" rating by SHA. Minor repair activities are performed by District Operational staff to better address the routine maintenance needs of the growing inventory. Routine upkeep or minor and preventive repairs are generally activities that address minor deficiencies and may include actions such as mowing, brush cutting, vegetative thinning, unwanted woody vegetation removal, invasive weed removal, and trash or debris removal. The purpose of the maintenance activities is to maintain the performance of the SWM facilities and prevent or eliminate conditions that deteriorate function. SWM facilities that are functioning as designed are kept on a schedule with District Maintenance in order to maintain their assigned “I” rating.

D.2. Routine Maintenance Procedures

SHA is currently developing a statewide operational manual for stormwater and drainage assets. The first draft of this manual has been completed for a Pilot District and is currently under review by the District Maintenance, the Highway Hydraulics Division, the Office of Environmental Design, the Office of Maintenance and others. Once the first draft is complete the same format will be used for the shops statewide.

E. Summary

The NPDES MS4 permit requires SHA to identify all infrastructure that captures, treats, and conveys stormwater runoff from SHA facilities such as roadways, welcome centers, and park and rides, including hydraulic structures and stormwater management facilities. SHA owns and maintains approximately 3638 SWM facilities statewide. Based on current estimates, SHA also owns and maintains over 130,000 hydraulic structures and 85,000 conveyances in MS4 Counties. Since 1999, SHA has maintained and expanded a comprehensive asset management program to locate, inspect, evaluate, and remediate stormwater facilities to sustain their functionality, improve water quality, and protect sensitive water resources. SHA has developed a comprehensive inspection and rating system to prioritize and plan remedial activities and preventive maintenance to extend the life expectancy of each asset.

The SHA Business Plan goals exceed the NPDES Phase I permit requirements by promoting a complete statewide inventory and maintaining high-efficiency SWM facility performance. A key goal is to maintain 90 percent of all SHA-owned SWM facilities at full functionality. Currently, 90.3% of the SHA-owned and maintained facilities within the inventory meet the functionality goal. Figure 2-9 on the following page shows the functional ratings and the projected SWM inventory growth and trend.

Key program components and structures exemplify a strategic approach to meet NPDES permit requirements, allowing for the enhancement of SWM facility performance efficiency and reducing the pollutant loads contained in highway runoff. The integration of these components significantly improves water quality in the local waterways and the sensitive Chesapeake Bay Watershed overall.

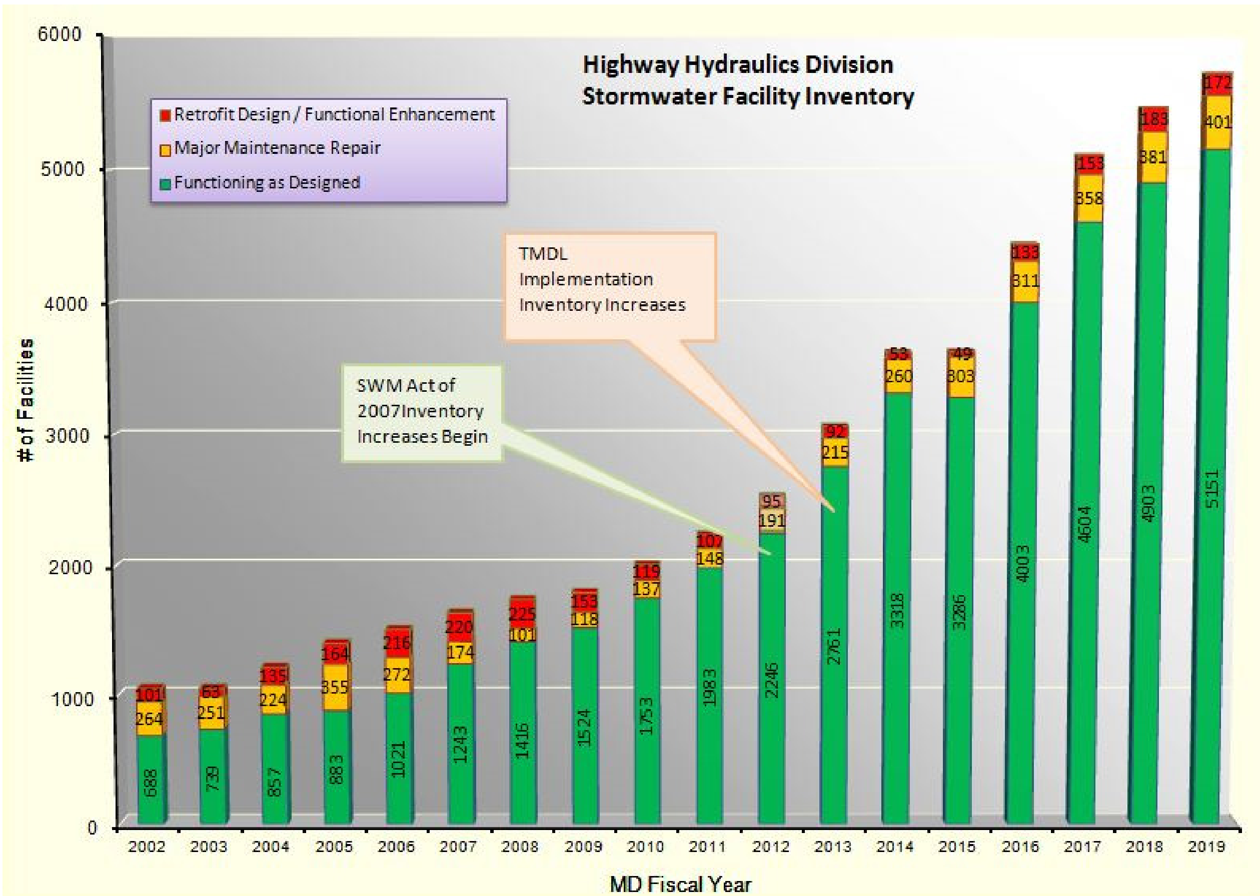


Figure 2-9: SWM Inventory Functional Rating and Projected Trend

Appendix A

Geospatial Database and Data Dictionary

Appendix A: SHA Database Dictionary

A Introduction

The NPDES Annual Report database submittal includes an Esri file geodatabase and several Microsoft Excel files prepared in compliance with table specifications detailed in the *SHA's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Discharge Permit, Attachment A: Annual Report Databases,* which was provided to SHA on June 26, 2012.

This database dictionary for the submittal incorporates the existing specifications for the required attribute definitions within each table specification and includes additional fields and associated descriptions provided by SHA. Supplemental information for each layer is provided, as necessary, to detail the lineage of the datasets.

B File Formats

The 2015 Annual Report databases for each table exhibit detailed in Attachment A of the permit are provided in Microsoft Excel and an ArcGIS 10.1 file geodatabase named *SHA_AttachmentA_Geodatabase.gdb*. This information was exported from the enterprise SDE geodatabase environment and processed into the required Attachment A table structures. A supplemental ArcGIS 10.1 file geodatabase of the full SHA stormwater facilities enterprise database has also been provided with this submittal.

C Contents

Within the "Databases" folder on the CD deliverable, the following Microsoft Excel files are provided:

- Table A - Storm Drain Outfalls.xlsx
- Table B - Urban BMP SWM Facilities.xlsx
- Table C - Impervious Surfaces.xlsx
- Table C1 - Impervious Watershed Acreages.xlsx
- Table D - Water Quality Improvement Projects.xlsx
- Table E - Monitoring Site Locations.xlsx
- Table E1 - Monitoring Site Locations - Land Use.xlsx
- Table E2 - Monitoring Site Locations - SWMBMP.xlsx
- Table F - Chemical Monitoring Results.xlsx
- Table H - Biological Habitat Monitoring.xlsx
- Table I - IDDE.xlsx

The associated spatial databases are provided in support of the deliverable within two separate Esri file geodatabases:

- SHA_AttachmentA_Geodatabase.gdb - Includes all Attachment A spatial datasets.
- SHA_NPDES_2015geodatabase.gdb - Includes a full export of the SHA enterprise structural stormwater facility database.

Contents of the SHA_AttachmentA_Geodatabase.gdb are listed below and the contents and data structures are described in the following pages:

- TABLE_A_STORM_DRAIN_OUTFALLS *(feature class)*

- TABLE_B_URBAN_BMP_SWM_FACILITIES *(feature class)*
- TABLE_C_IMPERVIOUS_SURFACES *(feature class)*
- TABLE_C1_IMPERVIOUS_WATERSHED_ACREAGES *(table)*
- TABLE_D_WATERQUALITY_IMPV_PROJECTS *(feature class)*
- TABLE_E_MONITORINGSITES_LOCATIONS *(feature class)*
- TABLE_E1_MONITORINGSITES_LANDUSE *(table)*
- TABLE_E2_MONITORINGSITES_SWMBMP *(table)*
- TABLE_E3_MONITORINGSITES_DRAINAGEAREAS *(feature class)*
- TABLE_F_CHEMICAL_MONITORING_RESULTS *(table)*
- TABLE_H_BIOLOGICAL_HABITAT_MONITORING *(table)*
- TABLE_I_IDDE *(table)*

The contents of the SHA_NPDES_2015geodatabase.gdb are detailed below in Table A-1.

Table A-1 SHA NPDES Geodatabase Contents

DATABASE SPATIAL LAYERS	TYPE	DESCRIPTION
SWMFAC	Feature Class	Polygon feature class that stores the spatial representation outline and tabular information pertaining to structural BMPs. Information includes location, BMP type, feature status, and other overlay attributes such as watershed.
BMP_CENTROID	Feature Class	Point feature class that stores the spatial representation of the SWMFAC polygon feature class records.
STRUCTURES	Feature Class	Point feature class that stores the spatial representation and tabular information pertaining to storm water structures (i.e., inlets, manholes, outfalls, control structures). Information includes structure type, feature status, major outfall (T/F), and other overlay attributes such as watershed.
CONVEYANCE	Feature Class	Line feature class that stores the spatial representation and tabular information pertaining to storm water conveyance (i.e., pipe and ditch). Information includes conveyance type, feature status, invert elevations, and other overlay attributes such as watershed.
DRAINAGE_STRUCTURE	Feature Class	Polygon feature class that stores the spatial representation and tabular information pertaining to structure features, mainly major outfalls. The drainage areas, in acres, is stored in the table.
DRAINAGE_SWMFACILITY	Feature Class	Polygon feature class that stores the spatial representation and tabular information pertaining to structural BMPs. The drainage areas, in acres, is stored in the table.
DATABASE TABLES	**TYPE**	**DESCRIPTION**
END_HEADWALL	Table	Contains the outfall and open upstream structures for a storm drain system, such as endsections, projection pipes, headwall, and endwalls. Information includes the type and material of the end structure.
INLET	Table	Contains the inlet features within the storm drain systems. Information includes the type and material of the inlet, the top of grate, and the length for COG and COS type inlets.
MANHOLE_CONN	Table	Contains the manhole and other connection features within the storm drain system. Information includes the material and top of manhole lid, when applicable.
PUMPSTN	Table	Contains the pump stations within the storm drain system. Information includes the station name, install date, number of pumps, and maximum capacity for the station.
DATABASE TABLES	**TYPE**	**DESCRIPTION**

Table A-1 SHA NPDES Geodatabase Contents

SWMRISER	Table	Contains the storm water BMP control structure, such as box risers and pipe barrel risers. Information includes the material, if a trash rack exists, riser type, and the stage storage elevation.
WEIR	Table	Contains the weirs and emergency spillways related to storm water BMP storage controls. Information includes the material, if a trash rack exists, and the stage storage elevation.
STRUCTURE_ISSUE	Table	Contains issues related to the storm water structure features, and ranks the issue as non-emergency and hazard to public. Selected issues can be buried outfalls, broken grates, damaged slabs, or manhole missing.
FLDSC_SITE	Table	Contains the feature and site location information pertaining to an outfall structure, mainly major outfalls, which are being inspected for damage and screened for illicit discharge. Information included includes location and type of outfall.
INSPECTION	Table	Contains the inspection records for outfall structures that are inspected and screened for illicit discharge. Information includes date inspected, flow observed (Y/N), and scoring values for odor, deposits, vegetation condition, structure condition, and erosion.
FLOW_CHAR	Table	Contains the water sampling results for an illicit discharge chemical sampling of an outfall structure. Information includes a scoring value for the color and clarity of flow, floatable present, water and air temperature, and results for chemical parameters tested for, such as ammonia and chlorine.
FILE_ATTACH_STR	Table	Contains photographs and filenames related to the outfall structure inspection and screening recorded in the INSPECTION table.
BMP_INSPECTION	Table	Contains the inspection records for SWM BMPs that are inspected. Information includes inspection scores for structural, environmental, safety, and functionality parameters. These parameters include riser, embankment, vegetation, performance, safety, and ponding factors.
BMP_INSPECTION_ACTION	Table	Contains records related to maintenance actions observed during a BMP inspection. These actions include removal of sediment, fixing structural issues related to the BMP, and maintenance of vegetation and erosion issues.
CONCERNS	Table	Contains records related to invasive vegetation and/or contaminants, such as oil, observed during the BMP inspection.
FILE_ATTACH_SWM	Table	Contains photographs and filenames related to the BMP inspection recorded in the BMP_INSPECTION table.
DITCH	Table	Contains the ditch features within the storm drain conveyance. Information included includes ditch material and dimensions.
PIPES	Table	Contains the pipe features within the storm drain conveyance. Information includes the type, length, and dimension of the pipe.
PIPE_INSPECTION	Table	Contains the information about the location and overall rating of a pipe that is inspected.
P_INSP_REC	Table	Contains high level information pertaining to a pipe inspection, such as if the pipe discharges to water of the US, if the pipe is blocked, or if scour is occurring.
P_INSP_SUBRATING	Table	Contains detailed rating pertaining to a pipe inspection, such as severe rusting on base of pipe, invert deterioration, complete collapse of the pipe.
P_INSP_PHOTO	Table	Contains photographs and filenames related to the pipe inspection recorded in the PIPE_INSPECTION table.
CONTRACT	Table	Contains the list of contract plan sets related to storm drain features. Information includes the contract number, year, and the location and limits of the project.
FILE_SCAN	Table	Contains the list of contract plan sheets that relate to a storm water management facility. These sheets include title, profiles, details, grading, and/or landscaping plan sheets.
OWNER	Table	Contains a list of owners that maintain the storm drain features within SHA's NPDES database. Information includes contact information of the owner.
METADATA_INFO	Table	Contains information pertaining to how and when the storm drain features was added or edited in the SHA NPDES database.
DATABASE TABLES	**TYPE**	**DESCRIPTION**
REF_SWMFAC_BASELINE	Table	Contains information that associates each SWM Facility record to the 2009 baseline or 2011 current capacity indicator.

Table A-1 SHA NPDES Geodatabase Contents

REF_RESTORATIONBMPS	Table	Contains permit restoration projects and associates SWM Facility information
REF_STRUCTURE_OVERLAYS	Table	Contains all structures with associated overlay information such as District, County, and other geographic information.
REF_SWMFAC_OVERLAYS	Table	Contains all stormwater facilities with associated watershed and land use information.

D Data Projection

These file geodatabase submittals have been re-projected from SHA's standard projection into the required projection for MDE, specifically NAD_1983_StatePlane_Maryland _FIPS_1900_Meters. The submittal geodatabases are developed in the following original spatial projection: NAD_1983_StatePlane_Maryland _FIPS_1900_Feet.

E BMP / Structure System Numbering Convention

The BMP system numbering methodology applies a unique seven-digit identification number to each asset. The first two (2) digits indicate the county where the system is located. Table A-2 lists the county code numbers for Maryland. For county codes that begin with a zero (ex. Baltimore County 03), the leading zero is not dropped from any naming convention. The remaining five (5) digits represent the unique system number. For example, 130140 is system 140 located in Howard County (County Code 13).

Table A-2 Maryland County Codes

Code	Abbreviation	County Name	Code	Abbreviation	County Name
01	AL	Allegany	13	HO	Howard
02	AA	Anne Arundel	14	KE	Kent
03	BA	Baltimore	15	MO	Montgomery
04	CA	Calvert	16	PG	Prince Georges
05	CO	Caroline	17	QA	Queen Anne's
06	CL	Carroll	18	SM	St. Mary's
07	CE	Cecil	19	SO	Somerset
08	CH	Charles	20	TA	Talbot
09	DO	Dorchester	21	WA	Washington
10	FR	Frederick	22	WI	Wicomico
11	GA	Garrett	23	WO	Worcester
12	HA	Harford	24	BC	Baltimore City
			99	SW	Statewide

The individual drainage structures located within a system receive a unique three (3) digit identification number. For example, 1300140.007 is the seventh (.007) structure in the 140th drainage system in Howard County.

Numbering begins with the most downstream structure, usually the outfall, which is assigned the structure number of .001. Structures are then numbered as the system is traced upstream. For initial data collection or adding new systems, the most downstream structure in any system should be numbered .001. This is convention only, and structures may be numbered out of sequence in the existing geodatabase.

Each system that flows into a BMP is a separate system. The control structure and outfall for a stormwater BMP also starts a new system. Figures A-1 and A-2 show examples of system, structure, and BMP numbering.

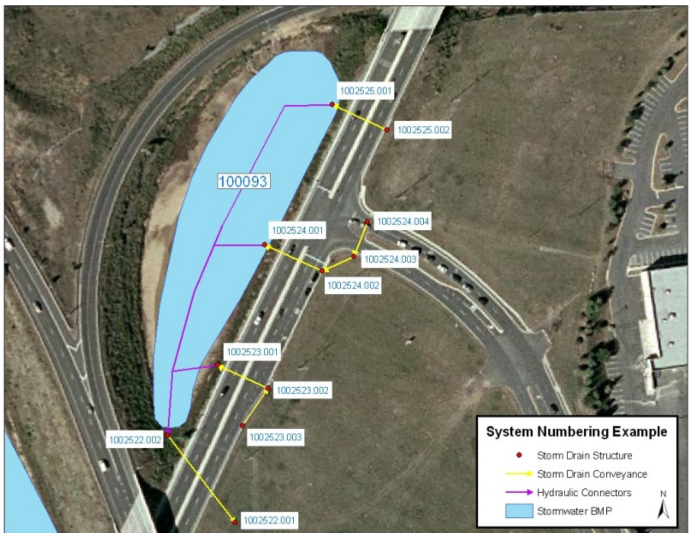


Figure A-1 System No. Ex. 1

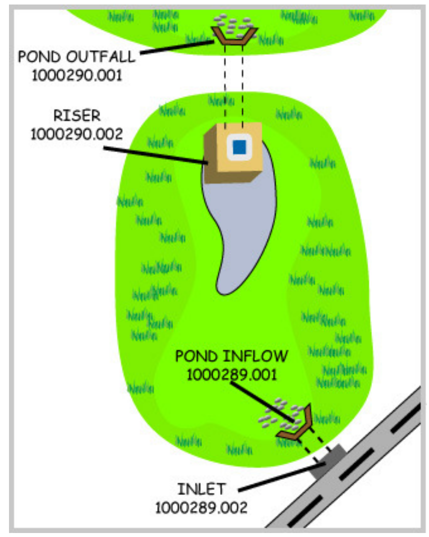


Figure A-2 System No. Ex. 2

The STRU_ID field definition in Attachment A tables requires a text field with a maximum length of 8 characters. MDE has requested that the STRU_ID number have the designation 'SHA' somewhere in the number. As defined above, SHA's unique STRU_ID values assigned are currently eight characters. SHA has added a field to the layers with Structure and BMP numbers called MDE_STRU_ID (text, 20) that has been processed to include the "SHA" prefix.

F Attachment A - Table Specifications Attribute Definitions

The following tables provide the table specifications for the layers in the SHA_AttachmentA_Geodatabase.gdb. In the database specification table below, SHA provides a *Double* number field type in compliance with the required number field designations.

TABLE_A_STORM_DRAIN_OUTFALLS:

The data (See Table A-3) provided is a point feature class representing all existing major outfalls statewide within SHA drainage systems. The drainage area layer is provided as a reference feature class layer in the SHA_NPDES_2015geodatabase.gdb named "DRAINAGE_STRUCTURE". The outfalls can be joined to this layer using the STRUCTURE_ID common field. The list of outfall type codes are provided below in Table A-4.

Table A-3. Storm Drain System Outfalls (Table A from Attachment A) - Attribute Structure Feature Class Name: TABLE_A_STORM_DRAIN_OUTFALLS

Column Name	Data Type	Length	Description
YEAR	DOUBLE		Annual report year

Table A-3. Storm Drain System Outfalls (Table A from Attachment A) - Attribute Structure Feature Class Name: TABLE_A_STORM_DRAIN_OUTFALLS

Column Name	Data Type	Length	Description
OUTFALL_ID	TEXT	11	Unique outfall ID
MD_NORTH	DOUBLE		Maryland grid coordinate (NAD 83 meters) Northing
MD_EAST	DOUBLE		Maryland grid coordinate (NAD 83 meters) Easting
DIM_OUTFL	TEXT	15	Outfall Dimensions in inches
WATERSHED_CODE	TEXT	12	Maryland 8 or 12-digit hydrologic unit code
TYPE_OUTFL	TEXT	5	Outfall Type (RCP, CMP, PVC, See Table A-4)
DRAIN_AREA	DOUBLE		Drainage area to outfall (acres) [1]
LAND_USE	TEXT	3	Predominant land use[2]
*MDE_OUTFALL_ID	TEXT	20	Unique outfall ID with the prefix of "SHA"

[1] GIS shapefile required
[2] Use attached Maryland Office of Planning land use codes
*Fields provided by SHA in addition to Attachment A

Table A-4 – Outfall Type Codes

Outfall Type Code	Description
PVC	Polyvinyl Chloride
RCP	Reinforced Concrete Pipe
HDPE	High Density Polyethylene
CONC	Concrete
SPP	Structural Plate Pipe
VC	Vitrified Clay
CMP	Corrugated Metal Pipe
CIP	Cast Iron Pipe
ACCMP	Asphalt Coated Corrugated Metal Pipe
BCCMP	Bituminous Coated Corrugated Metal Pipe
UNK	Unknown
OTHER	Other
ASRP	Aluminum Spiral Rib Pipe
TCP	Terracotta

***TABLE_B_URBAN_BMP_SWM_FACILITIES*:** The data (see Table A-5) provided is a polygon feature class representing all existing baseline SHA owned and maintained stormwater facilities in MS4 Phase I and Phase II counties within SHA drainage systems. The drainage area layer is provided as a reference feature class layer in the SHA_NPDES_2015geodatabase.gdb named "DRAINAGE_SWMFACILITY". The stormwater facility BMPs can be joined to this layer using the FACILITY_ID common field. The impervious area information associated to the stormwater facilities is currently being updated to support the establishment of an accurate baseline.

There are some facilities in the MS4 counties which do not have an impervious area acreage assigned due to limitations in the existing legacy data that is currently being processed with update improvements. The baseline facilities are being researched to determine existing treatment provided in accordance with the August 2014 *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated.*

This layer includes the BASELINE_YEAR field which indicates if the facility is associated with the 2011 existing treatment baseline (representing the baseline date of October 21, 2010).

Table A-5 Urban Stormwater BMPs (Table B from Attachment A) – Attribute Structure Feature Class Name: TABLE_B_URBAN_BMP_SWM_FACILITIES

Column Name	Data Type	Length	Description
YEAR	DOUBLE		Annual report year
STRU_ID	TEXT	6	Unique structure ID[5]
PERMIT_NO	TEXT	15	Unique permit number
STRU_NAME	TEXT	254	Structure name
ADDRESS	TEXT	254	Structure address
CITY	TEXT	254	Structure address
STATE	TEXT	254	Structure address
ZIP	TEXT	254	Structure address
MD_NORTH	DOUBLE		Maryland grid coordinate (NAD 83 meters) Northing
MD_EAST	DOUBLE		Maryland grid coordinate (NAD 83 meters) Easting
ADC_MAP	TEXT	20	ADC map book coordinate (optional if BMP has MD Northing\Easting)
WATERSHED_CODE	TEXT	12	Maryland 8 or 12-digit hydrologic unit code
STRU_TYPE	TEXT	254	Identify structure or BMP type[3]
LAND_USE	TEXT	3	Predominant land use[2]
CON_PURPOSE	TEXT	254	New development (NEWD), Redevelopment (REDE), or Restoration (REST)
DRAIN_AREA	DOUBLE		Structure drainage area (acres)[1]
IMP_ACRES	DOUBLE		Structure impervious drainage area (acres)[1]
TOT_DRAIN	TEXT	254	Total site area (acres)
WQ_VOLUME	TEXT	254	Volume of rainfall depth in inches managed by the practice
RCN	TEXT	254	Runoff curve number (weighted)
ON_OFF_SITE	TEXT	254	On or offsite structure
APPR_DATE	TEXT	254	Permit approval date
BUILT_DATE	DOUBLE		Construction completion date
INSP_DATE	DATE/TIME		Record most recent inspection date
GEN_COMNT	TEXT	120	General comments

Table A-5 Urban Stormwater BMPs (Table B from Attachment A) – Attribute Structure
Feature Class Name: TABLE_B_URBAN_BMP_SWM_FACILITIES

Column Name	Data Type	Length	Description
LAST_CHANGE	TEXT	254	Date last change made to this record
*COUNTY	TEXT	2	Codes for MD county.
*LOCATION	TEXT	120	Location descriptions
*BASELINE_YEAR	TEXT	100	2009 baseline or 2011 current capacity indicator, for MS4 counties only.
*MDE_STRU_ID	TEXT	20	Unique structure ID with the prefix of "SHA"

[1] GIS shapefile required
[2] Use attached Maryland Office of Planning land use codes
[3] Use attached urban BMP type code
[5] Use attached unique structure identification codes
*Fields provided by SHA in addition to Attachment A

***TABLE_C_IMPERVIOUS_SURFACES*:**
The data provided (see Table A-6) is a polygon feature class representing all existing impervious area with SHA right-of-way. The layer identifies the impervious area that is treated by SHA facilities. Within the dataset provided, the data for all Phase I & II permitted counties have been updated and represent current impervious and treatment conditions. The drainage area layer is provided as a reference feature class layer in the SHA_NPDES_2015geodatabase.gdb named "DRAINAGE_SWMFACILITY". The stormwater facility BMPs can be joined to this layer using the FACILITY_ID common field. The restoration fields are null at this point in time and will be prepared after the planned completion of the impervious data development updates.

Table A-6. Impervious Surfaces (Table C from Attachment A) – Attribute Structure
Feature Class Name: TABLE_C_IMPERVIOUS_SURFACES

Column Name	Data Type	Length	Description
YEAR	DOUBLE		Annual report year
WATERSHED_CODE	TEXT	12	Maryland 8 or 12-digit hydrologic unit code
IMP_ACREAGE	DOUBLE		Total impervious acreage in watershed[1]
IMP_CONTROLLED	DOUBLE		Impervious acreage controlled to the maximum extent practicable[1]
IMP_BASELINE	DOUBLE		Impervious acreage not controlled to the maximum extent practicable [1, 2]
RESTORATION_P	DOUBLE		Impervious acreage proposed for watershed restoration[1]
RESTORATION_UC	DOUBLE		Impervious acreage under construction for watershed restoration[1]
RESTORATION_C	DOUBLE		Impervious acreage completed (since program inception) [1]
*SHA_OWNED	TEXT	5	Impervious ownership by SHA (Yes or No)
*STATUS	TEXT	15	Determines if the impervious area is within a treatment drainage area (Inside or Outside)
*COUNTY	TEXT	50	County name

Table A-6. Impervious Surfaces (Table C from Attachment A) – Attribute Structure Feature Class Name: TABLE_C_IMPERVIOUS_SURFACES

Column Name	Data Type	Length	Description
*SOURCE_DESC	TEXT	200	Identifies the imagery used to compile the impervious area (source year of aerial imagery)
*CAPTURE_METHOD	TEXT	50	Describes the capture method
*ACREAGE	DOUBLE		Acreage of impervious surface
*IMPERVIOUS_ID	TEXT		Unique ID used to identify each impervious polygon
[1] GIS shapefile required [2] Fixed baseline based on MDE Guidance and approval *Fields provided by SHA in addition to Attachment A			

TABLE_C1_IMPERVIOUS_WATERSHED_ACREAGES: The data (see Table A-7) provided is a table of records that summarizes the impervious acreage by watershed.

Table A-7. Impervious Surface Acreages by Watershed (Table C1 from Attachment A) – Attribute Structure Table Name: TABLE_C1_IMPERVIOUS_WATERSHED_ACREAGES

Column Name	Data Type	Length	Description
YEAR	DOUBLE		Annual report year
WATERSHED_CODE	TEXT	12	Maryland 8 or 12-digit hydrologic unit code
*SUM_IMPERVIOUS_ACREAGE	DOUBLE		Total impervious acreage per watershed
*Fields provided by SHA in addition to Attachment A			

TABLE_D_WATERQUALITY_IMPV_PROJECTS: The data (see Table A-8) provided is a polygon feature class representing the watershed restoration projects presented in the Table 1-19 - Watershed Restoration Projects. This layer references specifically the retrofit projects for stormwater facilities. There are six projects for stream restoration and stabilization that are not mapped yet, as these layers are under construction and the information has been provided in the Microsoft Excel file for those projects. The drainage area layer is provided as a reference feature class layer in the SHA_NPDES_2015geodatabase.gdb named "DRAINAGE_SWMFACILITY". The stormwater facility BMPs can be joined to this layer using the FACILITY_ID common field.

Table A-8. Water Quality Improvement Project Locations (Table D from Attachment A) – Attribute Structure Feature Class Name: TABLE_D_WATERQUALITY_IMPV_PROJECTS

Column Name	Data Type	Length	Description
YEAR	DOUBLE		Annual report year
STRU_ID	TEXT	6	Unique structure ID[5]
STRU_NAME	TEXT	254	Structure name
MD_NORTH	DOUBLE		Maryland grid coordinate (NAD 83 meters) Northing
MD_EAST	DOUBLE		Maryland grid coordinate (NAD 83 meters) Easting

Table A-8. Water Quality Improvement Project Locations (Table D from Attachment A) – Attribute Structure
Feature Class Name: TABLE_D_WATERQUALITY_IMPV_PROJECTS

Column Name	Data Type	Length	Description
WATERSHED_CODE	TEXT	12	Maryland 8 or 12-digit hydrologic unit code
STRU_TYPE	TEXT	254	Identify structure or BMP type[3]
LAND_USE	TEXT	3	Predominant land use[2]
DRAIN_AREA	DOUBLE		Structure drainage area (acres)[1]
IMP_ACRES	DOUBLE		Structure impervious drainage area (acres) [1]
WQ_VOLUME	TEXT	254	Volume of rainfall depth in inches managed by the practice
LINEAR_FT	DOUBLE		Use this field for stream restoration or shoreline protection
POUNDS_TN	DOUBLE		Use this field for street sweeping or inlet cleaning
POUNDS_TP	DOUBLE		Use this field for street sweeping or inlet cleaning
POUNDS_TSS	DOUBLE		Use this field for street sweeping or inlet cleaning
APPR_DATE	TEXT	254	Permit approval date
BUILT_DATE	DOUBLE		Construction completion date
INSP_DATE	DATE/TIME		Record most recent inspection date
GEN_COMNT	TEXT	120	General comments *Note: Provided in a field width of 255 characters to minimize data loss.*
LAST_CHANGE	TEXT	254	Date last change made to this record
*COUNTY	TEXT	2	Abbreviations for MD county.
*LOCATION	TEXT	120	Location descriptions
*BASELINE_YEAR	TEXT	100	2009 baseline or 2011 current capacity indicator
*RESTORED_ACRES	DOUBLE		Identifies the restored acreage for the project
*RETRO_COMPDATE	DOUBLE		Identifies the year the retrofit was completed.
*STATUS	TEXT	19	Determines the status of the restoration project
*RESTORATION_TYPE	TEXT	55	Identifies the type of restoration project
*MDE_STRU_ID	TEXT	20	Unique structure ID with the prefix of "SHA"

[1] GIS shapefile required
[2] Use attached Maryland Office of Planning land use codes
[3] Use attached urban BMP type code
[5] Use attached unique structure identification codes
*Fields provided by SHA in addition to Attachment A

TABLE_E_MONITORINGSITES_LOCATIONS: The data (see Table A-9) provided is a point feature class representing the monitoring site locations associated with projects from 2014 through 2015.

Table A-9. Monitoring Site Locations (Table E from Attachment A) – Attribute Structure
Feature Class Name: TABLE_E_MONITORINGSITES_LOCATIONS

Column Name	Data Type	Length	Description
YEAR	DOUBLE		Annual report year
STATION	TEXT	50	Unique station and stream name
OUTFALL_OR_INSTREAM	TEXT	10	Outfall or instream station
WATERSHED_CODE	TEXT	12	Maryland 8 or 12-digit hydrologic unit code
MD_NORTH	DOUBLE		Maryland grid coordinate (NAD 83 meters) Northing
MD_EAST	DOUBLE		Maryland grid coordinate (NAD 83 meters) Easting
DRAIN_AREA	DOUBLE		Drainage area in acres[1]
*STUDY_YEARS	TEXT	50	Range of years for the study
[1] GIS shapefile required *Fields provided by SHA in addition to Attachment A			

TABLE_E1_MONITORINGSITES_LANDUSE: The data (see Table A-10) provided is a table of records representing the associated land use records for each specific monitoring site location during the period of 2014 through 2015. The STATION field can be used to associate the BMP records to the distinct monitoring site location.

Table A-10. Monitoring Site Locations – Multiple Land Use Values in Drainage Areas (Table E.1 from Attachment A) - Attribute Structure
Table Name: TABLE_E1_MONITORINGSITES_LANDUSE

Column Name	Data Type	Length	Description
YEAR	DOUBLE		Annual report year
STATION	TEXT	50	Unique station ID (associated with unique station ID in section E)
LAND_USE_RANK	DOUBLE		Ranking of land use from predominant to least
LAND_USE	DOUBLE		Identify land use[2]
DRAIN_AREA	DOUBLE		Drainage area in acres[1]
[1] GIS shapefile required [2] Use attached Maryland Office of Planning land use codes			

TABLE_E2_MONITORINGSITES_SWMBMP: The data (See Table A-11) provided is a table of records representing the associated stormwater BMPs for each specific monitoring site location during the period of 2014 through 2015. The STATION field can be used to associate the BMP records to the distinct monitoring site location.

Table A-11. Monitoring Site Locations – Multiple Stormwater BMPs in Drainage Areas (Table E.2 from Attachment A) - Attribute Structure
Table Name: TABLE_E2_MONITORINGSITES_SWMBMP

Column Name	Data Type	Length	Description
YEAR	DOUBLE		Annual report year
STATION	TEXT	50	Unique station ID
BMP_RANK	LONG INTERGER		Ranking of BMPs from predominant to last
STRU_TYPE	TEXT	10	Identify structure of BMP type[3]
BMP_DESCRIPTION	TEXT	60	Brief description of BMP
DRAIN_AREA	DOUBLE		Drainage area in acres[1]
[1] GIS shapefile required [3] Use attached urban BMP type code			

TABLE_E3_MONITORINGSITES_DRAINAGEAREAS: The data (see Table A-12) provided is a feature class of records representing the associated drainage areas for the study area. There are currently no drainage area delineations generated for the monitoring sites.

Table A-12. Feature Class Name: TABLE_E3_MONITORINGSITES_DRAINAGEAREAS

Column Name	Data Type	Length	Description
YEAR	DOUBLE		Annua report year
SHAPE_Length	DOUBLE		Determines the system generated perimeter of the drainage extent.
SHAPE_Area	DOUBLE		Determines the system generated area of the drainage extent in acres.

TABLE_F_CHEMICAL_MONITORING_RESULTS: There is no chemical monitoring data to report for the time frame of 2014 through 2015. The table (See Table A-13) would store records representing the chemical monitoring for events associated to the specific monitoring site locations. The STATION field can be used to associate the chemical monitoring records to the distinct monitoring site location.

Table A-13. Chemical Monitoring (Table F from Attachment A) - Attribute Structure
Table Name: TABLE_F_CHEMICAL_MONITORING_RESULTS

Column Name	Data Type	Length	Description
YEAR	DOUBLE		Annual report year
JURISDICTION	TEXT	50	Monitoring jurisdiction name
EVENT_DATE	DATE/TIME		Date of storm event
EVENT_TIME	DATE/TIME		Time monitoring begins

Table A-13. Chemical Monitoring (Table F from Attachment A) - Attribute Structure
Table Name: TABLE_F_CHEMICAL_MONITORING_RESULTS

Column Name	Data Type	Length	Description
STATION	TEXT	30	Station name (associated w/ unique station ID in section E.)
OUTFALL_OR_INSTREAM	TEXT	10	Outfall or instream station
STORM_OR_BASEFLOW	TEXT	10	Storm or base flow sample
DEPTH	DOUBLE		Depth of rain in inches
DURATION	DOUBLE		Duration of event in hours and minutes
INTENSITY	DOUBLE		Intensity = depth/duration
TOTAL_STORM_FLOW_VOLUME	DOUBLE		Total storm flow volume in gallons
WATER_TEMP	DOUBLE		Flow weighted average of water temperature (Fahrenheit)
pH	DOUBLE		Flow weighted average of pH
BOD_dt	DOUBLE		Biological Oxygen Demand detection limit used in analysis
BOD_EMC0	DOUBLE		EMC for Biological Oxygen Demand in mg/l using (0)*
BOD_EMC_dt	DOUBLE		EMC for Biological Oxygen Demand in mg/l using (dt)**
TKN_dt	DOUBLE		Total Kjeldahl Nitrogen detection limit used in analysis
TKN_EMC0	DOUBLE		EMC for Total Kjeldahl Nitrogen in mg/l using (0)*
TKN_EMC_dt	DOUBLE		EMC for Total Kjeldahl Nitrogen in mg/l using (dt)**
NITRATE_NITRITE_dt	DOUBLE		Record Nitrate + Nitrite detection limit used in analysis
NITRATE_NITRITE_EMC0	DOUBLE		Enter EMC for Nitrate + Nitrite in mg/l using (0)*
NITRATE_NITRITE_EMC_dt	DOUBLE		Enter EMC for Nitrate + Nitrite in mg/l using (dt)**
TOTAL_PHOSPHORUS_dt	DOUBLE		Record Total Phosphorus detection limit used in analysis
TOTAL_PHOSPHORUS_EMC0	DOUBLE		Enter EMC for Total Phosphorus in mg/l using (0)*
TOTAL_PHOSPHORUSEMC_dt	DOUBLE		Enter EMC for Total Phosphorus in mg/l using (dt)**
TSS_dt	DOUBLE		Total Suspended Solids detection limit used in analysis
TSS_EMC0	DOUBLE		EMC for Total Suspended Solids in mg/l using (0)*
TSS_EMC_dt	DOUBLE		EMC for Total Suspended Solids in mg/l using (dt)**
COPPER_dt	DOUBLE		Record Total Copper detection limit used in analysis
COPPER_EMC0	DOUBLE		Enter EMC for Total Copper in ug/l using (0)*
COPPER_EMC_dt	DOUBLE		Enter EMC for Total Copper in ug/l using (dt)**
LEAD_dt	DOUBLE		Record Total Lead detection limit used in analysis
LEAD_EMC0	DOUBLE		Enter EMC for Total Lead in ug/l using (0)*
LEAD_EMC_dt	DOUBLE		Enter EMC for Total Lead in ug/l using (dt)**
ZINC_dt	DOUBLE		Record Total Zinc detection limit used in analysis
ZINC_EMC0	DOUBLE		Enter EMC for Total Zinc in ug/l using (0)*

Table A-13. Chemical Monitoring (Table F from Attachment A) - Attribute Structure
Table Name: TABLE_F_CHEMICAL_MONITORING_RESULTS

Column Name	Data Type	Length	Description
ZINC_EMC_dt	DOUBLE		Enter EMC for Total Zinc in ug/l using (dt)**
HARDNESS_dt	DOUBLE		Record detection limit used in analysis
HARDNESS_EMC0	DOUBLE		Enter EMC for Hardness in ug/l using (0)*
HARDNESS_EMC_dt	DOUBLE		Enter EMC for Hardness in ug/l using (dt)**
TPH_dt	DOUBLE		Record detection limit used in analysis
TPH_EMC0	DOUBLE		EMC for Total Petroleum Hydrocarbons in mg/l using (0)*
TPH_EMC_dt	DOUBLE		EMC for Total Petroleum Hydrocarbon in mg/l using (dt)**
ENTEROCOCCI_dt	DOUBLE		Record detection limit used in analysis
ENTEROCOCCI_EMC0	DOUBLE		EMC for enterococci in MPN/100 using (0)*
ENTEROCOCCI_EMC_dt	DOUBLE		EMC for enterococci in MPN/100 using (dt)**
ECOLI_dt	DOUBLE		Record E. Coli detection limit used in analysis
ECOLI_EMC0	DOUBLE		Enter EMC for E. Coli in MPN/100ml using (0)*
ECOLI_EMC_dt	DOUBLE		Enter EMC for E. Coli in MPN/100ml using (dt)**
*LOCALCONCERN1_CHEM_TYPE	TEXT	50	Type of Chemical for Local Concern
LOCALCONCERN1_dt	DOUBLE		Record detection limit used in analysis
LOCALCONCERN1_EMC0	DOUBLE		Enter EMC for in mg/l using (0)*
LOCALCONCERN1_EMC_dt	DOUBLE		Enter EMC for in mg/l using (dt)**
*LOCALCONCERN2_CHEM_TYPE	TEXT	50	Type of Chemical for Local Concern
LOCALCONCERN2_dt	DOUBLE		Record detection limit used in analysis
LOCALCONCERN2_EMC0	DOUBLE		Enter EMC for in mg/l using (0)*
LOCALCONCERN2_EMC_dt	DOUBLE		Enter EMC for in mg/l using (dt)**
*LOCALCONCERN3_CHEM_TYPE	TEXT	50	Type of Chemical for Local Concern
LOCALCONCERN3_dt	DOUBLE		Record detection limit used in analysis
LOCALCONCERN3_EMC0	DOUBLE		Enter EMC for in mg/l using (0)*
LOCALCONCERN3_EMC_dt	DOUBLE		Enter EMC for in mg/l using (dt)**
*LOCALCONCERN4_CHEM_TYPE	TEXT	50	Type of Chemical for Local Concern
*LOCALCONCERN4_dt	DOUBLE		Record detection limit used in analysis
*LOCALCONCERN4_EMC0	DOUBLE		Enter EMC for in mg/l using (0)*
*LOCALCONCERN4_EMC_dt	DOUBLE		Enter EMC for in mg/l using (dt)**
*LOCALCONCERN5_CHEM_TYPE	TEXT	50	Type of Chemical for Local Concern
*LOCALCONCERN5_dt	DOUBLE		Record detection limit used in analysis

Table A-13. Chemical Monitoring (Table F from Attachment A) - Attribute Structure
Table Name: TABLE_F_CHEMICAL_MONITORING_RESULTS

Column Name	Data Type	Length	Description
*LOCALCONCERN5_EMC0	DOUBLE		Enter EMC for in mg/l using (0)*
LOCALCONCERN5_EMC_dt	DOUBLE		Enter EMC for in mg/l using (dt)**
GEN_COMNT	TEXT	255	Monitoring comments/documentation
*Fields provided by SHA in addition to Attachment A **key:** **mg/l** = milligrams per liter **ug/l** = micrograms per liter **MPN** = most probable number per 100 milliliters			

Table A-14. Pollutant Load Reductions (Table G from Attachment A)
Table Name: N/A (no data available)

This data is currently under construction and is not available at this time. The information will be provided with the next Annual Report submission.

TABLE_H_BIOLOGICAL_HABITAT_MONITORING:
The data (See Table A-15) provided is a table of records representing the associated biological and habitat monitoring projects performed during the period of 2013 through 2014.

Table A-15. Biological and Habitat Monitoring (Table H from Attachment A)
Table Name: TABLE_H_BIOLOGICAL_HABITAT_MONITORING

Column Name	Data Type	Length	Description
YEAR	DOUBLE		Annual report year
STATION	TEXT	50	Unique station ID
WATERSHED_CODE	TEXT	50	Maryland 8 or 12-digit hydrologic unit code
MD_NORTH	DOUBLE		Maryland grid coordinate (NAD 83 Meters) Northing
MD_EAST	DOUBLE		Maryland grid coordinate (NAD 83 Meters) Easting
DRAIN_AREA	DOUBLE		Drainage area in acres
BIBI	DOUBLE		Benthic index of biological indicators
EMBEDDEDNESS	DOUBLE		Rapid bioassessment protocol score for embeddedness
EPIFAUNAL	DOUBLE		Rapid bioassessment protocol score for epifaunal
HABITAT	DOUBLE		Rapid bioassessment protocol score for habitat
LAND_USE	SHORT INTEGER		Predominant land use
STUDY_DATE	DATE/TIME		Date the monitoring project occurred

***TABLE_I_IDDE*:**
The IDDE results provided cover the period of September 2013 through September 2014 and represent screenings and samplings performed on major outfalls in Montgomery County. See Table A-16 for data descriptions. The drainage area layer is provided as a reference feature class layer in the SHA_NPDES_2015geodatabase.gdb named "DRAINAGE_STRUCTURE". The outfalls can be joined to this layer using the STRUCTURE_ID common field.

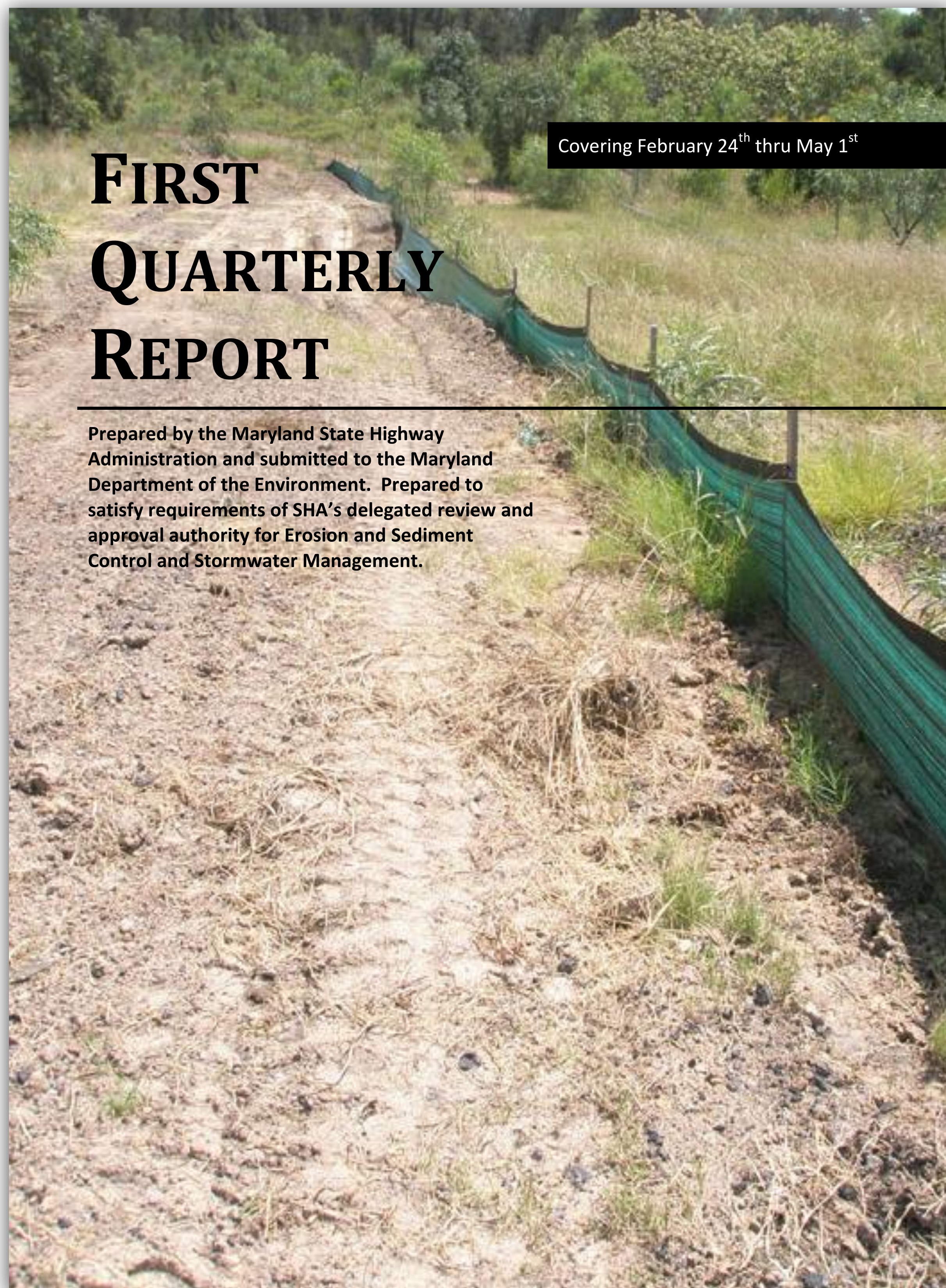
Table A-16. Illicit Discharge Detection and Elimination (Table I from Attachment A) – Attribute Structure
Table Name: TABLE_I_IDDE

Column Name	Data Type	Length	Description
YEAR	DOUBLE		Annual report year
OUTFALL_ID	TEXT	15	Unique outfall ID used in Section A. database
SCREEN_DATE	DATE/TIME		Field screening date
TEST_NUM	TEXT	5	Initial screening, follow-up test, 3rd, etc.
LAST_RAIN	DATE/TIME		Date of last rain > 0.10”
SCRTIME	DATE/TIME		Field screening time
OBSERV_FLOW	TEXT	3	Was flow observed? (yes/no)
CFS_FLOW	DOUBLE		Flow rate in cubic feet per second (CFS)
WATERTEMP	DOUBLE		Water temperature (Fahrenheit)
AIRTEMP	DOUBLE		Air temperature in (Fahrenheit)
CHEM_TEST	TEXT	3	Was chemical test performed? (yes/no)
pH	DOUBLE		pH meter reading
PHENOL	DOUBLE		Milligrams per Liter (mg/l)
CHLORINE	DOUBLE		mg/l
DETERGENTS	DOUBLE		mg/l
COPPER	DOUBLE		mg/l
AMMONIA	DOUBLE		Mg/l
ALGAEGROW	TEXT	3	Was algae growth observed? (yes/no)
ODOR	TEXT	2	Type of odor[4]
COLOR	TEXT	2	Discharge color[4]
CLARITY	TEXT	2	Discharge clarity [4]
FLOATABLES	TEXT	2	Floatables in discharge[4]
DEPOSITS	TEXT	2	Deposits in outfall area[4]
VEG_COND	TEXT	2	Vegetative condition in outfall area[4]
STRUCT_COND	TEXT	2	Structural condition of outfall[4]
EROSION	TEXT	2	Erosion in outfall area[4]
COMPLA_NUM	TEXT	3	Is screening complaint driven? (yes/no)
ILLICIT_Q	TEXT	3	Was illicit discharge found? (yes/no)
ILLICIT_ELIM	TEXT	3	Was illicit discharge eliminated? (yes/no)
*DRAINAGE_AREA	DOUBLE		Structure Drainage Area[1]
*COUNTY	TEXT	2	Codes for MD county.

[1] GIS shapefile required
[4] Use Attached Pollution Prevention Activities Codes
* Fields provided by SHA in addition to Attachment A

Appendix B

Quarterly Report



FIRST QUARTERLY REPORT

Covering February 24th thru May 1st

2015

Prepared by the Maryland State Highway Administration and submitted to the Maryland Department of the Environment. Prepared to satisfy requirements of SHA's delegated review and approval authority for Erosion and Sediment Control and Stormwater Management.

SHA State Highway Administration Maryland Department of Transportation

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Appendix E. Investigations of Citizen Complaints and Inquiries

I. Introduction

The Maryland State Highway Administration (SHA) and the Department of the Environment (MDE) signed a Memorandum of Understanding (MOU), dated July 8, 2014, designating SHA as an approving authority for erosion and sediment control and stormwater management plans for SHA projects in accordance with the applicable sections of the Code of Maryland (COMAR). This authority was given by a letter of authorization from MDE on February 24, 2015. The MOU includes several conditions and this report is written to satisfy the condition pertaining to reporting which requires SHA to report on relevant activities on a quarterly basis for the first year of delegated authority including:

- Project status reports detailing the progress of design, review, approval, and construction activity achieved to date
- Findings related to plan review program activities
- Explanations and justifications for any design elements not meeting Environmental Site Design to the Maximum Extent Practicable according to the Design Manual or the 2011 standards
- Changes or modifications to the Guidelines and Administrative Procedures
- Significant staffing changes
- Summaries of site inspections conducted

The letter of authorization, in addition to the previous reporting requirements, requires SHA to report:

- Comments received and written responses provided to local agencies
- Findings related to quality assurance and quality control activities
- Summaries of public outreach meetings
- Investigations of citizen complaints and inquiries

For the purpose of this report, summaries of site inspections conducted have been combined with findings related to quality assurance and quality control activities.

II. Project Status Report

Project status reports detail and show the progress of design, review, approval and construction activity achieved during the reporting period. The Plan Review Division maintains a database to track submittals and design progress on all projects. During this reporting period, the Plan Review Division received 53 submissions on 31 projects, provided 40 comment memorandums, and approved eleven concept design stage submittals and one site development stage submittal. No projects were issued a final design approval during the reporting period. The applicable information from this database is included in Appendix A.

III. QA/QC Activities and Summaries of Site Inspections

SHA ensures quality assurance and control of approved erosion and sediment control plans through inspections of SHA construction projects for compliance with the approved Erosion and Sediment Control Plans, utilizing a checklist and rating system. During this period, SHA performed 727 inspections on 193 projects to check for compliance with the approved erosion sediment control plans and found two projects to be non-compliant. These non-compliance issues were subsequently corrected.

Appendix B includes details and findings regarding the quality assurance and quality control program.

IV. Design Elements Not Meeting ESD to the MEP

The Maryland Legislature enacted the Stormwater Management Act of 2007 which established stringent requirements to implement Environmental Site Design (ESD) to the Maximum Extent Practicable (MEP). Whenever the Plan Review Division approves design elements not meeting this criterion at the Final Design stage, these will be reported. There are no projects that have been approved at the Final Design stage and therefore nothing to report for this section.

V. Modifications to the Guidelines and Administrative Procedures

During the reporting period, there have been no documented changes or modifications to the Guidelines, Administrative Procedures or other documents submitted to obtain authorization.

VI. Significant Staffing Changes

The Plan Review Division had one significant staffing change during this reporting period. At the start of the period there were two open Team Leader positions. The Office of Highway Development used a competitive selection process including interviews and offered Mr. Jeffrey Knaub, PE a team leader position. He accepted and joined the Plan Review Division on April 1, 2015. There remains one vacant team leader position which the division is actively looking to fill. Appendix C includes an organizational chart for the Plan Review Division as of May 1, 2015.

VII. Local Agency Comments and Responses

State Highway Administration staff from the Plan Review Division and Highway Hydraulics Division met with Montgomery, Prince George's and Baltimore County to discuss county waiver concurrence for stormwater quantity management. SHA has received some resistance from counties regarding requests from SHA for concurrence for stormwater management waivers. They have expressed concern about the associated liability for their respective county. SHA is working closely with several counties to resolve this issue.

VIII. Summaries of Public Outreach Meetings

SHA values opinions of the public, our most important customer, and holds numerous public outreach meetings to solicit input to add value to our designs and to obtain useful feedback. Appendix D includes a summary of scheduled meetings on various projects during the reporting period. This summary was compiled from monthly lists prepared by SHA's Office of Planning and Preliminary Engineering Environmental Planning Division's Public Involvement Section. SHA holds public outreach meetings for projects in all phases of the design and delivery process including planning, design and construction. Many of these projects are not under review by the Plan Review Division and may not be at Maryland Department of Environment for review.

IX. Investigations of Citizen Complaints and Inquiries

SHA strives to provide outstanding customer service; the Highway Hydraulics Division utilizes a tracking tool to assist in providing this. There were twenty-six inquiries and complaints received between February 24, 2015 and May 1, 2015 with twelve being brought to a resolution. A report from the tracking tool is included in Appendix D and shows all incoming drainage and erosion complaints and inquiries to the Highway Hydraulics Division during the reporting period.

X. Plan Review Program Activity Findings

There are several findings and activities to report:

- There is general confusion amongst designers regarding the new process and procedures and the Plan Review Division is developing training and outreach for designers to explain the process to SHA offices and districts.
- SHA is investigating the Q_2 and Q_{10} year flow quantity management table and has determined there are discrepancies between Table 1 and the respective county stormwater management ordinances.
- The Plan Review Division has met with three counties to discuss quantity management and, at this time, the Guidelines are being followed. The guidelines specify that concurrence should be obtained from the county for all variances for quantity control.
- In addition to reviewing projects, the Plan Review Division is working towards reconciling the SHA/MDE water quality bank, developing water quality summary sheet definitions, developing review procedures for projects within the Anne Arundel Soil Conservation District and procedures for SHA compliance.

APPENDIX A.

PROJECT STATUS REPORT

PRD#	Stage	Submission	Contract #	Route	Name	Received Submission	Admin Complete Notice	Complete (Y/N)	Draft Comments	Comment Memo Date	Concept Approved	Site Dev Approved	Final Approved
15-PR-0001	Concept	1	CE4035174	MD 272	MD 272, North of Rogues Harbor Rd	01/07/2015	01/20/2015	Y	02/24/2015	02/24/2015			
15-PR-0001	Concept	2				04/21/2015	04/24/2015	Y					
15-PR-0002	Concept	1	BA5155184	US 1	US 1, Baltimore City Line to I-695	01/21/2015	01/23/2015	Y	02/24/2015	03/06/2015			
15-PR-0002	Concept	2				04/22/2015	04/23/2015	Y	04/24/2015	04/29/2015			
15-PR-0003	Concept	1	BA7295470	MD 140	MD 140, Culvert Break-out	02/13/2015	02/19/2015	Y	02/24/2015	02/24/2015			
15-PR-0003	Concept	2				03/13/2015	03/17/2015	Y	03/13/2015	03/13/2015	03/19/2015		
15-PR-0003	Site Development	0			Submission withdrawn by HHD 4/15/15	04/09/2015 (withdrawn 04/15/15)	N/A	N/A	N/A	N/A			
15-PR-0003	Site Development	1				04/21/2015	04/24/2015	Y	04/24/2015	04/27/2015			
15-PR-0003	Site Development	2				04/30/2015		Y					
15-PR-0004	Concept	1	CE2915279	MD 267	MD 267, Market St to W. Old Philadelphia Rd, Sidewalk Retrofit	01/23/2015	02/24/2015	Y	02/24/2015	02/24/2014			
15-PR-0005	Concept	1	PG8235177	I-95	From I-495 to 1000' N of Old Gunpowder Road	01/30/2015	02/02/2015	Y	02/24/2015	03/06/2015			
15-PR-0005	Concept	2				03/13/2015	03/13/2015	Y	N/A	N/A	03/13/2015		
15-PR-0005	Site Development	1				03/23/2015	03/26/2015	Y	03/25/2015	03/25/2015			
15-PR-0006	Concept	1	PG5115177	MD 210	MD 210, from MD 373 (Livingston Road) to Farmington Road	01/30/2015	02/24/2015	Y	02/24/2015	02/24/2015			
15-PR-0006	Concept	2				04/08/2015	04/08/2015	Y	04/09/2015	04/09/2015	04/09/2015		
15-PR-0006	Site Development	1				04/14/2015	04/17/2015	Y	N/A	N/A		04/16/2015	
15-PR-0006	Final Design	1				04/20/2015	04/24/2015	Y	04/24/2015				
15-PR-0007	Concept	1			Withdrawn and submitted to MDE I-695, W of Stevenson Rd Br to W of Greenspring Ave		02/03/2015	Y	02/24/2015				
15-PR-0008	Concept	1	BA0365177	MD 7	MD 7, From Golden Ring Rd to Rossville Blvd	01/30/2015	02/20/2015	Y	02/24/2015	02/24/2015			
15-PR-0008	Concept	2											
15-PR-0009	Concept	1	PG4675223	I-95	I-95/I-495 College Park Truck Weigh and Inspection Station	02/10/2015	02/12/2015	N	02/24/2015	03/06/2015			
15-PR-0009	Concept	2				04/27/2015	04/29/2015	Y	04/29/2015	04/30/2015			
15-PR-0010	Concept	1	BA6855176	US 40	US 40, Chesaco Ave to Todds Lane, Safety & Spot Improvements	02/11/2015	02/12/2015	Y	02/24/2015	03/06/2015			
15-PR-0010	Concept	2				04/17/2015	04/21/2015	Y	04/21/2015	04/21/2015	04/21/2015		
15-PR-0011	Concept	1	AX7665582	varies	SWM at Various Locations in Washington County - Group 1	02/11/2015	02/24/2015	Y	02/24/2015	02/24/2015			
15-PR-0012	Concept	1	AW730A21	MD346	MD 346, 12-DM-WO-002 Slope Stabilization and Repair	02/12/2015	02/13/2015	Y	02/24/2015	03/06/2015			
15-PR-0012	Concept	2				04/24/2015	04/24/2015	Y	04/27/2015	04/27/2015	04/27/2015		
15-PR-0013	Concept	1	AW730A21	MD 589	MD 589, 12-DM-WO-003, Turvill Creek Slope Stabilization & Repair	02/12/2015	02/19/2015	Y	02/24/2015	02/26/2015			
15-PR-0013	Concept	2				04/27/2015		Y					
15-PR-0014	Concept	1	AT0445182	varies	TMDL Grass Swales, Anne Arundel Co	02/13/2015	02/18/2015	Y	02/24/2015	02/26/2015			
15-PR-0014	Concept	2				04/08/2015	04/09/2015	Y	04/09/2015	04/14/2015	04/14/2015		
15-PR-0015	Concept	1	HA4265177	MD 924	MD 924, Holly Wreath Drive to St. Clair Dr	02/19/2015	02/20/2015	Y	02/24/2015	02/24/2015			
15-PR-0015	Concept	2				03/06/2015	03/09/2015	Y	03/09/2015	03/09/2015			
15-PR-0015	Concept	3				03/19/2015	03/19/2015	Y	03/25/2015	03/25/2015			
15-PR-0015	Concept	4				04/10/2015	04/17/2015	Y	04/14/2015	04/16/2015	04/16/2015		
15-PR-0015	Site Development	1				04/21/2015	04/27/2015	Y					
15-PR-0016	Concept	1	WA2815123	I-81	I-81 SB Escort Vehicle Area Geometric Improvements	02/25/2015	02/26/2015	Y	N/A	N/A	02/26/2015		
15-PR-0017	Concept	1	PG3335172	I-95	I-95/I-495 Greenbelt Metro Interchange	02/25/2015	03/13/2015	Y	03/13/2015	03/20/2015			
15-PR-0018	Concept	1	WO1915174	US 113	Critical Area Mitagation at Firehouse wetland site	03/03/2015	03/03/2015	Y	03/06/2015	03/06/2015			
15-PR-0018	Concept	2				04/07/2015	04/08/2015	Y	N/A	N/A	04/09/2015		
15-PR-0019	Concept	1	AA7955282	various	TMDL SWM Design, Group 1, Anne Arundel County	03/03/2015	03/03/2015	Y	03/10/2015	03/23/2015			
15-PR-0020	Concept	1	MO1665187	I-270	I-270 Slip Ramp South of Gude Dr.	03/13/2015	03/26/2015	Y	03/26/2015 04/06/2015	04/08/2015			
15-PR-0021	Concept	1	XX1115180	MD 950	Emergency Replacement of Str. 16097X0 MD 950 over Beaverdam Cr	03/13/2015	03/13/2015	N/A	site mtg 3/18/15	N/A			
15-PR-0021	Concept	2				03/19/2015	03/19/2015	N/A	N/A	N/A	03/19/2015		
15-PR-0021	Site Development	1			submission returned - no plan, report, application or checklist provided	04/23/2015	04/23/2015	N	N/A	N/A			
15-PR-0022	Concept	1	PG5105177	MD 210	MD 210NB Farmington to Old Fort Rd	03/23/2015	03/24/2015	Y	03/25/2015	03/26/2015			
15-PR-0023	Concept	1	AA4365471	MD 175	West of Reece Rd to East of Disney Rd	03/23/2015	03/23/2015	Y	03/27/2015	04/08/2015			
15-PR-0024	Concept	1	WA2515176	I 68	0.9 Miles East of Mountain Rd to Sideling Hill Rest Area	03/25/2015	03/26/2015	Y	03/30/2015	03/30/2015			
15-PR-0025	Concept	1	CE3395176	MD 272	MD 272 South of US 40 to Rogers Ave	03/31/2015	04/03/2015	Y	04/20/2015	04/22/2015			
15-PR-0026	Concept	1	AL2735177	MD 51	Pack Horse Road to Town Creek	04/06/2015	04/07/2015	Y	04/08/2015	04/09/2015	04/09/2015		
15-PR-0027	Concept	1	CL3045130	MD 26	At Oakland Mills Road	04/06/2015	04/08/2015	Y	04/17/2015	04/22/2015			

PRD#	Stage	Submission	Contract #	Route	Name	Received Submission	Admin Complete Notice	Complete (Y/N)	Draft Comments	Comment Memo Date	Concept Approved	Site Dev Approved	Final Approved
15-PR-0028	Concept	1	FR3905184	MD 180	US 340 to Old Holter Road	04/15/2015	04/15/2015	Y	04/16/2015	04/17/2015			
15-PR-0029	Concept	1	HO1905181	I-95	Welcome Center Truck Parking Expansion	04/17/2015	04/17/2015	Y	04/17/2015	04/17/2015			
15-PR-0030	Concept	1	WA2785187	I-81	I-81 from I-70 to Halfway Blvd	04/27/2015	04/27/2015	Y	04/29/2015	04/30/2015			
15-PR-0031	Concept	1	BA5005249	N/A	Hereford Shop-Storage Tank Removal and Replacement	04/27/2015		Y					
					Totals	**53**	**50**		**40**	**40**	**11**	**1**	**0**

APPENDIX B.

QUALITY ASSURANCE

AND

NON-COMPLIANCE FINDINGS/ACTIONS TAKEN

Quality Assurance Inspections By District

2/24/2015 To 4/30/2015

District: 1

Contract No	Project Description	# Inspections	# Non-Compliance (D-F)
DO3485129	Replacement of the Administration's Cambridge Maintenance Facilities- Dorchester County	4	0
SO4095171	MD 675 (Somerset Ave.) from MD 362 to MD 822 (UMES Blvd.)	5	0
WI2205177	Grind & Resurfacing on US 50, Old Railroad Rd to E. of Rockawalkin Rd in Wic. Co.	2	0
WI2335130	U.S. 13 Business at South Division St. Intersection Improvements, Wic. Co.	5	0
WI3095176	Geometric Improvements U.S. 50 at Walston Switch Rd.	3	0
WI3285274	US 13 Bus. Drainage Improvements from E. Church St. to N. of London Ave	4	0
WI3285574	U.S. 13 Business Drainage Improvement from W. College Ave. to N. of South Blvd. (Phase 5)	4	0
WI3835130	MD Route 349 (Nanticoke Road) at Crooked Oak Lane Intersection Improvements	4	0
WO2035176	US 113 at MD 12 and MD 365 (Widen and Resurface)	4	0
WO2235180	Bridge Rehabilitation Dual Steel Beam Bridge No. 2301601 and 2301602 on US 13 (Ocean Highway) over Pocomoke River	4	0
XY2335177	Miscellaneous concrete work for ADA compliance at various locations in Dorchester, Somerset, Wicomico, and Worcester Counties	1	0
Project Count: 11	**Total Inspections:**	**40**	**0**

Quality Assurance Inspections By District

2/24/2015 To 4/30/2015

District: 2

Contract No	Project Description	# Inspections	# Non-Compliance (D-F)
AW8965270	MD 404 Dualization West of 309 to Cemetry Road phase 1B	5	0
CE2895177	From Md 273-A to the Pennsylvania Line	4	0
CE3925177	Safety & Resurfacing MD282 from West of Corporate Town Limits of Cecilton to MD 213	1	0
CE4005123	TC-35 at MD 299 CCTV Camera Installation at Cecilton Weigh Station	1	0
CE4465180	Replacement of Bridge No. 07036 on MD 272 over AMTRAK	4	0
KE2955177	Md. 213, Md. 290 & Md. 313A at Corp. Limits of Galena-Proposed Resurfacing and Safety Improvements	4	0
KE2965130	MD 20 at MD 291 in Kent County proposed Geometric improvements roundabout	2	0
QA2105185	Reconstruction of Lighting Systems East of MD 8 to West of US 50/301 split (GAP - OOTS)	4	0
QA2655170	US 301 at Md. 304 Interchange Improvements	7	0
QA4845180	Replacement of deck and Rehabilitation of Bridge No. 17030 on Md. 313 over Chester River	5	0
QA4865177	US. 50 from 301 to .05 miles west of Md. 40-mill and Resurface	4	0
TA3925171	Steel and Prestressed Concrete Girder Bridge No. 2003400 On MD 331 (Dover Road) Over Choptank River	6	0
XX5275233	Sidewalk Project Side Walk-ADA Project - Dist. 2 Area Wide	4	0
XY1315185	Modification/ Installation/ Reconstruction of Traffic Signals in Districts 1 & 2 (GAP- OOTS)	1	0
XY2345133	Area wide ADA Compliance	4	0
XY4055177	Mill/ Grind Patch and resurface Roadway Pavements var. Locations	1	0
XY4145177	Mill/ Grind Patch and resurface Roadway Pavements Var. Locations Kent County	1	0
XY4175177	Mill/ Grind Patch and resurface Roadway Pavements Var. Locations -Queen Anne County	1	0
Project Count: 18	**Total Inspections:**	**59**	**0**

Quality Assurance Inspections By District

2/24/2015 To 4/30/2015

District: 3

Contract No	Project Description	# Inspections	# Non-Compliance (D-F)
AT0655474	Drainage & System Preservation at Various Locations Statewide (GAP-ICD)	5	0
AT0865182	Drainage improvements at various locations in District 3	4	0
AT0905180	Invert Paving and Restoration of Various Structures	3	0
AX0805124	Integrated Rdside Vegetation Mngm., Invasive Species Cntrl & Native Plant Est.- I-95/I-495 Corridor from MD Rt 202 to I-95 & I-95 Corridor from I-495 to Ho./PG County Line, & Specified Wetland Mitigation Sites throughout PG & Mont. Counties (GAP-LOD)	4	0
AX2645282	Construction of Stormwater Management Quality Control Facilities Throughout D-3 (GAP - ICD)	5	0
AX3765H60	ICC PG-C Fish Passage Improvements Indian Creek	5	0
AX3765L60	Intercounty County Connector NW-4 Stream Restoration of Cricket Lane Tributary	3	0
AX3785R60	Intercounty Connector ES Hollywood Branch Stream Restoration at Site PB-12	4	0
AX9295182	TMDL Legacy Pavement Improvements in Prince Georges County (GAP - ICD)	5	0
MO1155177R	MD RT 185 From DC Line to North of MD RT 410. (Safety & Resurface)	2	0
MO1315477	Safety and Resurfacing On MD 28, From Monroe St. MD 911 and on MD 355, From MD 28 to MD 911	2	0
MO1315677	MD185 (Connecticut Ave) Off Ramp 6 Off I-495 to Dupont Ave (Safety and Resurfacing)	2	0
MO1405129	Construction of a Salt Storage Facility at the Administration's Clarksburg Facility in Montgomery County	3	0
MO1495179	MD 355 Wisconsin Ave. From Grafton St. to MD 191 (Bradley Lane) Sidewalk Retrofit / Montgomery County (GAP-OOTS)	5	0
MO1595877	MD 124 from MD28 to Orchard Ridge Drive Safety and Resurfacing	3	0
MO2145186	Chart Depot at Kensington Satelite Maintenance Shop in Montgomery County	3	0
MO2635177	MD Rt 97 / US 29 From DC / Montgomery Co. Line to MD 390, Safety & Resurfacing Improvements	3	0
MO4235180	Bridge Deck Replacement on MD RT 650 over Sligo Creek	3	0
MO4325176	MD124 (MidCounty Highway) at Saybrooke Oaks Blvd Woodfield Road Safety and Spot Improvements	2	0
MO5825180	Superstructure Replacement with Substructure Rehabilitation for Bridge # 1513600 on Maryland RT. 193 over I-495	4	0
MO5935270	MD 355 (Rockville Pike) at Ceder Land (Phase 2 and 3) Intersection Reconstruction	3	0
MO5935370	MD 187 (Old Georgetown Road) from South of Center Dr. to North of W. Cedar Ln. /Oakmont Ave. Intersection Reconstruct	2	0
MO6735174	US 29-RETROFIT OF SWM FACILITY 150173 AND SLOPE STABILIZATION	3	0
MO8355176	MD 586 (Veirs Mill Road) at Ferrara Ave - Geometric Improvements	3	0
MO8545171	Interchange Reconstruction MD 97 at Randolph Rd.	4	0
MO9745277	MD 182 From MD 97 to Longmead Road (Safety and Resurfacing)	3	0

Quality Assurance Inspections By District

2/24/2015 To 4/30/2015

District: 3

Contract No	Project Description	# Inspections	# Non-Compliance (D-F)
MO9745477	MD 190 River Road From I-495 to MD 614 (Goldsboro Road) Safety and Resurfacing	2	0
PG0785126	Sound Barrier at US 50 and MD 410	4	0
PG0925174	MD RT 216 NB Outfall Improvement at the Patuxent River-Drainage Improvement	4	0
PG3655176	MD Rt 197 from MD Rt 295 Southbound off ramp To Brock Bridge Rd. (Safety, Spot Improvements & Resurfacing)	4	0
PG4195172	I-95 at Contee Road - Interchange Construction	4	0
PG4945172	Phase 2-Reconstruct MD 5 (Branch Ave.) from Auth Way to South of I-495\I-95 & Construction of Access Road to Branch Ave. Metro Station	4	0
PG5395177	I-95/I495 (Capital Beltway) from Glenarden Parkway to North of US 50	4	0
PG5405177	I-95 / I-495 (Capital Beltway) From D'Arcy Rd. to Arena Dr., Safety and Resurfacing	4	0
PG5435174	US-1 (Baltimore Avenue) Ammendale Road Drainage Improvements	4	0
PG5465184	MD 500 from MD 208 to MD 410 - Neighborhood Conservation	3	0
PG6645180	Replacement of Bridge #1618101, and #1618102, on MD Rt 4 (Pennsylvania Ave.) over MD Rt 223 (Woodyard Rd.), and Resurfacing MD Rt 4 from Ritchie Marboro Rd. To 0.13 Miles North of Dower House Rd.	5	0
PG7785284	MD 201 from Kenilworth Towers to Riverdale Rd.	4	0
PG7825184	MD 5 from Curtis Drive to North of Suitland Parkway	5	0
PG7865577	US 301 Safety & Re-surfacing - From MD 5 to Westwood Drive	4	0
PG7865777	MD RT. 458 (Silver Hill Road) from MD RT 5 to Walker Mill Road, Safety & Resurface	4	0
PG7945126	I-595 Sound Absorptive Material Removal and Protective Coating Application	4	0
PG9055177	MD 301 (Robert S Crain Hwy South) from Old Crain Hwy to Railroad Crossing 529 579U	1	0
PG9795377	MD RT 414 (St. Barnabas Road) from I-95 to MD RT 5-Safety & Resurface.	4	0
PG9795577	MD 5 (Branch Ave.) From MD 223 to South of I-95 Safety & Re-surface	5	0
PG9795677	MD 201 (Kenilworth Ave.) From Good Luck Road to I-95 Safety & Resurfacing	4	0
XX1115180	Preservation and Minor Rehab of Movable Bridges,Fixed Bridges,Culverts,and Noise Walls Area Wide (GAP-SIRE)	7	0
XX2255480	Preservation and Minor Rehab of moveable bridges, fixed bridges, soundwalls, culverts, retaining walls statewide (GAP-SIRE)	7	0
XX5265233	Placement and Replacement of Sidewalks and ADA Ramps at various locations in District 3 Area Wide (GAP-OOTS)	4	0
XY1515185	Area Wide Traffic Signal Modification, Installation APS, Reconstruct CPS (GAP-OOTS)	4	0
XY1555185	TS Modify /Reconstruction with APS/CPS in Districts 3,4,7	1	0

Quality Assurance Inspections By District

2/24/2015 To 4/30/2015

District: 3

Contract No	Project Description	# Inspections	# Non-Compliance (D-F)
XY2385185	Traffic Signal/MOD/Install/Reconstruct/APS/CPS in District 3/Area Wide (GAP-OOTS)	5	0
Project Count: 52	**Total Inspections:**	**193**	**0**

Quality Assurance Inspections By District

2/24/2015 To 4/30/2015

District: 4

Contract No	Project Description	# Inspections	# Non-Compliance (D-F)
AT0905280	Invert Paving and Restoration of Various Structures (Statewide- Baltimore, Cecil, Frederick, Garrett, Harford, Prince Georges's, Queen Anne's, Talbot, and Washington Counties)	2	0
AX0705124	Integrated Roadside Vegetation Management, Invasive Species Control and Native Plant Establishment along the I-83 corridor from I-95 (SW Blvd.) to US-40 (Pulaski Hwy) in Baltimore County and at Specific Wetland Mitigation Sites (GAP-LOD)	2	0
BA0335185	I-695 at Hollins Ferry Road/Washington Boulevard (GAP-OOTS)	4	0
BA0335285	I-83 at Padonia Road (Interchange Lighting) Baltimore County (GAP-OOTS)	4	0
BA0495177	I-195 From the Park & Ride to the Bridge over Francis Avenue Rehabilitation and Resurfacing	3	0
BA0515177	US-40 From East of Patapsco River Bridge to Pine Street	3	0
BA0545177	MD-150 From North Point Boulevard to Diamond Point Road Resurfacing and Rehabilitation	4	0
BA0585177	MD 587 from MD 150 to Strawberry Point Road (Safety and Resurfacing) Baltimore County	4	0
BA0595177	US 40 (Pulaski Highway) from Todds Lane to Md 700 (Martin Boulevard) Safety and Resurfacing	4	0
BA0615174	I-695 Drainage Improvement from Double Rock Townhouses to US 1 Southbound	1	0
BA0725185	I-83 at Shawan Road Interchange Lighting (GAP-OOTS)	4	0
BA0785288	US 1 (Southwestern Blvd) Bicycle and Sidewalk Retrofit Fron US 1 Alt to Baltimore City Line.	1	0
BA0915177	Safety and Resurfacing on I-695 From MD 122 to 2,000 Feet South of MD 26	4	0
BA0935181	I-83 at MD 439 East of Interchange Park and Ride Lot Expansion	4	0
BA3665170	Replacement of Bridge No. 0311305 on I-695 Inner Loop over Benson Avenue and Bridge No. 0311405 on I-695 inner Loop over Leeds Avenue, US 1, Amtrack, and Herbert Run, Realignment of I-695 Inner Loop Ramp 8 Bridge No. 03116 from US 1 over Leeds Avenue.	4	0
BA4055277	Safety and Resurfacing US-40 Eastbound from Ebenezer Rd to Days Cove Road	5	0
BA4215180	Replacement of Bridge No. 03214 on Middletown Road over I-83	4	0
BA4585172	I-695 From 41 (Perring Pkwy) to MD 147 (Harford Rd.)	3	0
BA4625280	Replacement of Bridge on I-695 over Milford Mill Road	5	0
BA5025180	Deck Replace/Rehab of Bridge MD 129 over I-695	5	0
BA5215176	Reconstruct Interstate Lighting I-695 at I-795, Perring Pkwy and Providence Rd.in Baltimore County (GAP - OOTS)	4	0
BA5965177	MD 26 from I-695 to City/County Line Resurfacing and Rehabilitation - Baltimore County	4	0
BA5975177	Safety and Resurface on MD 45 from North of Timonium Road to South of Padonia Road in Baltimore County	3	0

Quality Assurance Inspections By District

2/24/2015 To 4/30/2015

District: 4

Contract No	Project Description	# Inspections	# Non-Compliance (D-F)
BA7275380	Frederick Road (MD 144) Interchange Reconstruction Baltimore County	4	0
BA7725187	MD 145 & MD 146 Intersection Improvements Baltimore County	3	0
BA8405149	Pipe Yard Facility Removal Action	4	0
BA8555180	Replacement of Deck for Bridge No. 03095 On MD 150 Over MD 700	4	0
BA8735277	I-83 From I-695 to Shawan Road Safety Resurfacing and Rehabilitation	5	0
BA9015171	New Salt Storage and Brine Manufacturing Facilities at the Administration's Route 7 Maintenance Yard, Baltimore County	3	0
BA9885185	I-83 & Timonium Road and I-695 Edmondson Avenue (GAP-OOTS)	5	0
HA1075176	Safety & Spot Improvements WB US 40 Parking / Service Road; Between MD 132 & Robinson Ave.	4	0
HA2145184	MD 755 (Edgwood Road) Phase II from Willoughby Beach Road to MARC Edgewood Station Harford County.	4	0
HA2425180	Prestressed Concrete Slab Bridge No.12009 on MD 7 over James Run in Harford County	3	0
HA3345171	MD 24 from Deer Creek Bridge to 1000 feet South of Bridge- Section A	4	0
HA3485270	Intersection Improvements @ US 40 & MD7 / MD159	4	0
HA3485570	MD 22 @ Old Post Road Capacity Improvements	4	0
HA3515176	Widening and Resurfacing I-95 Northbound Off Ramp at MD 543	3	0
HA4995177	US 40 East Bound from Long Bar Harbor Road. to Spesutia Rd.; Safety & Resurface	2	0
XX2255180	Preservation and minor rehab of moveable and fixed bridges, retaining walls, culverts, retaining walls state wide (GAP-SIRE)	8	0
XX4505180	Replacement of Concret Arch on Grey Rock Drive over tributary of Jones Falls (MD 129) (GAP-SIRE)	4	0
XY1365185	Area Wide Sign Structure Replacement - District 4	5	0
XY1435185	I-695- MD 45, MD 147, MD 139 Sign Structure Replacement - District 4 - Area Wide (GAP-OOTS)	1	0
XY1475133	Areawide ADA Sidewalk Compliance in D4- Baltimore and Harford Counties	4	0
XY1485176	Areawide Safety and Operational Improvements In District 4 at Various Locations in Baltimore and Harford Counties Area Wide	3	0
XY1545185	MOD/Install/Recon of Signals Area Wide (GAP-OOTS)	5	0
Project Count: 45	**Total Inspections:**	**167**	**0**

Quality Assurance Inspections By District

2/24/2015 To 4/30/2015

District: 5

Contract No	Project Description	# Inspections	# Non-Compliance (D-F)
AA1375133	MD 424 From MD 3 to MD 450 Pedestrian Access Upgrades, AA County.	5	0
AA1545180	Cleaning and Painting of Existing Bridge #'s 0211011, 0201102, 0208000, 0208203, 0208204, 0208403, 0208404, 0208503, 0208504, 02100303 and 0210304 on various routes in AA county	4	0
AA2705130	MD 2 @ Harwood Drive left turn lane improvements	2	1
AA2785187	MD 2 (Governor Ritchie Highway) At Earliegh Heights/Magothy Bridge Road Intersection Improvements	4	0
AA4315181	MD 424 @ US 50 Park & Ride Addition	5	0
AA4915130	MD 2 @ MD 256 (Deale Road) Geometric Improvements AA County	5	0
AA4925130	MD 2 at MD 255 Intersection Improvements AA County	5	1
AA5805670	MD 175 @ Reece Rd. & Mapes Rd./Charter Oaks Blvd. Intersection Improvements	4	0
AT0655374	Drainage and Stormwater Remediation at Various Locations Statewide (GAP-ICD)	5	0
AT0875182	TMDL Stormwater Enhancements in AA county	3	0
AT7995382	TMDL- Legacy Pavement Improvements AA and CH Counties Area Wide (GAP - ICD)	5	0
AT8125274	Drainage, Erosion, and Sediment Control, and Remediation at Various Locations Statewide (GAP-ICD)	6	0
CA3825176	MD 2 at Mount Harmony Road Geometric Improvement CA County	3	0
CA4805180	Bridge Replacement Prestressed Concrete Girder Bridge No. 0401100 On MD 261 (Bayside Road) Over Fishing Creek	3	0
CH2045129	Installation and Construction of a Vactor Truck Dewatering Station at the La Plata, MD Shop.	4	0
CH2095180	Emergency Bridge Replacement Prestressed Concrete Girder Bridge No. 8036 on MD 234 over Allens Fresh Run	5	0
SM2165176	MD 4 (Patuxent Beach Rd.) from MD 235 (Three Notch Rd.) to Patuxent Blvd. Widening and Resurface SM County	4	0
SM3665180	Bridge Replacement Prestressed Concrete Slab Bridge # 18008 on MD 5 over Eastern Branch SM County	2	0
XX2255380	Preservation and Minor Rehabilitation of Fixed Bridges, Culverts, Retaining Walls and Noise walls (GAP- SIRE)	7	0
XX5295178	Pedestrian Access to Transit in District #5 Area Wide (GAP-ICD)	5	0
Project Count: 20	**Total Inspections:**	**86**	**2**

Quality Assurance Inspections By District

2/24/2015 To 4/30/2015

District: 6

Contract No	Project Description	# Inspections	# Non-Compliance (D-F)
AL2925177	Safety and Resurfacing on US 40 From West Shipley Rd. to 0.13 Miles E. of Structure 01175	1	0
AL4095180R	Rehabilitation of Bridge No. 0108200 on MD 51 over CSX and Canal Parkway and Bridge No. 0109600 on I-68 over Wills Creek, CSX & Municipal	4	0
AL4215180	Deck Replacement and Substructure Rehabilitation for Steel Beam Bridge No. 01102 and 01103 on I-68	5	0
AL4395177	Safety & Resurfacing on MD 51 from Town Creek Bridge to 0.16 mi west of Comerford Drive	5	0
AW5515280	Cleaning and Painting of Existing Bridges No.s 0101900, 0110000, 0110600, 1100500, 1104103, 1104104, 1104400, 1104800, and 1105400 on Various Routes in Allegany and Garrett Counties	4	0
GA2065229	Keysers Ridge Maintenance Shop Complex	5	0
GA3255177	Safety and Resurfacing on I-68 0.54 miles East of Lower New Germany Road Bridge No. 11 041 00to 1.01 miles West of MD 546 Bridge no. 11 012 00	1	0
GA3505130	MD 495 at New Germany Road Intersection Improvement Garrett County	5	0
GA3555180	Replacement Bridge No, 11023 on US 219 (Garrett Highway) over Cherry Creek	2	0
WA2405149	Remove Existing Storage Tanks and Install New Above ground Tanks at the Administrations Hagerstown Maintenance Facility in Washington County	2	0
WA4165180	Replacement of bridge 21108 over Md. 63	6	0
WA4205180	Deck Replacement for Bridge No. 2113600 on US 40 over I-70	5	0
XY1345185	Modify/Installation/Reconstruction of Signing Districts 6 and 7 (GAP-OOTS)	5	0
XY4215177	Mill/Grind, Patch & Resurface Roadway Pavements @ Various locations - Washington County	1	0
Project Count: 14	**Total Inspections:**	**51**	**0**

Quality Assurance Inspections By District

2/24/2015 To 4/30/2015

District: 7

Contract No	Project Description	# Inspections	# Non-Compliance (D-F)
AT0885182	TMDL Improvements, MD 32 and MD 100 Howard County, US 15 and MD 144 Frederick County District 7	5	0
AX0315132	Traffic Barrier Improvements from East of Bethany Lane to Tyson Road and from Johnny Cake Road to Coleridge Road in Baltimore and Howard County.	5	0
AX2645482	Total Maximum Daily Load (TMDL) Legacy Pavement Improvements in Carroll, Frederick, Howard and Washington Counties. (GAP - ICD)	3	0
BA6075180	Widening and Superstructure Replacement for Bridge No. 0308300 on Md 140 (Westminster Pike) over North Branch of Patapsco River	4	0
CL2105177	MD 140 From West of MD 91 to West of Sandymount Road Safety and Resurfacing Carroll County	4	0
CL2365130	Relocation of Stone Road at MD 97	4	0
FR2255181	MD 75 at I70 Park & Ride Expansion in Frederick County	5	0
FR3275184	MD-144 From West Royal Oak Drive to Bye Alley Community Safety Enhancement	4	0
FR4185180	Replacement of Bridge No. 10098 on Motter Avenue over US 15 including Improvements along Motter Avenue and Oppossumtown Pike in Frederick County	4	0
FR4575180	Replacement of Bridge No. 10094 on MD 550 over Isreal Creek	4	0
FR5045180	Replacement of Bridge No. 10065 on MD 140 over Monocacy River	4	0
FR6085181	MD 17 at Ventrie Court Ridesharing Facilities	4	0
FR6705175	US-15 at MD-77 Emergency Stream Repair	5	0
HO2065182	Upper Little Patuxent River Stream Restoration Project in Howard County	5	0
HO2195129	Construction of a Salt Storage Facility at the Administration's Jessup Maintainance Facility	4	0
HO2425185	Reconstruct Interstate Lighting (I-95 @ MD 100 and MD 175 Howard County (GAP - OOTS)	2	0
HO2435185	US 29 at MD 103, MD 108 and US 40 Interchange Lighting	1	0
HO2485126	Extension of Existing Southbound I-95 Timberview Community Noise Barrier (13027NO) 5000 Feet North of MD 100 to Maontgomery Road	4	0
HO2935181	I-95 South Welcome Center Truck Parking Expansion in Howard County	4	0
HO2945181	MD 175 At Snowden River Parkway - Park and Ride Lot Expansion in Howard County	4	0
HO3175170	US 29 Northbound Widening Phase I from South of Md 175 (Phase 1B Northbound Widening and Noise Barriers)	4	0
HO3175270	US 29 Northbound Widening Phase I From South of Seneca Drive to South of Md 175 (Phase IA - Old Columbia Road Access Only	4	0
HO3915170	MD 32 at Linden Church Road Interchange Construction - Design/Build	3	0
HO4725176	MD 32 (Sykesville Road) from Day Road to West Friendship Road in Howard County - Widening for Left Turn Lane and SWM	4	0

Quality Assurance Inspections By District

2/24/2015 To 4/30/2015

District: 7

Contract No	Project Description	# Inspections	# Non-Compliance (D-F)
XX2255280	Preservation and Minor Rehab of Fixed Bridges, Culverts, Retaining Walls, and Noise Walls Statewide (GAP-SIRE)	8	0
XX5245185	Mod/Install/Recon of Traffic Signals - District 6 & 7 - Area Wide (GAP-OOTS)	4	0
XX6305279	Areawide Sidewalk Project in District 7	5	0
XY1305185	Sign Structure Replacement - District 7 - Area Wide (GAP-OOTS)	5	0
Project Count: 28	**Total Inspections:**	**116**	**0**

Quality Assurance Inspections By District

2/24/2015 To 4/30/2015

District: 8

Contract No	Project Description	# Inspections	# Non-Compliance (D-F)
AT3765D60	ICC Contract D/E	5	0
AX3765560	RC-A, NB-1 and NB-3, Stabilize the Cherrywood Manor Tributary and Manor Run reducing sediment input into the North Branch of Rock Creek	4	0
AX3765T60	Northwest Branch and Patuxent River Stormwater Management and Stream Restoration Sites NW-39 and PR-257 in Montgomery County	4	0
AX3775460	MO-B Northwest Branch Recreational Park	1	0
AX3785T60	ICC SWM Ponds NW-32 and NW-40 Pond Retrofits	1	0
Project Count: 5	**Total Inspections:**	**15**	**0**

QA Non-Compliance Findings

Contract AA2705130 **Inspection Date** 4/22/15 1:00 pm **Inspector** Walker Martin

Project MD 2 @ Harwood Drive left turn lane improvements

Rating F 35.70

Reason This Non-Compliance was the result of a low score. The identified issues included failing to install controls prior to disturbing area of intended control, Failing to seek necessary modifications, stagging and stockpiling in an unapproved area, ESCM duties not in conformance with the specifications along with incorrect installation of Diversion Fence, Gabion Outlet Structures and Super Silt Fence. There were also stabilization issues on the site.

Contractor : Francis O. Day Co., Inc.
Project Engineer : Greta Hartman

Action Taken The administration shut down the project and directed the contractor to correct the issues noted. The issues were corrected within 48 hours.

The contract documents specify for the administration to seek liquidated damages in the amount of $3,666.00 for each day of the non-compliance for a total of $7,332.00.

Follow-up Rating B 83.4 **Follow-up Date** 4/27/15 3:02 pm

Contract AA4925130 **Inspection Date** 4/19/15 3:34 pm **Inspector** Walker Martin

Project MD 2 at MD 255 Intersection Improvements AA County

Rating D 64.70

Reason This non-compliance was the result of a follow-up to a "C" rating. The contractor did not complete all of the items listed on the previous "C" report. The outstanding issues were Earth Dike maintenance, Temporary Stone Outlet Structure maintenance and Super Silt Fence maintenance. Improper stabilization also contributed to the low score.

Contractor : Ardent Co. LLC.
Project Engineer : Greta Hartman

Action Taken The Administration shut down grading operations and directed the contractor to correct the outstanding environmental issues. The correction were complete within 24hrs.

The contract documents specify for the administration to seek liquidated damages in the amount of $3,823.00 for each day of the non-compliance for a total of $3,823.00.

Follow-up Rating A 96.0 **Follow-up Date** 4/20/15 3:28 pm

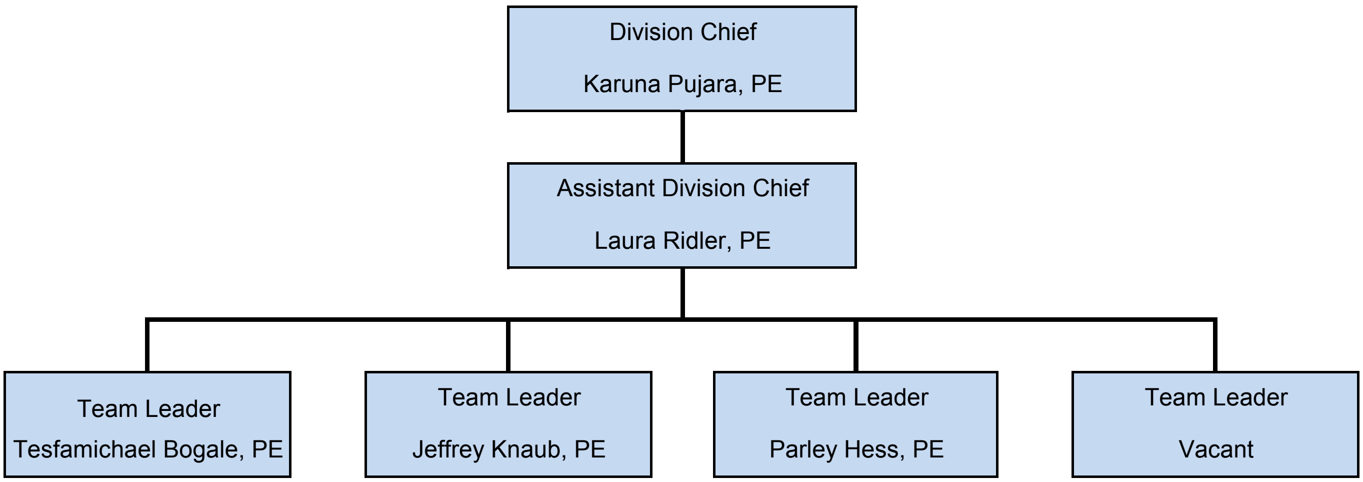
APPENDIX C.

PLAN REVIEW DIVISION

ORGANIZATIONAL CHART

Office of Highway Development - Plan Review Division Organizational Chart

Date: May 1, 2015



APPENDIX D.

SUMMARIES OF PUBLIC OUTREACH

Public Outreach Meetings

ROUTE	DESCRIPTION / PROJECT NAME	Meeting Type/Purpose	Meeting Date	City/County
MD 54	MD 54 over Mockingbird Creek	Informational	04/20/15	Wicomico
MD 4	MD 4 Thomas Johnson Bridge	Informational	04/22/15	St. Mary's
MD 370	MD 370 over Miles River	Informational	05/12/15	Talbot
US 220	US 220	Informational	06/15/15 (Tentative)	Allegany
MD 4	MD 4-Silver Hill Road to Forestville Road	Preconstruction	06/16/15 (Tentative)	Prince George's
MD 97	MD 97 Montgomery Hills	Hearing	06/23/15 (Tentative)	Montgomery
MD 500	MD 500 Community Safety & Enhancement Project	Informational	03/18/15	Prince George's
MD 625	MD 625 Hughesville Community Safety Enhancement Project	Informational	03/18/15	Charles
MD 28/MD 198	MD 28/MD 198	Informational	03/19/15	Montgomery
US 29	US 29 – Interchange Improvements at Fairland Road and Musgrove Road	Informational	03/24/15	Montgomery
MD 16	MD 16 from Brannock Neck Road to MD 335 Community Safety & Enhancement	Informational	March/April 2015	Dorchester
MD 4	MD 4 Thomas Johnson Bridge	Informational	04/22/2015 (Tentative)	St. Mary's
MD 54	MD 54 over Mockingbird Creek	Informational	04/20/2015 (Tentative)	Wicomico
US 220	US 220	Informational	June	Allegany
MD 97	MD 97 Montgomery Hills	Hearing	June	Montgomery
I-695	I-695 Southwest Outer Loop Widening	Informational	02/24/15	Baltimore
US 29	US 29 – Interchange Improvements at Fairland Road and Musgrove Road	Informational	02/26/15	Montgomery
US 301/MD 228	US 301/MD 228	Informational	03/05/15	Charles
MD 2/MD 4	MD 2/MD 4	Informational	03/11/15	Calvert
MD 500	MD 500 Community Safety & Enhancement Project	Informational	03/18/2015 (Tentative)	Prince George's
MD 625	MD 625 Hughesville Community Safety Enhancement Project	Informational	03/18/2015 (Tentative)	Charles
MD 28/MD 198	MD 28/MD 198	Informational	03/19/2015 (Tentative)	Montgomery
MD 16	MD 16 from Brannock Neck Road to MD 335 Community Safety & Enhancement	Informational	March/April 2015	Dorchester
MD 4	MD 4 Thomas Johnson Bridge	Informational	April	St. Mary's

Appendix E.

Investigations of Citizen Complaints and Inquiries

Route	Location	SHA District	Status	Resolution Date
MD-3	Priestbridge Salt Barn/MD 3 drainage erosion	3	Initial Customer Contact	
MD-17	9019 Myersville Rd- Ditch Erosion	7	Initial Field Visit	
US-301	Pipe washout along NB US 301 1.1 miles northeast of Potomac River	5	Initial Field Visit	
MD-7	Homeowner unhappy with BMP and ditches constructed as part of intersection improvement project	4	Report Complete	4/24/2015
MD-135	MD 135 at Vine Street	6	Initial Field Visit	
MD-151	Request for pipe installation at Baltimore Towing Company	4	Assigned	
I-495	Severe outfall erosion adjacent to ramp from SB MD 650 to WB I 495	3	Initial Field Visit	
I-270	Pipe Outfall Failure into Montgomery County Detention Center SWM Pond	3	Initial Field Visit	
MD-10	Erosion Beneath Noise Wall	5	Assigned	
MD-316	Failing 26" CMP	2	Initial Customer Contact	
MD-346	Poor Drainage at 8133 Old Ocean City Road	1	Report Complete	3/31/2015
MD-117	Intersection Flooding, MD 117 and Firstfield	3	Report Complete	5/13/2015
MD-32	1585 Sykesville Rd, flooding of property	7	Assigned	
MD-632	Yard flooding at 8818 Downsville Pike	6	Report Complete	4/23/2015
MD-950	Culvert Failure, Ardwick Ardmore Ramp to US 50 WB	3	Report Complete	3/9/2015
MD-36	MD 36 in Midland (Wilson Property)	6	Report Complete	3/23/2015
US-11	Yard sinking along Pennsylvania Ave (US 11) in Hagerstown	6	Report Complete	4/23/2015
MD-495	Pipe Separation, 48" RCP north of Str 11063X0	6	Initial Field Visit	
MD-129	Drainage Investigation Request for 10625 Park Heights Ave	4	Report Complete	5/13/2015
MD-97	Erosion along guardrail on MD-97	7	Report Complete	3/18/2015
US-219	US 219 at Rock Lodge Road	6	Report Complete	3/23/2015
US-201	Slope Failure along US201, Town of Edmonston	3	Report Complete	3/3/2015
US-1	Water running down and eroding along the edge of shoulder on US 1.	4	Report Complete	2/11/2015
MD-5	Drainage Evaluation for Roadway Transfer of MD 5G	5	Report Complete	3/16/2015
I-695	Slope Failure along inner loop of I-695	4	Initial Field Visit	
I-695	I-695 Slope Failure	4	Report Complete	4/23/2015

First Quarterly Report

Covering February 24, 2015 to May 1, 2015

Submitted To:

Water Management Administration
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, Maryland 21230

Submitted by:

Maryland State Highway Administration
707 North Calvert Street
Baltimore, Maryland 21202

Appendix C

Monitoring Report

Assessment of Stream Restoration Projects in Maryland

2014-2015 Report

Prepared for:

Maryland Department of Transportation
State Highway Administration
Highway Hydraulics Division
707 North Calvert Street
Baltimore, MD 21202

Prepared by:

Principal Investigator

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Appalachian Laboratory
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Frostburg, MD 21532-2307

June 2015

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APPENDIX A. 56

Introduction

The Maryland Department of Transportation, State Highway Administration (SHA) receives state and federal funding for assessment of stream restoration projects in Maryland. SHA requires scientific support (primarily biological) to assess and/or to monitor a selected set of stream restoration projects already completed, or projected to be done in the future, by the administration. Information collected from these studies, undertaken by the Appalachian Laboratory of the University of Maryland Center for Environmental Science, provides a framework and historical database of recommendations for future SHA stream restoration projects, and for assessment and potential revitalization of existing SHA restoration projects throughout Maryland.

Rationale

Stream restoration is of critical importance to the State of Maryland, as well as to the entire Chesapeake Bay watershed. The overall quality of life, now and in the future, is highly dependent on aquatic ecosystem integrity for both the quantity and quality of freshwater (Simon 1999). The integrity of surface water resources is dependent on chemical variables, flow regimes, biotic factors, energy sources, and habitat structure (Karr et al. 1986). Over the last quarter century, numerous surveys of fish and benthic communities assessed freshwater ecosystem health (Simon 1999). Significant advances in this arena led to the development of integrative ecological indices, such as Indices of Biotic Integrity (IBIs), which relate fish communities to both biotic and abiotic ecosystem components (Karr 1981, Karr et al. 1986). Coupled with chemical-physical water quality attributes, habitat quality (and often quantity) is important to consider when examining fish and benthic communities, especially for any and all derived IBIs (Yoder and Smith 1999).

Stream restoration strongly focuses on revitalization of the physical habitat. However, indices of habitat quality to assess post-restoration processes have lagged behind both fish and benthic IBI development. In part, this is because of the difficulty in developing accurate, precise and complete methodologies to quantitatively and qualitatively habitat assess characteristics (Platts 1976, Platts et al. 1983). The impetus for including stream habitat as an important measure came initially from western U.S. restoration activities (reviewed in Platts et al. 1983). For example, Binns (1979) developed a Habitat Quality Index for trout streams, soon to be followed by both Habitat Evaluation Procedures models (HEP) and Habitat Suitability Index models (HSI) for use with the U. S. Fish and Wildlife Service in-stream flow models. Important improvements in more generalized habitat models came with the development of EPA's Rapid Bioassessment Protocols (Plafkin et al. 1989) and the Ohio EPA's Qualitative Habitat Evaluation (Rankin 1989).

Wallace (1990) points out that there are a number of factors to consider in looking at stream recovery, especially in light of recent restoration attempts for lotic systems. Recolonization of a disturbed or restored area is a function of many factors, often depending on stream size. Implicit in restoration is that long-term stream physical stability eventually recovers. However, benthic macroinvertebrates respond to many disturbances, and restoration processes directed towards only the physical habitat may not take into account other critical stressors present in the watershed. The importance of nearby biotic refugia, as a source for recolonization is also critical (Wallace 1990), especially upstream refugia and, to a degree, the presence of either downstream or nearby lateral watershed refugia.

Hall et al. (1999, 2002) initially developed a Physical Habitat Index for Maryland using data collected from the first round of the Maryland Biological Stream Survey (MBSS), soon followed by the development of a revised Physical Habitat Index for Maryland (Paul et al. 2002). Coupled with the development of fish IBIs (Roth et al. 1998) and benthic IBIs (Stribling et al. 1998) from the MBSS data set, powerful analytical tools are now available to assess stream integrity in Maryland, and to examine restoration efficiency. These biotic indices were robust, and allowed inferences on stream integrity and stability, either regionally, statewide, or at site-specific levels. In addition, these indices were even more refined with additional MBSS rounds completed, especially with the development of coldwater fish IBIs and a finer level of benthic IBIs (Southerland et al. 2005, 2007).

Functional rehabilitation of degraded streams is critical, since streams may provide multiple environmental benefits, as well as critical ecological services (Morris and Moses 1999, National Research Council 1992). Functional rehabilitation is the major key to stream restoration since a return to pre-colonization stream status is impossible, especially in Maryland, where complex patterns of land use evolved since pre-colonial days. However, analytical evaluation of stream restoration or enhancement projects is often lacking. Monitoring these projects often serves as an important "first step" in evaluating effectiveness, and is essential to adaptive resource management (Bash and Ryan 2002). Downs and Kondolf (2002) and Morgan (2005) noted that post-project appraisals, or evaluations of restoration effectiveness, are critical to assess both short-term and long-term performance attainment of stream restoration projects. Often, this critical step is lacking in most restoration projects (Downs and Kondolf 2002). SHA project analyses completed from 1998 to 2010 for SHA were discussed in Morgan et al. (2010). In this 2010 report, eight recommendations for the assessment improvement of SHA stream restoration projects were described.

Project Objective

The overall project objective is to assess and monitor completed and proposed SHA stream restoration projects and to make recommendations for future restoration projects, as well as for the improvement and revitalization of current restoration projects. In addition, a monitoring schedule for examining all completed stream restoration projects in the long-term (5, 10, and 25 years) was developed based on results for each SHA stream restoration site, and is in constant refinement with new sites added, and old sites revisited (Morgan et al. 2010).

Materials and Methods

Site Locations

Site details for each SHA restoration location are described in the results and discussion section, with benthic macroinvertebrate data summaries found in Appendix A. Control sites are often very difficult to find in highly developed urban watersheds or in headwater streams. We always attempted to find control sites upstream of pre-restoration or post-restoration sites; however, many of these restoration sites were in the extreme upper part of a watershed and did not reflect the restoration area, or there were changes in control sites during the study. To compensate for this problem, we employed data from all rounds of the MBSS for comparison to the restoration site. Normally, one would try to collect samples where the condition is present and where it is absent, with all other factors being the same (Green 1979). This approach determines an effect at a site relative to a control. However, there is so much anthropogenic activity in the landscape of the coastal plain and Piedmont, as well as other physiographic provinces of Maryland, that watersheds are strongly altered through time and space. It may be necessary at some sites to move downstream into the lower part of a watershed and then determine current conditions to assess the upstream site. However, this is not the desired approach.

Benthic Macroinvertebrates

Assessment of benthic macroinvertebrates at each sampling site followed benthic macroinvertebrate protocols for MBSS sampling (Kazyak 1996, Stranko et al. 2010). At each pre-construction or post-construction project, two samples (~ 10-20 sweeps each with D-nets depending on stream size) were taken within the project boundary after site surveys (lower and middle sections, if possible). One sample was always collected near the lower (downstream boundary) of the project. The middle sample was collected approximately one-third to one-half of the distance from the upper upstream boundary of the project (benthic sampling was frequently modified dependent on specific site characteristics). Two additional samples, serving as replicate controls, were collected upstream of the stream restoration project, assuming that the upstream area served as a suitable control area. If no suitable upstream control was present, one or two site samples were taken downstream. For any pre-construction sites, two benthic samples were taken within the proposed project boundaries, along with two controls from an upstream area (or downstream area) if possible. We also identified a number of MBSS reference streams to provide baselines for benthic invertebrate quality for the project.

Benthic Field Sampling Protocols

A series of D-net samples (a total of ~ 1-2 m^2) were taken at each sampling location (Kazyak 1996), with an emphasis on selecting riffle/run habitat. Benthic macroinvertebrate sampling was conducted in order to qualitatively describe the community composition and relative abundance in favorable habitats. All survey methods for benthic macroinvertebrates followed MBSS protocols (Kazyak 1996), with benthic samples, as often as possible, collected from stream riffle areas because this is typically the most productive habitat in stream ecosystems. When riffle habitat was not present, other habitats sampled in the following order of preference were: gravel/broken peat and/or clay lumps in run areas; snags/logs that create partial dams or are in run habitat; undercut banks and associated root mats in moving water; submerged aquatic vegetation and associated bottom substrate in moving water; and detritus/sand areas in moving water. In the field, samples were transferred to polyethylene bottles and preserved in denatured ethanol. These benthic samples were collected during the MBSS spring index period and during the MBSS fall index period (Kazyak 1996), weather conditions permitting.

Benthic Laboratory Protocols

In the laboratory, samples were washed, picked, and organisms stored in 70% isopropyl alcohol. The first 300 organisms (to the nearest grid) were picked for identification to the lowest taxon possible (Plafkin et al. 1989), with the first 100 organisms separated for the calculation of the MBSS BIBI. Only the 100 organism sample was used for MBSS metric calculations since the MBSS BIBI development was based on this sample number. The first 300 organisms were used for the EPA RBP III calculations. If the sample contained less than 300 organisms, the sample was picked completely. In any report table, an asterisk denotes either a lack of 100 organisms for the MBSS BIBI, or a lack of 300 organisms for the EPA RBP III protocol.

Benthic Macroinvertebrate Statistical Protocols

MBSS - A revised Maryland benthic index of biotic integrity (BIBI) was employed for this project (Southerland et al. 2005, 2007). The new BIBI was broken into Coastal Plain, Eastern Piedmont and Combined Highlands (Table 1). For any of the three MBSS strata, BIBI scores were determined by adding the threshold score for each metric, and then dividing by the number of metrics for each stratum. The BIBI collected at each station was compared to the control area as well as to MBSS reference stations in the vicinity of the SHA project. A BIBI score range of 4.0 - 5.0 is rated as good, 3.0 - 3.9 is fair, 2.0 - 2.9 is poor, and 1.0 - 1.9 is very poor (Table 2).

EPA – Benthic metrics were derived using the EPA RBP III procedures using a 300 + organism count (Plafkin et al. 1989, Klemm et al. 1990, Barbour et al. 1999). The derived metrics are: taxa richness = total number of taxa recognized; Hilsenhoff Biotic Index = tolerance value of each macroinvertebrate multiplied by the number of those individuals and then the sum of the products divided by the total number of specimens; ratio of scraper and filtering collector functional feeding groups; ratio of shredder functional feeding group to total number of individuals; ratio of total number of Ephemeroptera, Plecoptera, and Trichoptera (EPT) individuals to total Chironomidae; EPT Index = number of distinct taxa within the orders Ephemeroptera, Plecoptera and Trichoptera; and the percent contribution of the dominant taxon in the riffle community.

Physical Habitat Assessment

Stream physical habitat data is an essential component of any biological assessment program. Habitat data is normally used to assess trends in water quality and to investigate the influence of land use practices that may affect stream water quality. Habitat assessments, based on an earlier MBSS protocol (Kazyak 1996), were performed at all SHA sites in order to determine biological integrity and fishability. Although there are now revised physical habitat metrics for the MBSS (Paul et al. 2002), the Maryland physical habitat index (MPHI), developed by Hall et al. (1999, 2002) based on MBSS fish IBI data sets, was calculated and compared to control areas and to MBSS reference data in the vicinity of the SHA project. This approach was used to maintain consistency in the physical habitat index measurement over time, especially for those SHA sites being revisited since the earliest sites were initiated in Fall 1998 (Morgan et al. 2010).

A number of variables were assessed qualitatively at each site. These include the following: instream habitat, epifaunal substrate, velocity/depth diversity, pool/glide/eddy quality, riffle quality, channel alteration, bank stability, embeddedness, channel flow status, and shading (scores assigned for each metric). Observations of the surrounding area were used to evaluate aesthetic value (based on amounts of human refuse) and remoteness (based on ease of access and presence of human activity). The presence, or absence, of other stream habitat features (i.e., morphological characteristics, stream channelization, woody debris, and land uses visible from each site) was also recorded for each site. In the field, physical habitat assessments were integrated across controls and across the stream restoration area.

Physical habitat metrics with the best discriminatory power for SHA coastal plain sites were: instream habitat, velocity/depth diversity, pool/glide/eddy quality, embeddedness, maximum depth and aesthetic rating. The final index calculations for the coastal plain weighed all metrics equally except embeddedness, maximum depth, and aesthetics that were weighted ½. The final equation used for the coastal plain habitat index (CPPHI) was:

$$\text{CPPHI} = (\text{instream habitat} + \text{velocity/depth diversity} + \text{pool quality} - \text{embeddedness}/10 + \text{maximum depth}/10 + \text{aesthetics}/2)/\ 6.$$

Physical habitat metrics with the best discriminatory power for SHA non-coastal plain sites (primarily Piedmont) were: instream habitat, velocity/depth diversity, riffle/run quality, embeddedness, number of rootwads and aesthetic rating. All metrics were weighted equally except embeddedness (weighted ½) and aesthetics (weighted $^{1}/_{3}$). The final equation used for the non-coastal plain habitat index (NCPHI) was:

$$\text{NCPHI} = [\text{instream habitat} + \text{velocity/depth diversity} + \text{riffle/run quality} - \text{embeddedness}/10 + 3(\text{number of rootwads}) + \text{aesthetics}/3]/\ 6.$$

Each metric was calculated by site (metrics were integrated across the controls and the restoration sites) and a statistically based algorithm was used to convert the physical habitat score to centiles (Hall et al. 1999, 2002). Physical habitat categories were defined as: good being > 72 (> 50th centile), fair 42-72 (30th to 50th centile), poor 12-42 (10th to 30th centile) and very poor < 12 (10th centile).

In addition, digital images were periodically taken at each site to document selected stream habitat features, and then these images forwarded to SHA. All site maps were generated through Google™Earth and PowerPoint.

Water Quality

Baseflow water quality samples were taken at each SHA site for the determination of water quality parameters following the standard analyses performed for the MBSS, in addition to some new MBSS analytes for the fourth round of random sampling. These samples were taken following current MBSS protocols during the Spring and Fall sampling at each site, with samples transported to the Appalachian Laboratory for analyses. We calculated the 10-90th percentile range for each analyte based on the data base for all random sites in the MBSS program during the first three random site rounds.

Table 1. MBSS BIBI for Maryland by stratum and with metric scoring thresholds.			
Stratum and Metric	**Thresholds**		
	1	**3**	**5**
Coastal Plain (7)			
Number of taxa	< 14	14-21	≥ 22
Number of EPT taxa	< 2	2-4	≥ 5
Number of Ephemeroptera taxa	< 1	1-1	≥ 2
Percent intolerant to urban	< 10	10-27	≥ 28
Percent Ephemeroptera	< 0.8	0.8-10.9	≥ 11
Number of scraper taxa	< 1	1-1	≥ 2
Percent climbers	< 0.9	0.9-7.9	≥ 8
Eastern Piedmont (6)			
Number of taxa	< 15	15-24	≥ 25
Number of EPT taxa	< 5	5-10	≥ 11
Number of Ephemeroptera taxa	< 2	2-3	≥ 4
Percent intolerant to urban	< 12	12-50	≥ 51
Percent Chironomidae	> 63	4.7-63	≤ 4.6
Percent clingers	< 31	31-73	≥ 74
Combined Highlands (8)			
Number of taxa	< 15	15-23	≥ 24
Number of EPT taxa	< 8	8-13	≥ 14
Number of Ephemeroptera taxa	< 3	3-4	≥ 5
Percent intolerant to urban	< 38	38-79	≥ 80
Percent Tanytarsini	< 0.1	0.1-3.9	≥ 4
Percent scrapers	< 3	3-12	≥ 13
Percent swimmers	< 3	3-17	≥ 18
Percent Diptera	> 50	27-49	≤ 26

Table 2. Narrative descriptions of stream biological integrity associated with each of the BIBI (or FIBI) scores.

Good	BIBI score 4.0 - 5.0	Comparable to reference streams considered to be minimally impacted. Fall within the upper 50% of reference site conditions.
Fair	BIBI score 3.0 - 3.9	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of these minimally impacted streams. Fall within the lower portion of the range of reference sites.
Poor	BIBI score 2.0 - 2.9	Significant deviation from reference conditions, with many aspects of biological integrity not resembling the qualities of these minimally impacted streams, indicating some degradation.
Very Poor	BIBI score 1.0 - 1.9	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of these minimally impacted streams, indicating severe degradation.

Results and Discussion

Each current SHA restoration project evaluated in 2014-2015 will be reviewed, discussed and synthesized into the context of regional Maryland values, as derived from the Maryland Biological Stream Survey (all rounds). Basic information collected at each site for FY15 is included in each site summary. In the past, summary lists of benthic invertebrates collected at each restoration site (all controls plus middle restoration and lower restoration samples) were included within each site discussion. These benthic taxa lists are now placed in Appendix A to reduce excessive tables within each section. Any cell within the benthic summary tables marked with an asterisk indicates fewer than 100 organisms were present in the sample for that site (for the 300 + samples, metric calculations were not done if less than 100 organisms were present in the sample).

Long Draught Branch (LDB)

Site Description: Long Draught Branch is a small first-order stream located in a very highly urbanized area of Montgomery Country that includes residential development, large and small office complexes, numerous shopping centers and very large amounts of impervious surface due to parking lots, extensive road systems and numerous buildings (Figure LDB 1). There is a small dam located in the upstream area of Long Draught Branch (Note: In lower Long Draught Branch, there is another small dam located along Rabbit Road that is slated for future removal to enhance downstream connectivity).

A segment of Long Draught Run flows through a park area with a swimming pool and playground. Many of the parking areas adjacent to the numerous apartment units have direct flow pathways into the stream through rip-rapped drainage swales. In the spring, there is significant refuse found in the stream after winter. Often, this trash forms small blockage dams throughout the stream with significant pooling, especially in the area between the two restoration sites. Part of the restoration area is heavily wooded.

Throughout its stream course until it enters Clopper Lake, there are numerous storm drains discharging into the stream as well as overland drainage from parking lots and roads**.** There is also a major sewage line paralleling the stream throughout the proposed restoration area with a few surface seeps present.

Long Draught Branch Site Coordinates:

Site coordinates for Long Draught Branch (Figure LDB 1).			
Station	Latitude (N)	Longitude (W)	Comments:
Middle	39.142313	-77.225865	Projected middle restoration site.

Lower	39.144377	-77.228521	Projected lower restoration site.
Alpha Control	39.143820	-77.222785	Upstream Control One
Beta Control	39.143660	-77.222066	Upstream Control Two

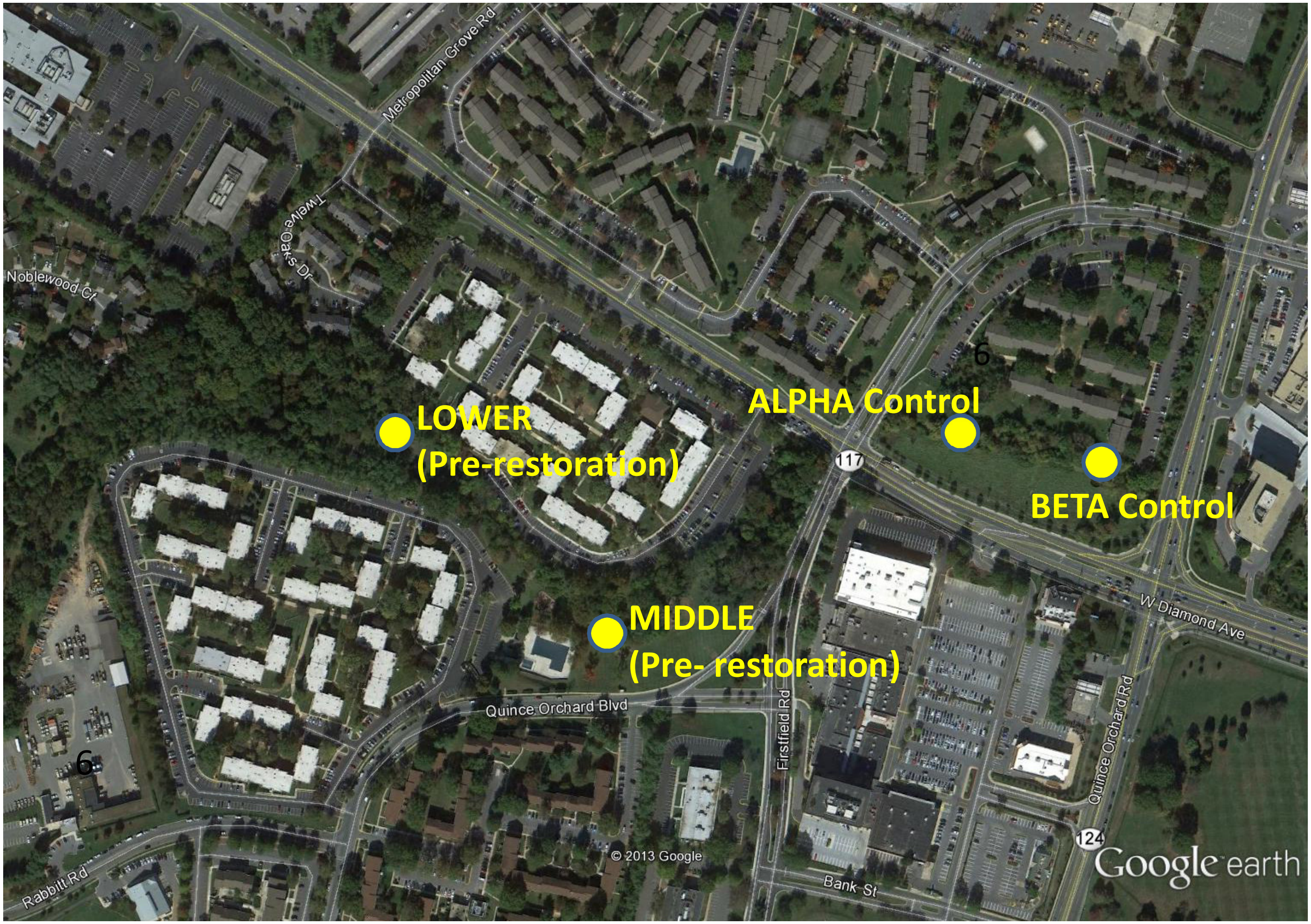
Metropolitan Grove Rd
Twelve Oaks Dr
Noblewood Ct
LOWER
(Pre-restoration)
ALPHA Control
BETA Control
117
MIDDLE
(Pre- restoration)
W Diamond Ave
Quince Orchard Blvd
Firstfield Rd
Quince Orchard Rd
124
Rabbitt Rd
Bank St
© 2013 Google
Google earth

Figure LDB 1. Site locations for sampling of Long Draught Branch (LDB) in Montgomery County.

Fall 2014 Benthic Community (LDB) - For subsamples with the MBSS 100 + macroinvertebrate count, total EPT taxa, number of ephemeroptera taxa, and the percent intolerant urban macroinvertebrates were low (Table LDB 1). Taxa richness and percent clingers were moderate at the Lower Restoration site and low at the remaining stations. The percent of chironomids collected was low at the Alpha Control site and moderate at the three remaining stations. *Cheumatopsyche* sp. dominated the EPT taxa and was the dominant clinger at the Lower Restoration site, but was in low numbers or nonexistent at the remaining sites. The IBI value ranged from 1.3 at the Beta Control and Middle Restoration sites to 2.0 at the Lower Restoration site on Long Draught Run – these values fall into either the poor or very poor category based on MBSS criteria.

Although in a heavily urbanized area, the number of benthic taxa present in the stream was surprising (8-22 in the 100 + organism count), with higher numbers present in the proposed restoration area (Table LDB 1). However, there were a high percentage of the organisms present as chironomids at three stations, with a high percent of clingers present at the Lower Restoration site. EPT taxa were low, reflecting the poor water quality in Long Draught Branch, variability in the flow regime due to impervious surface, and loss of connectivity with any EPT source populations in the immediate area.

Table LDB 1. Data summary of benthic macroinvertebrates collected in D-frame samples on 22 September 2014 at four stations in Long Draught Branch.

MBSS Piedmont Metrics	Riffle Community (MBSS 100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Taxa Richness	8	13	22	13
Total EPT Taxa	0	1	4	1
Ephemeroptera taxa	0	0	1	1
% Intolerant Urban	4.5%	0.0%	0.0%	2
% Chironomidae	2.7%	16.4%	16.7%	21.4%
% Clingers	0.0%	2.7%	70.6%	9.2%
BIBI	1.7	1.3	2.0	1.3

For subsamples with a 300 + count, taxa richness ranged from 26 at the Lower Restoration site to 12 at the Alpha Control site (Table LDB 2). The Hilsenhoff Biotic Index was lowest at the Lower Restoration site and highest at Alpha Control. The ratio of scrapers to filtering collector functional feeding groups was lowest (0.00) at the Beta Control site and highest (0.50) at Alpha Control site.

Scraper taxa were in low numbers at all sites. Filtering collectors, Sphaeridae, trichopteran larva, and Simulid larva, varied among the sites, but were in lowest numbers at the Alpha Control. Shredder numbers were low at all stations. The ratio of total EPT to chironomids was highest at the Lower Restoration site (2.9) and lowest at Alpha Control (0.00). The number of EPT taxa was highest (4) at the Lower Restoration site and nonexistent at the Alpha Control site.

Naididae oligochaetes were the dominant (59.6% and 32.1%, respectively) macroinvertebrate collected at the Alpha and Beta Control sites. *Cheumatopsyche* sp. larvae were the predominant (25.9%) macroinvertebrate collected at the Lower Restoration site while Turbellaria were abundant in the Alpha Control, Beta Control and at the Middle Restoration site, but low at the Lower Restoration site.

Table LDB 2. Data summary of benthic macroinvertebrates collected in D-frame samples on 22 September 2014 at stations in Long Draught Branch.

RBP III Metrics	Riffle Community (RBP III 300 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Taxa Richness	12	17	26	19
Hilsenhoff Biotic Index	8.9	8.3	5.9	7.6
Ratio Scrapers to Filtering Collectors (%)	0.50 (50.0%)	0 (0.0%)	0.01 (1.1%)	0.13 (13.3%)
Ratio Shredders to Total Individuals (%)	0.01 (0.7%)	0 (0.0%)	0.02 (2.4%)	0.01 (1.1%)
Total EPT Individuals to Total Chironomids (%)	0 (0.0%)	0.13 (12.7%)	2.89 (289%)	0.70 (71%)
EPT Index	0	2	4	3
Percent Contribution of Dominant Taxon	59.6%	32.1%	25.9%	29.6%

Spring 2015 Benthic Community (LDB) - For subsamples with a 100 + macroinvertebrate count, taxa richness was moderate at the Middle Restoration and low at the remaining stations (Table LDB 3). The number of EPT taxa, number of ephemeroptera taxa, and percent of intolerant macroinvertebrates was low at all stations. *Cheumatopsyche* sp., when present, was the dominant EPT taxon collected. No ephemeroptera or intolerant urban taxa were collected at any of the sites. The percent of chironomids collected was high at the Lower Restoration site and moderate at the remaining stations. The percent of clingers was low at all stations, with *Cheumatopsyche* sp. being most abundant at the Lower Restoration site. The BIBI value ranged from 1.0 at the Lower Restoration site to 1.8 at the Beta Control site.

Table LDB 3. Data summary of benthic macroinvertebrates collected in D-frame samples on 30 March 2015 at stations in Long Draught Branch.

MBSS Piedmont Metrics	Riffle Community (MBSS 100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Taxa Richness	12*	10*	13	17*
Total EPT Taxa	0*	0*	3	1*
Ephemeroptera taxa	0*	0*	0	0*
% Intolerant Urban	0.0%*	0.0%*	0.0%	0.0%*
% Chironomidae	29.4%*	37.5%*	63.7%	48.3%*
% Clingers	0.0%*	2.5%*	21.6%	8.0%*
BIBI	1.3	1.8	1.0	1.7

For subsamples with a 300 + count, low abundance resulted in no EPA RBP III analyses for the two control sites. Taxa richness ranged from 18 at the Middle Restoration site to 20 at the Lower Restoration site (Table LDB 4). The Hilsenhoff Biotic Index was 6.1 at the Lower Restoration site and 7.1 at the Middle Restoration site. The ratio of scrapers to filtering collector functional feeding groups was 0.03 at the Lower Restoration site and 0.47 at the Middle Restoration site station. Scraper taxa were low in numbers at both sites, while *Cheumatopsyche* sp. dominated the filtering collector functional feeding group. The number of shredder macroinvertebrates was low at both sites. The ratio of total EPT individuals to chironomids ranged from 0.40 at the Lower Restoration site to 0.10 at the Alpha Control station. The number of EPT taxa four (4) at the Lower Restoration site and one (1) at the Middle Restoration site. The trichopteran larva, *Cheumatopsyche* sp., dominated the EPT macroinvertebrates. *Orthocladius* sp. larvae were most abundant macroinvertebrate seen at both sites.

Table LDB 4. Data summary of benthic macroinvertebrates collected in D-frame samples on 30 March 2015 at stations in Long Draught Branch.

EPA RBP III Metrics	Riffle Community (EPA RBP III 300 + subsample)	
	Lower Restoration	Middle Restoration
Taxa Richness	20	18*
Hilsenhoff Biotic Index	6.1	7.1*
Ratio Scrapers to Filtering Collectors (%)	0.03 (2.5%)	0.47* (47.1%)
Ratio Shredders to Total Individuals (%)	0.00 (0.0%)	0.01* (0.6%)
Total EPT Individuals to Total Chironomids (%)	0.40 (39.5%)	0.10* (10.0%)
EPT Index	3	1*
Percent Contribution of Dominant Taxon	56.0%	45.4%*

Physical Habitat: Physical habitat in the control area was good, although there was a limited buffer width along the stream. Shading was good for most of the control area. However, there were three problems that we observed during all benthic sampling in the upper control region, and reported on in earlier reports. First, there was a dam upstream of the control area that formed a small pond clogged with cattails (dam coordinates: 39.142686° N; -77.219645° W). During the summer, this shallow pond could create high temperature spikes downstream during storm events and may even create excessive stream temperatures during the summer without storm events. In addition, there were several outfalls from pavement discharging into the stream that would generate significant temperature spikes during summer rain events. Second, Long Draught Branch flows underground through large culverts for a significant distance (an estimate of ~ 0.18 km). Third, the stream originated very close to I-270 and West Diamond Avenue from spring seeps in this area. Consequently, the upstream characteristics of Long Draught Branch affected both the control and the potential stream restoration area.

The stream area to be restored on Long Draught Branch was truly an urban chaos. There were numerous, large (~1 m high) undercut banks and large amounts of large urban debris, including shopping carts, bicycles, mattresses and springs as well as smaller refuse. More of this material was present in 2015 than in earlier years. There was some shading along the stream, but the stream buffer was broken in most areas, with a fairly large expanse of grass in the park area. In past surveys, we observed some whitish-brown effluent draining from a culvert into the stream, as well as some surface drainage problems from a stream sewer system very close to Long Draught Branch.

The MPHI was 21.1 for the control area and 8.1 for the restoration area – a drop in both metrics from previous years. Basically, the restoration area was a classic example of the effects of urbanization on stream physical habitat structure.

Assessment Recommendation: Long Draught Branch is a contentious pre-restoration site. Prior to the construction of any proposed stream stabilization projects, it should be resampled at least one more time, and then 2-4 years after the completion of stream restoration construction.

Marbury Drive (MAR)

Site Description: The Marbury Drive SHA site is located in the Coastal Plain of Prince Georges County in the town of District Heights. This first order perennial stream is an unnamed tributary to Ritchie Branch, then flowing to the Southwest Branch of Western Branch, and onward to Western Branch which eventually flows into the Patuxent River. The stream restoration site parallels Marbury Drive; MAR will be used as the code for this SHA site rather than UTRB. This stream is in the extreme headwaters of the Western Branch of the Patuxent River and arises from a series of headwater springs and seeps.

The stream is a SHA pre-restoration site (Figure MAR 1). However, it appeared that there was some past work on this site since there was some rip-rap present as well as some other in-stream structures, including small dam structures. There are a number of large drainage pipes feeding into the site as well as drainage from roads and other impervious surfaces. During the Fall 2014 sampling, we sampled two sites in the Middle Restoration area to obtain some sense of the benthic community present throughout this long reach. The Lower Restoration site is below the Kipling Parkway road crossing (a potential restoration problem since there is a very large pool formed by the stream downstream).

Site Coordinates:

Site coordinates for (Figure MAR 1).			
Station	Latitude (N)	Longitude (W)	Comments:
MR 1	38.859162	-76.879542	Middle restoration site 1
MR 2	38.858251	-76.878081	Middle restoration site 2
Lower	38.868398	-76.881420	Lower restoration site
Alpha Control	38.857690	-76.877063	Upstream control one
Beta Control	39.857051	-76.875914	Upstream control two

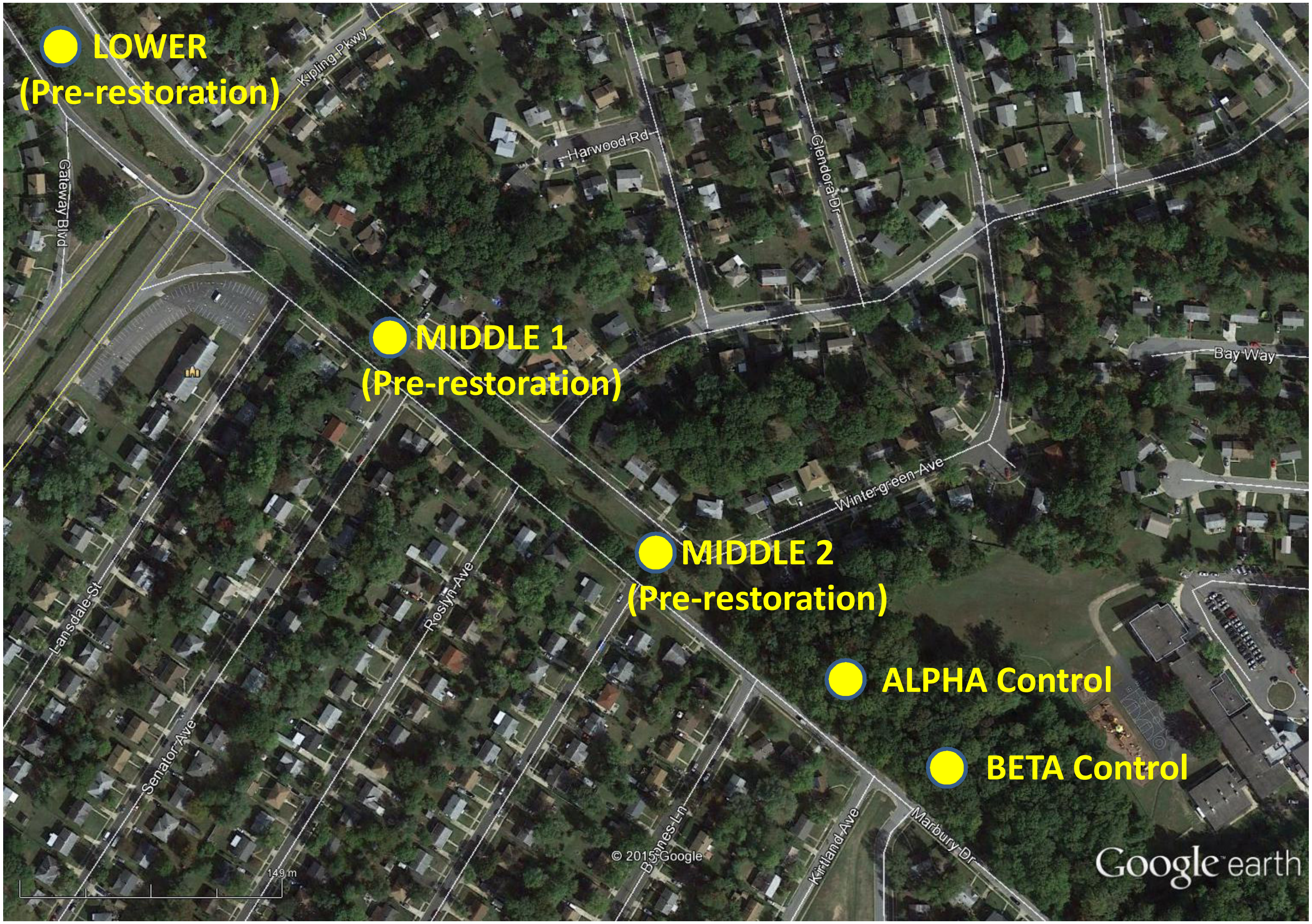

Figure MAR 1. Site locations for sampling of Marbury Drive (MAR) - UTRB (Prince Georges County).
MIDDLE 2 was only sampled in Fall 2014.

Fall 2014 Benthic Community (MAR) – For the MBSS subsamples with a 100 + macroinvertebrate count, taxa richness was moderate at the two Middle Restoration sites and high at remaining stations (Table MAR 1). The number of EPT taxa was moderate at the Alpha Control and Middle Restoration 2 sites and high at remaining sites. Hydropsychid larvae were the dominant EPT macroinvertebrate collected. The number of ephemeroptera taxa and percent of macroinvertebrates intolerant of urban conditions was low at all stations. The percent of ephemeroptera to total collection was high at the Lower and Middle Restoration 2 sites. Baetid nymphs were the only ephemeropteran found. The number of EPT taxa found at all stations was somewhat surprising given the urban characteristics of the stream; however, the control area is forested and serves as refugia for the EPT taxa.

No scraper taxa were collected at the Alpha Control site; however, scrapers were high at the Beta Control site and moderate at the remaining stations (Table MAR 1). Although in low numbers, gastropods and *Stenelmis* sp. beetles were the predominant scrapers collected. The percent of climbers was high at the Alpha Control station and moderate at the remaining sites. The chironomid, *Polypedilum* sp., was the dominant climber found. The BIBI ranged from 3.0 at Alpha Control and the two Middle Restoration sites to 3.6 at Beta Control and the Lower Restoration site (all BIBI values were in the MBSS fair range).

Table MAR 1. Data summary of benthic macroinvertebrates collected in D-frame samples on 29 September 2014 at stations on unnamed tributary near Marbury Drive.

Coastal Plain Metrics	Riffle Community (MBSS 100 + subsample)				
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration 1	Middle Restoration 2
Taxa Richness	25	25	23	21	19
Total EPT Taxa	4	5	5	5	4
Ephemeroptera taxa	1	1	1	1	1
% Intolerant Urban	1.8%	0.0%	1.4%	0.0%	0.0%
% Ephemeroptera	3.5%	3.4%	12.3%	3.5%	13.5%
No. Scraper Taxa	0	3	1	1	1
% Climbers	12.3%	6.8%	2.2%	4.4%	3.8%
IBI	3.0	3.6	3.6	3.0	3.0

For subsamples with a 300+ count, taxa richness ranged from 25 at Lower and Middle Restoration 1 sites to 28 at the Beta Control station (Table MAR 2). The Hilsenhoff Index ranged from 5.5 at the Lower Restoration site to 6.7 at the Beta Control. The ratio of scrapers to filtering collectors was lowest (0.02) at the Lower and two Middle Restoration sites and highest (0.06) at the Beta Control station. Gastropods and the elmid larva, *Stenelmis* sp., were the most common scrapers collected while hydropsychid larvae were the dominant filtering collectors seen. The ratio of shredders to total number of macroinvertebrates collected ranged from 0.03 at the Lower Restoration site to 0.09 at the two control stations. The chironomid larva, *Polypedilum* sp., and tipulid larvae were the dominant shredders collected. The ratio of EPT macroinvertebrates to total chironomids ranged from 0.42 at Alpha Control to 1.01 at the Middle Restoration 1 site. The number of EPT taxa was 5 at all the stations with hydropsychid larvae and baetid nymphs dominating the EPT macroinvertebrate collections. The percent contribution of the dominant taxon ranged from 10.3% (*Rheocricotopus* sp.) at the Beta Control site to 27.7% (*Symphytopsyche* sp.) at the Lower Restoration site.

Table MAR 2. Data summary of benthic macroinvertebrates collected in D-frame samples on 29 September 2014 at the Marbury Drive.

EPA RBP III Metrics	**RIFFLE COMMUNITY (300 + subsample)**				
	Alpha Control	**Beta Control**	**Lower Restoration**	**Middle Restoration 1**	**Middle Restoration 2**
Taxa Richness	26	28*	25	25	27
Hilsenhoff Biotic Index	6.4	6.7*	5.5	6.3	6.4
Ratio Scrapers to Filtering Collectors (%)	0.04 (4.3%)	0.06* (5.7%)	0.02 (1.7%)	0.02 (1.9%)	0.02 (1.6%)
Ratio Shredders to total Individuals (%)	0.09 (9.3%)	0.09* (8.6%)	0.03 (3.3%)	0.04 (3.7%)	0.04 (3.8%)
Total EPT Individuals to Total Chironomids (%)	0.42 (42%)	0.76* (76%)	0.78 (78%)	1.01 (101%)	0.71 (71%)
EPT Index	5	5*	5	5	5
Percent Contribution of Dominant Taxon	11.2%	10.3%*	27.7%	15.5%	20.9%

Spring 2015 Benthic Community (MAR) - For subsamples with a 100 + macroinvertebrate count, taxa richness and EPT taxa were moderate at all the stations (Table MAR 3). The number of ephemeroptera taxa, percent ephemeroptera, and percent intolerant were low at all sites. *Hydropsyche* sp. larvae were the dominant EPT macroinvertebrate collected. Gastropods were the dominant scraper collected at the Middle Restoration site and no scraper taxa were collected at the remaining stations. The percent of climbers was moderate at all sites, with the chironomid, *Polypedilum* sp., the dominant climber found. The BIBI ranged from 1.6 at Beta Control to 2.4 at the Middle Restoration site – these values are in the very poor and poor range. This was a steep decline in the BIBI scores versus the Fall sampling; however, this trend is commonly observed in the headwater streams where the Fall BIBI is often higher than the Spring BIBI (Morgan et al. 2010).

Table MAR 3. Data summary of benthic macroinvertebrates (100 + sample) collected in D-frame samples on 30 March 2015 at stations on unnamed tributary near Marbury Drive.

Coastal Plain Metrics	Riffle Community (MBSS 100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Taxa Richness	16	15*	17	19
Total EPT Taxa	3	1*	3	3
Ephemeroptera taxa	0	0*	0	0
% Intolerant Urban	0.0%	0.0%*	0.0%	0.0%
% Ephemeroptera	0.0%	0.0%*	0.0%	0.0%
No. Scraper Taxa	0	0*	0	5
% Climbers	2.8%	5.2%*	5.7%	7.2%
BIBI	1.9	1.6	1.9	2.4

For subsamples with a 300 + count, abundance was low so less than 300 macroinvertebrates were collected for analysis at the two control sites (Table MAR 4). Taxa richness was 21 at both restoration sites. The Hilsenhoff Index ranged from 6.6 at the Middle Restoration site to 6.7 at the Lower Restoration site. The ratio of scrapers to filtering collectors and shredders to total individuals collected was lower at the Lower Restoration site than at the Middle Restoration station. The number of scrapers was low to nonexistent at the stations while *Hydropsyche* sp. larvae dominated the filtering collector functional feeding group.

The ratio of shredders to total individuals collected was higher at the Middle Restoration site. *Tipula* sp. and *Polypedilum* sp. larvae were the dominant shredders collected (Table MAR 4). The ratio of EPT individuals to total chironomids was higher at the Lower Restoration station. Hydropsychid larvae were the dominant filtering collectors seen. The number of EPT taxa collected was three (3) at both stations. The number of EPT taxa was 5 at all the stations with Hydropsychid larvae dominating the EPT macroinvertebrate collections. The percent contribution of the dominant taxon was approximately 27% at both sites with *Hydropsyche* sp. larvae dominating the collection at the Lower Restoration site and *Orthocladius* sp. dominating the Middle Restoration station.

Table MAR 4. Data summary of benthic macroinvertebrates (300 + sample) collected in D-frame samples on 30 March 2015 at stations on unnamed tributary near Marbury Drive.

EPA RBP III Metrics	**RIFFLE COMMUNITY (300 + subsample)**	
	Lower Restoration	**Middle Restoration**
Taxa Richness	21*	21*
Hilsenhoff Biotic Index	6.7*	6.6*
Ratio Scrapers to Filtering Collectors (%)	0.02 (1.7%)*	0.23 (22.7%)*
Ratio Shredders to total Individuals (%)	0.04 (4.4%)*	0.07 (7.0%)*
Total EPT Individuals to Total Chironomids (%)	1.05 (105.3%)*	0.47 (46.8%)*
EPT Index	3*	3*
Percent Contribution of Dominant Taxon	26.8%*	26.6%*

Physical Habitat: The SHA restoration area (Figure MAR 1) is generally devoid of shading throughout most of its stream reach, with only limited trees, mainly planted along the roadsides, to provide any stream shading. In this area, the stream is bordered by roads on both sides of the stream, with the control area bordered by a road on one side of the stream. The restoration area is basically a grassy swale. However, the upstream control area is well-shaded with a mixture of large trees and shrubs along the stream. There are a few exotic species present at the control and restoration sites.

There are a number of large stormwater drains along the stream in the restoration area, as well as a few small dam structures and some rip-rap material. There are a few places where there is significant bank slumping. In addition, there is a sewage line running along the stream that could potentially affect water quality. The MPHI was 40.4 for the control area and 30.3 for the restoration area – both falling into the poor category.

Recommendations: This site is a SHA pre-restoration site slated for stream work in FY 2016 (or beyond). It is recommended that this site be re-assessed one year (or two) after the stream restoration work is totally completed.

Plumtree Run (PTR)

Site Description: Plumtree Run (pre-construction in the FY12-13 work, early post-construction in Spring 2014 and mostly completed in Fall 2014 and Spring 2015) is a first-order stream located in Harford County near Bel Air, MD (Figure PTR 1). It parallels Route 24 from its headwaters to West Ring Factory Road and then crosses under Route 24. The stream area restoration scheduled to be completed in 2014 is between West Ring Factory Road and Route 24. At the lower end of the restoration area, Plumtree Run crosses back under Route 24 (a high-density roadway with a significant median) and then eventually flows into the Atkisson Reservoir (the headwaters of Winters Run draining into the Bush River).

Plumtree Run presented a past problem in benthic analyses since it is located on the Fall Line in Maryland, with the Piedmont to the west and the western Coastal Plain to the east of the site. After consultation with MBSS personnel and examining the MBSS data base, we assigned Plumtree Run to the eastern Piedmont for all current and future reports.

The upper headwaters of Plumtree Run are heavily affected by urbanization, with numerous, large residential and commercial developments on either side of the stream, along with a large hospital complex, road infrastructure, and numerous shopping centers. There is an overabundance of parking for the hospital, MD DMV and the shopping centers, as well as an overall high road density in the Atkisson Run watershed (~ 4.0 km/km^2).

Site Coordinates:

Site coordinates for Plumtree Run (Figure PTR 1).			
Station	Latitude (N)	Longitude (W)	Comments:
Middle	39.509828	-76.339641	Middle site.
Lower	39.507872	-76.338807	Lower site.
Alpha Control	39.511721	-76.342286	Upstream control one.
Beta Control	39.512320	-76.342612	Upstream control two.
Gamma Control	39.506910	-76.339581	Downstream control one.
Delta Control	39.506712	-76.339755	Downstream control two.

Figure PTR 1. Site locations for sampling on Plumtree Run (Harford County).

Fall 2014 Benthic Community: For subsamples with a 100 + macroinvertebrate count and Piedmont metrics, taxa richness (13 – 20) and total EPT taxa (4 - 5) were moderate at most sites (Table PTR 1). Numbers of ephemeropteran taxa and percent macroinvertebrates intolerant of urban conditions were low at all stations. The percent of chironomids was moderate at all the sites while the percent of clingers was moderate at the Beta Control site and high at the remaining stations. The BIBI for Piedmont metrics ranged from 2.3 at Beta, Gamma, and Delta Control stations to 2.7 at the remaining sites (Alpha Control and Lower and Middle Restoration sites). These values all fall into the poor range for the MBSS BIBI.

Table PTR 1. Data summary of benthic macroinvertebrates (MBSS 100 + sample) collected in D-frame samples on 22 September 2015 at stations on Plumtree Run.

	Riffle Community (MBSS 100 + subsample)					
Piedmont Metrics	**Alpha Control**	**Beta Control**	**Gamma Control**	**Delta Control**	**Lower Restoration**	**Middle Restoration**
Taxa Richness	15	19	15	13	18	20
Total EPT Taxa	5	5	4	5	5	5
Ephemeroptera taxa	1	1	1	1	1	1
% Intolerant Urban	4.2%	2.1%	2.8%	2.7%	0.8%	4.1%
% Chironomidae	10.0%	26.6%	12.5%	9.1%	8.1%	15.7%
% Clingers	90.0%	64.9%	88.9%	89.1%	91.1%	75.2%
BIBI	2.7	2.3	2.3	2.3	2.7	2.7

For benthic subsamples with a 300 + count (EPA RBP III), taxa richness ranged from 22 at the Delta Control to 31 at the Beta Control (Table PTR 2), with the Hilsenhoff Index ranging from 4.7 at Delta Control to 5.2 at Beta Control. The ratio of scrapers to filtering collectors was lowest (0.02) at Beta Control and highest (0.14) at Alpha Control. *Stenelmis* sp. and *Phesphenus* sp. were the most common scrapers collected while hydropsychid and philopotomatid larvae were the dominant filtering collectors. The ratio of shredders to total number of macroinvertebrates collected ranged from 0.02 at Delta Control and the Lower Restoration site to 0.05 at the Middle Restoration site.

Chironomid larvae (*Polypedilum* sp.) were the dominant shredders collected. The ratio of EPT macroinvertebrates to total chironomids ranged from 1.8 at Beta Control to 10.2 at the Delta

Control site. The number of EPT taxa ranged from 5 to 7 with both hydropsychid and philopotomatid larvae dominating the EPT macroinvertebrate collections. The percent contribution of the dominant taxon ranged from 17.9% (*Cheumatopsyche* sp.) at the Middle Restoration site to 46.8% (*Chimerra* sp.) at the Delta Restoration site.

Table PTR 2. Data summary of benthic macroinvertebrates collected in D-frame samples on 22 September 2014 at control stations in Plumtree Run.

RBP III Metrics	Riffle Community (EPA RBP III 300 + subsample)					
	Alpha Control	**Beta Control**	**Gamma Control**	**Delta Control**	**Lower Restoration**	**Middle Restoration**
Taxa Richness	24	31	28	22	23	28
Hilsenhoff Biotic Index	4.9	5.2	5.0	4.7	4.8	5.1
Ratio Scrapers to Filtering Collectors (%)	0.14 (14.3%)	0.02 (1.7%)	0.06 (5.8%)	0.04 (3.6%)	0.03 (3.5%)	0.03 (30.0%)
Ratio Shredders to total Individuals (%)	0.01 (0.7%)	0.03 (3.3%)	0.0 (1.6%)	0.02 (1.5%)	0.02 (2.0%)	0.03 (2.5%)
Total EPT Individuals to Total Chironomids (%)	4.70 (470%)	1.82 (182%)	5.21 (521%)	10.2 (1024%)	8.81 (881%)	4.47 (447%)
EPT Index	6	5	7	5	5	7
Percent Contribution of Dominant Taxon	28.9%	27.5%	30.6%	46.8%	26.6%	17.9%

Spring 2015 Benthic Community: For subsamples with a 100 + macroinvertebrate count and MBSS Piedmont metrics, taxa richness was moderate at the Beta Control and Middle Restoration sites and low at the remaining stations (Table PTR 3). The number of EPT ranged from 2-4 taxa, but ephemeropteran taxa and percent of intolerant macroinvertebrates were nonexistent at all PTR sites. The percent of chironomids was high at all stations with the percent of clingers low at all the stations. *Cheumatopsyche* sp., *Chimarra* sp., and *Antocha* sp. were the dominant macroinvertebrates in the clinger habit category collected. The BIBI for the Piedmont metrics ranged from 1.0 at the Alpha, Gamma, and Delta Control and Lower Restoration sites, to 1.3 at the two remaining sites. These BIBI values fall into the very poor range.

Table PTR 3. Data summary of benthic macroinvertebrates (MBSS 100 +) collected in D-frame samples on 31 March 2015.

Piedmont Metrics	Riffle Community (MBSS 100 + subsample)					
	Alpha Control	Beta Control	Gamma Control	Delta Control	Lower Restoration	Middle Restoration
Taxa Richness	13	18	11	7	13	16
Total EPT Taxa	3	3	2	2	4	4
Ephemeroptera taxa	0	0	0	0	0	0
% Intolerant Urban	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomidae	75.0%	78.4%	81.4%	92.7%	76.4%	78.0%
% Clingers	24.1%	11.3%	16.7%	6.3%	23.6%	17.4%
BIBI	1.0	1.3	1.0	1.0	1.0	1.3

For benthic subsamples with a 300 + count, taxa richness ranged from 11 at Delta Control to 24 at the Lower Restoration site (Table PTR 4). The Hilsenhoff Index ranged from 5.7 at the Lower Restoration site to 6.3 at Beta Control. The ratio of scrapers to filtering collectors was lowest (0.00) at Delta Control and highest (0.38) at Beta Control. *Stenelmis* sp. was the most common scraper collected while hydropsychid and *Chimarra* sp. larvae were the dominant filtering collectors. The shredder, *Polypedilum* sp., was the most common shredder collected, but in low numbers at the Lower and Middle Restorations sites, and not at all of the remaining stations. The ratio of EPT macroinvertebrates to total chironomids ranged from 0.03 (Delta Control) to 0.23 (Lower Restoration). The number of EPT taxa ranged from 3 to 5 with hydropsychid and *Chimarra* sp. larvae dominating the EPT macroinvertebrate collections. The percent contribution of the dominant taxon ranged from 56.6% (*Orthocladius* sp.) at the Middle Restoration site to 84.4% (*Orthocladius* sp.) at the Delta Restoration site.

Table PTR 4. Data summary of benthic macroinvertebrates collected in D-frame samples on 31 March 2015 at stations in Plumtree Run.

RBP III Metrics	Riffle Community (EPA RBP III 300 + subsample)					
	Alpha Control	**Beta Control**	**Gamma Control**	**Delta Control**	**Lower Restoration**	**Middle Restoration**
Taxa Richness	18	21	15	11	24	22
Hilsenhoff Biotic Index	5.8	6.3	5.8	5.9	5.7	5.9
Ratio Scrapers to Filtering Collectors (%)	0.36 (36.0%)	0.38 (38.5%)	0.09 (9.1%)	0.00 (0.0%)	0.04 (3.8%)	0.02 (2.1%)
Ratio Shredders to total Individuals (%)	0.00 (0.0%)	0.00 (0.0%)	0.00 (0.0%)	0.00 (0.0%)	0.01 (0.1%)	0.01 (0.6%)
Total EPT Individuals to Total Chironomids (%)	0.11 (10.6%)	0.07 (7.0%)	0.13 (12.5%)	0.03 (2.6%)	0.23 (22.9%)	0.21 (21.3%)
EPT Index	5	4	4	3	5	5
Percent Contribution of Dominant Taxon	70.5%	57.3%	68.3%	84.4%	60.2%	56.6%

Physical Habitat: For Plumtree Run, the upstream control area (Figure PTR 1) is bounded by heavy development for a distance of ~ 1.2 km upstream to its approximate spring source. For most of the stream length, the stream is well shaded with relatively good stability along the banks, and with a variety of plant species present (both native and introduced). This stream corridor varies greatly in width as a function of housing developments and commercial properties. The eastern bank of Plumtree Run is in close proximity to Route 24 in the lower section, and is effectively forced into a channel with some gradient. There appeared to be some minimal stream stabilization work in the past when Route 24 was constructed. In the control area, the stream bottom is a mixture of boulders, cobble, gravel, and some fine sediment.

The restoration area, ~ 0.64 km in length, is downstream of the junction of Route 24 and West Ring Factory Road, and ends where Plumtree Run crosses under Route 24 again. In this area, Plumtree Run has more of a flood plain than in the control area. Substrate throughout this control area was quite variable, ranging from large cobble to fine silt and clay.

Before restoration work, there were a number of large root wads present along the banks with deep pools present that provided adequate fish habitat (fish were observed throughout the restoration area). Shading was good throughout the restoration reach, but bank stability was poor reflecting the flashy nature of the stream. There was an abundance of multiflora rose as well as other native and non-native plant species.

During the Fall 2014 benthic collections, fishes were present throughout the restoration area, with numerous fish present near the in-stream structures. The restoration work completely changed the nature of the stream, and bank stability was significantly improved. The MPHI was 22 for the control area (poor) and 59 for the restoration area (fair).

Assessment Recommendation: Now that the construction phase is completed for the Plumtree Run restoration, sampling should be done for the next year, followed by either a five or ten year cycle.

Upper Little Patuxent River (ULPR)

Site Description: The Upper Little Patuxent River (ULPR) was a pre-restoration site sampled in the 2012 – 2013 work (FY 13). It is located to the south of Route 144 (Old Frederick Road) in Ellicott City, with one control site near Route 144 and one near Route 40 (Figure ULPR 1). The restoration area is located in a broad floodplain, with residential housing on both sides of the stream. There is some commercial development along Route 40 at the junctions of Bethany Lane, Centennial Lane, Route 144 and Route 40 that may potentially affect the Upper Little Patuxent River.

This site was resampled in the 2014 – 2015 work. In the Fall, we observed some construction activities near Frederick Road, essentially the construction of a stormwater management pond. However, most stream work was done after that Fall sample period, and was fairly complete by the Spring sampling.

Site Coordinates:

Site coordinates for Upper Little Patuxent River (Figure ULPR 1).			
Station	Latitude	Longitude	Comments:
Middle	39.273403	-76.852169	Projected middle site.
Lower	39.271883	-76.852429	Projected lower site.
Alpha Control	39.275718	-76.852465	Upstream control I.
Beta Control	39.278771	-76.852984	Upstream control II.

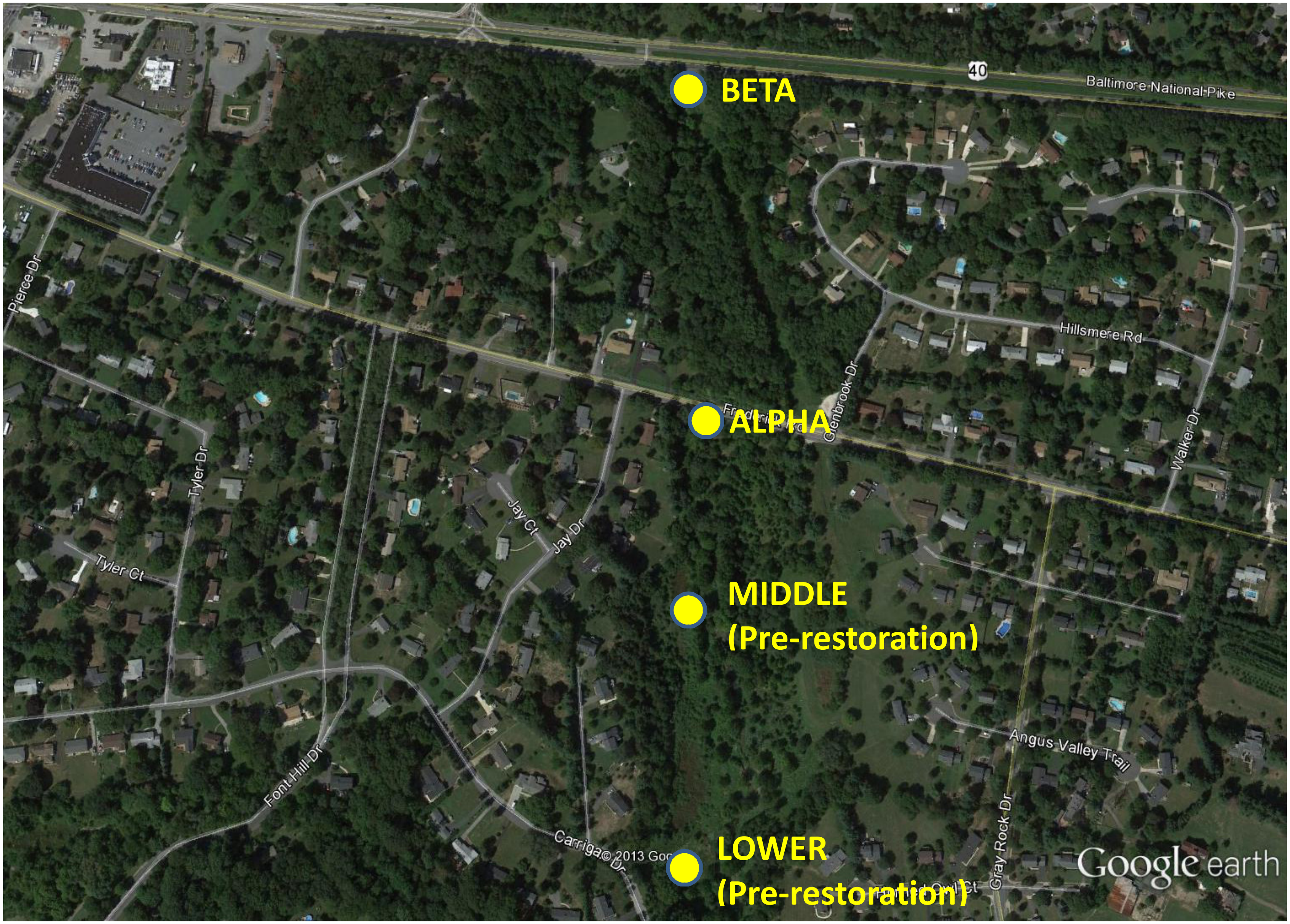

Figure ULPR 1. Site locations for sampling of Upper Little Patuxent River (Howard County).

Fall ULPR 2014 Benthic Community – For subsamples with the MBSS 100 + macroinvertebrate count, taxa richness, total EPT taxa, and percent chironomids were moderate (Table ULPR 1). Hydropsychid larvae dominated the EPT collections at all sites and also were the dominant clinger observed. The number of ephemeroptera taxa was moderate at the Alpha Control site and low at the remaining three sites. Chironomids dominated the two restoration sites, but were lower at the two control sites. A reverse pattern was seen with % clingers, where the percentages were higher at the two control sites and less at the two restoration sites. The percent of macroinvertebrates intolerant of urban conditions was low at all sites. The BIBI ranged from 2.3 at the Lower and Middle Restoration sites to 3.0 at the Alpha Control site.

Table ULPR 1. Data summary of benthic macroinvertebrates collected in D-frame samples on 22 September 2014 at stations in Upper Little Patuxent.

Piedmont Metrics	Riffle Community (MBSS 100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Taxa Richness	18	17	17	23
Total EPT Taxa	6	5	6	6
Ephemeroptera taxa	2	1	1	1
% Intolerant Urban	1.4%	3.9%	1.0%	3.1%
% Chironomidae	15.2%	11.7%	50.5%	26.8%
% Clingers	85.5%	84.5%	58.7%	68.0%
BIBI	3.0	2.7	2.3	2.3

For subsamples with the RBP III 300 + count, taxa richness ranged from 24 at the Alpha Control site to 32 at the Middle Restoration site (Table ULPR 2). The Hilsenhoff Biotic Index was lowest at the Beta Control site and highest at the Lower Restoration site. The ratio of scrapers to filtering collector functional feeding groups was lowest (0.02) at the Middle Restoration site and highest (0.08) at Beta Control site. Scraper taxa, primarily elmid larvae, were most abundant at the Beta Control site. Hydropsychid larvae were the dominant filtering collector at all sites. The shredder, *Polypedilum* sp., was most abundant at the Lower Restoration site and in low numbers at remaining sites. The ratio of total EPT to chironomids was highest at the Beta Control site (6.5) and lowest at the Lower Restoration site (0.84). Seven EPT taxa were collected at the Lower Restoration site and six EPT taxa at the remaining sites. *Cheumatopsyche* sp. larvae were the dominant (15.1%) macroinvertebrate collected at the Alpha Control while *Chimerra* sp. larvae predominated (25.0%)

the collections at Beta Control. Baetid nymphs were the most abundant (17.0% and 21.5%, respectively) macroinvertebrate seen at the Lower and Middle Restoration sites.

Table ULPR 2. Data summary of benthic macroinvertebrates collected in D-frame samples on 22 September 2014 at stations in Upper Little Patuxent.

RBP III Metrics	Riffle Community (RBP III 300 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Taxa Richness	24	24	26	32
Hilsenhoff Biotic Index	5.3	5.1	6.0	5.5
Ratio Scrapers to Filtering Collectors (%)	0.03 (2.8%)	0.08 (8.5%)	0.05 (4.5%)	0.02 (2.3%)
Ratio Shredders to total Individuals (%)	0.03 (2.9%)	0.02 (1.7%)	0.17 (16.7%)	0.05 (5.5%)
Total EPT Individuals to Total Chironomids (%)	4.52 (451.8%)	6.50 (650.0%)	0.84 (83.8%)	2.75 (275.0%)
EPT Index	6	6	7	6
Percent Contribution of Dominant Taxon	15.1%	25.0%	17.0%	21.5%

Spring ULPR 2015 Benthic Community - For subsamples with the MBSS 100 + macroinvertebrate count, taxa richness was moderate at the Lower Restoration site and low at all remaining sites (Table ULPR 3). The total number of EPT taxa, the number of ephemeropteran taxa, and the percent intolerant macroinvertebrates were low at all sites. The hydropsychid larva, *Cheumatopsyche* sp., dominated the EPT collections at all sites. The number of ephemeroptera taxa was low to nonexistent at all sites, and no intolerant urban macroinvertebrates were collected at any of the four sites.

The percent of chironomid larvae collected was moderate at the Alpha Control site and higher at remaining sites (Table ULPR 3). The percent of clingers was high at the Alpha Control site and low at remaining sites. The dominant clingers collected were *Cheumatopsyche* sp., *Chimarra* sp., and *Polypedilum* sp. larvae. The BIBI ranged from 1.0 at the Beta Control and Middle Restoration sites to 2.0 at the Alpha Control site.

Table ULPR 3. Data summary of benthic macroinvertebrates collected in D-frame samples on 31 March 2015 at stations in Upper Little Patuxent River.

Piedmont Metrics	Riffle Community (MBSS 100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Taxa Richness	12	8	15	11
Total EPT Taxa	4	3	3	0
Ephemeroptera taxa	0	1	0	0
% Intolerant Urban	0.0%	0.0%	0.0%	0.0%
% Chironomidae	21.1%	84.5%	86.1%	90.9%
% Clingers	79.8%	15.5%	14.8%	10.1%
BIBI	2.0	1.0	1.3	1.0

For subsamples with the RBP III 300 + count, abundance was low at the Middle Restoration site so no analysis was available. Taxa richness ranged from 19 at Alpha Control to 30 at the Lower Restoration site (Table ULPR 4). The Hilsenhoff Biotic Index was lowest (5.2) at Alpha Control and highest (6.0) at the Beta Control site. The ratio of scrapers to filtering collector functional feeding groups was lowest (0.00) at the Alpha Control site and highest (0.27) at the Lower Restoration site. Elmid larvae were the dominant scraper taxa collected and *Cheumatopsyche* sp. larvae the most abundant filtering collector seen.

The ratio of shredders was highest at the Lower Restoration site, with *Polypedilum* sp. the most abundant shredder collected (Table ULPR 4). The ratio of total EPT to Chironomids was highest (3.3) at the Alpha Control site and lowest (0.09) at the Lower Restoration site. The dominant EPT taxon collected was *Cheumatopsyche* sp. at all sites. The number of EPT taxa collected was highest (7) at the Lower Restoration site and lowest (4) at the Alpha Control site. *Orthocladius* sp. larvae dominated the collections at Beta Control and Lower Restoration sites while *Cheumatopsyche* sp. larvae dominated the collections at the Alpha Control station.

Table ULPR 4. Data summary of benthic macroinvertebrates collected in D-frame samples on 31 March 2015 at stations in Upper Little Patuxent River.

RBP III Metrics	Riffle Community (RBP III 300+ subsample)		
	Alpha Control	Beta Control	Lower Restoration
Taxa Richness	19	30	27
Hilsenhoff Biotic Index	5.2	6.0	5.9
Ratio Scrapers to Filtering Collectors (%)	0.00 (0.3%)	0.06 (6.0%)	0.27 (26.9%)
Ratio Shredders to total Individuals (%)	0.02 (1.5%)	0.02 (2.0%)	0.06 (5.56%)
Total EPT Individuals to Total Chironomids (%)	3.31 (330.6%)	0.18 (17.6%)	0.09 (8.86%)
EPT Index	4	5	7
Percent Contribution of Dominant Taxon	28.0%	65.9%	59.2%

Physical Habitat: For the Upper Little Patuxent River stream restoration project, the proposed restoration area below MD Route 144 is in a broad flood plain (historically, was there a small dam and reservoir in this area sometime in the past?). The stream bottom was primarily fine sands and clay with very little solid substrate present, and there were areas with deep entrenchment of the stream into the softer materials present. There was great difficulty in finding riffle areas suitable for benthic sampling, not only in the restoration site, but also in the control area. There was poor shading in the restoration area since most of the vegetation was low understory plants. A number of exotic plants were observed in the proposed restoration area.

For both the control and restoration area, there was a gas pipeline located along the eastern side of the stream. In addition, there was also a sewage line running through both the control and restoration areas. It appears that the area between Route 40 and Route 144 is mowed frequently, and there is evidence of human disturbance throughout both areas. The MPHI was 68 for the control area (fair) and 30 for the restoration area (poor).

Assessment Recommendation: The ULPR sites should be assessed after the stream restoration is completed for two complete sample cycles, and then be placed on a revisit schedule of either 5 or 10 years.

Watkins Mill Road (UTSC)
Site Description: This SHA pre-restoration site is located in Montgomery County, and is adjacent to I-270 – the major high-traffic density road between Frederick, MD and I-495 – the Washington Beltway (Figure UTSC 1). In addition, it is close to the interchange of I-270 and SR 124 (Quince Orchard Road), and also close to the SHA pre-restoration site on Long Draught Branch.

The current construction plan is for the building of a bridge across I-270 that will link the southern and northern extensions of Watkins Mill Road. During the bridge construction, stream restoration work will be done with the upper limit of work being where the stream crosses under I-270. The lower work area limit is the power line corridor that crosses I-270 to the west of SR 124. The UTSC flows into Seneca Creek just to the west of Game Preserve Road.

During the 2014-2015 work, we noted that this unnamed tributary flows under I-270 through a large culvert. During the Fall 2015 work, we plan on assessing the feasibility of sampling UTSC to the north of I-270. However, there is very limited access to the stream and it is located next to the westbound on-ramp for I-270, which may create safety problems. In addition, access (and permission) may be difficult since a major defense contractor has a fenced perimeter that may cross into the headwaters of UTSC.

Site Coordinates:

Site coordinates for the Unnamed Tributary to Seneca Creek (UTSC) site at Watkins Mill Road (Figure UTSC 1).

Station	Latitude	Longitude	Comments:
Middle	39.156352	-77.226806	Projected middle site.
Lower	39.158406	-77.229986	Projected lower site.
Alpha Control	39.152463	-77.221602	Upstream control I.
Beta Control	39.151496	-77.220157	Upstream control II.
Potential Control Area	39.150461	-77.217267	Control area

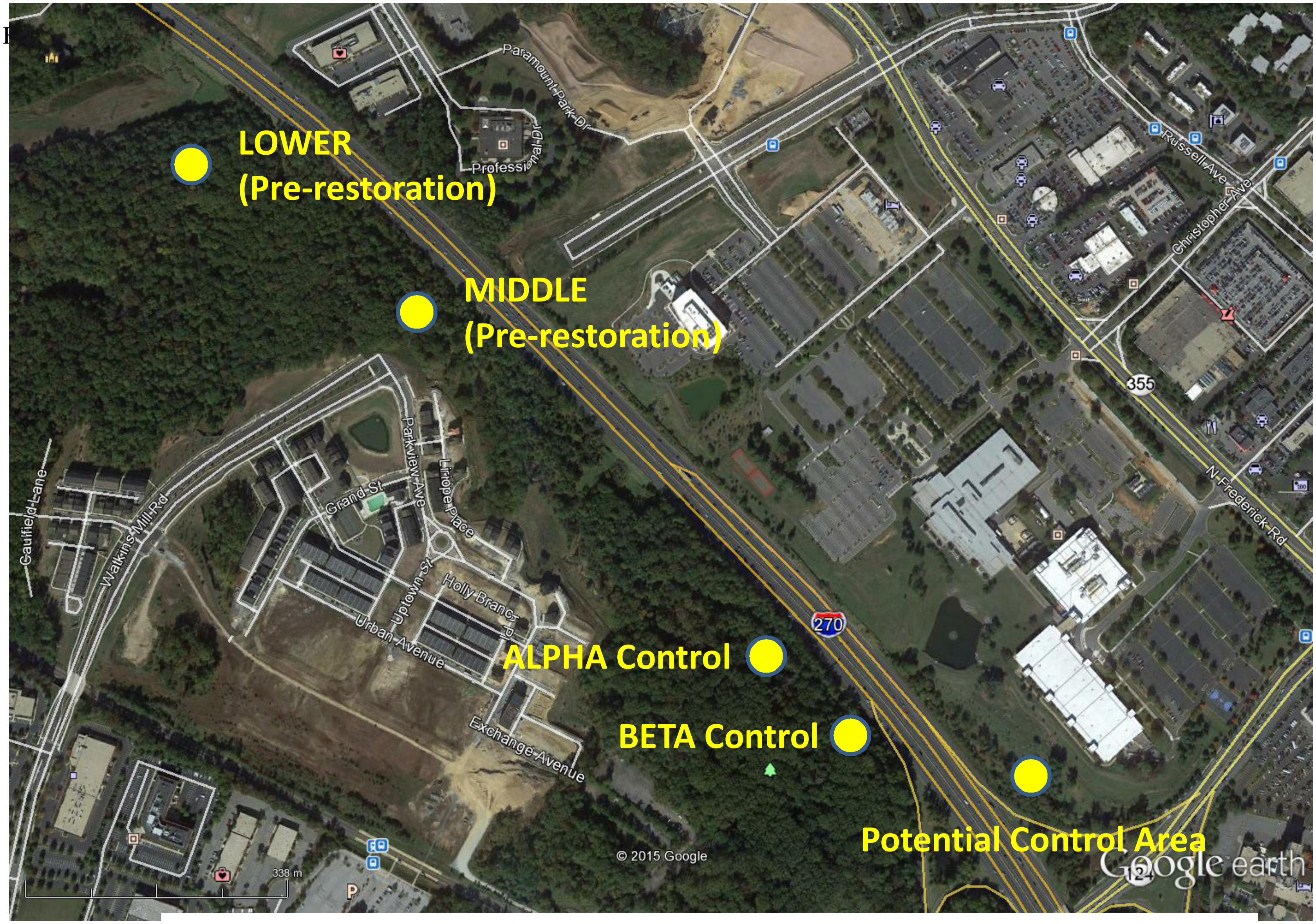

Figure UTSC 1. Site locations for sampling of unnamed tributary to Seneca Creek at Watkins Mill Road (Montgomery County).

Fall 2014 UTSC Benthic Community - For subsamples with a 100+ macroinvertebrate count, the number of EPT taxa, number of ephemeroptera taxa, and percent intolerant macroinvertebrates were low (Table UTSC 1). Taxa richness was moderate at the Alpha Control and low at the remaining stations. The percent of chironomids was moderate at all the stations. The percent clingers was moderate at the two control sites and high at the restoration sites The trichopterans *Cheumatopsyche* sp. and *Chimerra* sp. dominated the EPT taxa and they were also the dominant macroinvertebrate clinger collected. The IBI value ranged from 1.7 (very poor) at the Beta Control site to 2.3 (poor) at the Middle Restoration site.

Table UTSC 1. Data summary of benthic macroinvertebrates collected in D-frame samples on 22 September 2014 at stations in an unnamed tributary to Seneca Creek at Watkins Mill Rd.

Piedmont Metrics	Riffle Community (MBSS 100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Taxa Richness	15	13	13	11
Total EPT Taxa	4	4	4	5
Ephemeroptera taxa	1	0	1	1
% Intolerant Urban	4.2%	1.0%	2.8%	2.1%
% Chironomidae	17.7%	22.0%	9.4%	8.3%
% Clingers	46.9%	65.0%	85.8%	76.0%
BIBI	2.0	1.7	2.0	2.3

For subsamples with a 300 + count (Table UTSC 2), taxa richness was higher (23 and 25, respectively) at the two control sites than at the restoration sites (18 and 20, respectively). The Hilsenhoff Biotic Index was higher at the two control sites and lower at the two restoration sites. The ratio of scrapers to filtering collector functional feeding groups was lower at the two restoration sites compared to the two control sites. The dominant scrapers were physid snails and the elmid *Stenelmis* sp. while the dominant filtering collectors were the trichopteran larvae *Cheumatopsyche* sp. and *Chimerra* sp. The chironomid, *Polypedilum* sp., was the dominant shredder collected and was highest at the Alpha Control site. Alpha and Beta Controls and the Lower Restoration sites had proportionally more total EPT macroinvertebrates than chironomids, resulting in higher ratios there than at the Middle Restoration Site. *Cheumatopsyche* sp. and *Chimerra* sp. were the dominant EPT macroinvertebrates collected. The EPT index (5) was the same at all stations. The percent contribution of the dominant taxon was highest (40.2%) at the Lower Restoration Site and lowest (22.8%) at the Alpha Control Site. The dominant taxon collected was *Cheumatopsyche* sp. at the two control sites and *Chimerra* sp. at the two restoration sites.

Table UTSC 2. Data summary of benthic macroinvertebrates collected in D-frame samples on 22 September 2014 at stations in an unnamed tributary to Seneca Creek at Watkins Mill Rd.

RBP III Metrics	Riffle Community (RBP III 300 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Taxa Richness	23	25	18	20
Hilsenhoff Biotic Index	6.5	6.3	5.3	5.4
Ratio Scrapers to Filtering Collectors (%)	0.04 (4.2%)	0.10 (9.9%)	0.05 (4.5%)	0.0 (0.0%)
Ratio Shredders to total Individuals (%)	0.08 (8.2%)	0.06 (5.6%)	0.03 (3.3%)	0.03 (3.1%)
Total EPT Individuals to Total Chironomids (%)	1.66 (166%)	2.5 (250%)	55.7 (574%)	0.70 (70.3%)
EPT Index	5	5	5	5
Percent Contribution of Dominant Taxon	22.8%	34.1%	40.2%	32.6%

Spring 2015 UTSC Benthic Community - For subsamples with a 100 + macroinvertebrate count, number of ephemeroptera taxa and percent intolerant macroinvertebrates was low (Table UTSC 3). Taxa richness was low at the Control sites and moderate at the restoration sites. Total EPT taxa were moderate at the Lower Restoration site but low at the remaining sites. The percent of chironomids and percent of clingers was moderate at all the stations. The trichopterans *Cheumatopsyche* sp. and *Chimarra* sp. dominated the EPT taxa collected. The BIBI value ranged from 1.7 (very poor) at the Alpha and Beta Control sites to 2.3 (poor) at the Lower Restoration site.

Table UTSC 3. Data summary of benthic macroinvertebrates collected in D-frame samples on 30 March 2015 at stations in an unnamed tributary to Seneca Creek at Watkins Mill Rd.

Piedmont Metrics	Riffle Community (MBSS 100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Taxa Richness	10	10*	15	17
Total EPT Taxa	4	2*	5	4
Ephemeroptera taxa	0	0*	0	0
% Intolerant Urban	0.0%	0.0%*	1.0%	0.0%
% Chironomidae	50.4%	44.3%*	26.0%	41.7%
% Clingers	36.5%	40.5%*	63.5%	44.7%
BIBI	1.7	1.7	2.3	2.0

For subsamples with a RBP III 300 + count, low abundance resulted in no macroinvertebrates for the two control stations (Table UTSC 4). Taxa richness was higher (23) at the Middle Restoration site than at the Lower Restoration site (18). The Hilsenhoff Biotic Index and ratio of scrapers to filtering collectors was higher at the Middle Restoration site than at the Lower Restoration site. However, the ratio of shredders to total individuals collected, and the total EPT to chironomids was higher at the Lower Restoration as compared to the Middle Restoration site.

Although in low abundance, the dominant scrapers were physid snails and the elmid, *Stenelmis* sp., while the dominant filtering collectors were the trichopteran larvae *Cheumatopsyche* sp. and *Chimarra* sp. (Table UTSC 4). Both *Cheumatopsyche* sp. and *Chimerra* sp. were also the dominant EPT macroinvertebrates collected. The number (5) of EPT taxa was the same at both stations. The percent contribution of the dominant taxon was highest (36.2%) at the Lower Restoration Site and lowest (20.5%) at the Middle Restoration site. The dominant taxon collected was *Cheumatopsyche* sp. at both sites.

Table UTSC 4. Data summary of benthic macroinvertebrates collected in D-frame samples on 30 March 2015 at stations in an unnamed tributary to Seneca Creek at Watkins Mill Rd.

Metrics	Riffle Community (RBP III 300 + subsample)	
	Lower Restoration	Middle Restoration
Taxa Richness	18	23
Hilsenhoff Biotic Index	5.2	5.6
Ratio Scrapers to Filtering Collectors (%)	0.01 (0.9%)	0.02 (2.3%)
Ratio Shredders to total Individuals (%)	0.01 (1.1%)	0.01 (0.7%)
Total EPT Individuals to Total Chironomids (%)	5.89 (588.9%)	1.32 (131.7%)5
EPT Index	5	5
Percent Contribution of Dominant Taxon	36.2%	20.5%

Physical Habitat: The UTSC arises from a series of springs on the north side of I-270 adjacent to Quince Orchard Road, and then flows under I-270 through a long culvert. After passing under I-270, the stream is well-shaded until it reaches the treeless power line corridor (~ 113 m in width at stream crossing of corridor). Through the proposed restoration reach, there are mature trees present of several species, as well as significant undergrowth and several exotic species. Numerous trees have fallen into the stream, creating a number of stable pools. In the upper part of the stream reach, there is strong evidence of impervious surface effects with erosion of bed material down to bedrock, as well as deep incisions into bed material throughout the entire restoration reach. There are abundant debris bars, of small stones to moderate cobble, formed in the stream. Numerous pool-riffle zones are present, with many of the larger, deeper pools having fishes present.

Bank slumping was observed in the upper reaches, as well as numerous perched tree roots in many areas, indicating a severing of the riparian zone from the stream. Sections of the stream appeared to have had some past stabilization work, with several rip-rap areas present. In addition, there was also a sewage line running through both the stream reach. The MPHI was 60 for the control area (fair) and 57 for the restoration area (fair).

Assessment Recommendation: The UTSC site should be assessed for one more cycle (2015-2016). After the bridge is finished and all stream restoration work is completed and

stabilized, the site should be visited for two complete FY sample cycles, and then be placed on a revisit schedule of either 5 or 10 years.

SHA Site Water Chemistry

Water Quality (WQ): All five FY 15 sites were sampled for MBSS water quality parameters during the September 2014 and March 2015 SHA field work. In addition, we collected water quality samples from the Little Paint Branch and Muddy Bridge Branch SHA sites (sampled during the Fall and Spring of the SHA FY 14 work) in September 2014 in order to continue to develop a stream water quality database for use in all SHA restoration site evaluations, both pre-construction and post-construction.

Specific conductance and ANC values for several of these SHA sites fell outside of the upper 90th percentile (Table WQ 1). All TN and TP values fell within the 10-90th percentile range, with only one high value (5.7 mg/l) observed for TSS at the Muddy Bridge Branch site. Closed pH was within the 10-90th percentile for all sites, both in the Fall and Spring water quality sampling. ANC was generally elevated at all SHA sites, with the Upper Little Patuxent River and Long Draught Branch being high in both Fall and Spring, with Long Draught Branch having the highest ANC observed of 1713 µeq/L. Although the Plumtree Run site was below the 90th percentile of 1292 µeq/L, the ANC was 1149 µeq/L (Fall) and 934 µeq/L (Spring) – both well elevated over the 50th ANC percentile (610 µeq/L). For the Marbury Drive site, ANC values for both the Fall and Spring sampling were below the 90th percentile (Table WQ 1).

For Long Draught Branch, Plumtree Run, the Upper Little Patuxent River and Watkins Mill (UTSC), specific conductance (457-1564 µS/cm) was elevated in both the Fall and Spring sampling, with the highest value found at Long Draught Branch with a specific conductance over 1500 µS/cm (Table WQ 1). The Marbury Drive site had the lowest specific conductance values (~ 400 µS/cm) in both Fall and Spring sampling. Stream specific conductivity exceeded the 25th percentile (145 µS/cm) for the Northern Piedmont (EPA Level III) ecoregion sites (all SHA sites except for Muddy Bridge Branch and Marbury Drive which fall into EPA Level III Southeastern Plains) by a factor of 3.2-10.8 times (Morgan et al. 2012). Both Muddy Bridge Branch and Marbury Drive exceeded the Southeastern Plains 25th percentile (103 µS/cm) by a factor of approximately 4.0 times.

This elevated stream specific conductivity (and possibly the high ANC values) observed for the SHA restoration sites potentially reflects the urban stream syndrome (Walsh et al. 2005) where there is frequently high stream conductivity due to inputs from road salts (primarily sodium chloride) and many other urban-related sources. In particular, many of these SHA sites are in very close proximity to several major metropolitan road systems (I-270, I-70, I-97, I-495, I-695, I-95, Route 40, Route 144, Route 24 and others) that are excessively salted during ice and snow events. Other contributions to stream conductivity may come from leaking sewage pipes, runoff from impervious surfaces and fertilizers, as well as legacy salt along roads and in groundwater.

Although all TN and TP values fell within the 10-90th percentile range (Table WQ I), several sites exceeded the TN 25th percentile estimates (Morgan et al. 2013) for the Northern Piedmont (1.6 mg/L) and Southeastern Plains (0.33 mg/L) ecoregions of Maryland for both the Fall and Spring sampling. In addition, numerous sites also exceeded the TP 25th percentile estimates (Morgan et al. 2013) for the Northern Piedmont (0.010 mg/L) and Southeastern Plains (0.016 mg/L) ecoregions of Maryland, also for both the Fall and Spring sampling. Indeed, many sites exceeded both the TN and TP values similarly derived using the EPA Y-intercept and 75th percentile estimations (Morgan et al. 2013). These exceedances of the derived TN and TP criteria, based on EPA methodology, may be a major concern for any stream restoration project since eutrophic stream conditions would not be favorable for either stream recovery or recolonization over time (Morgan et al. 2013, Ashton et al. 2014).

For DOC, ortho-phosphate, ammonia, nitrite and nitrate (Table WQ 2), none of the values, except one for ammonia, exceeded the calculated 90th percentile value. There was one exceedance of ammonia (0.1084 mg/L) at Muddy Bridge Branch in September. Nitrate was elevated at several sites, mimicking the TN levels observed at the SHA sites, and possibly a strong signal for urban effects.

Chloride concentrations at the SHA sites exceeded the 10-90th percentile ranges for all September and March sites, except for Muddy Bridge Branch in September 2014 (Table WQ 3). These chloride levels correlate to the specific conductance measurements at these sites (Table WQ 1) as expected since there is a strong relationship between chloride concentration and specific conductance in Maryland non-tidal streams (Morgan et al 2012). For the Northern Piedmont SHA sites, chloride exceeded the derived 25th Cl percentile (17.8 mg/L) by factors ranging from 4.7 to 21.0. For the Southeastern Plains SHA sites, chloride exceeded the derived 25th Cl percentile (10.9 mg/L) by factors ranging from 5.3 to 8.4. In SHA stream restoration sites, these elevated chloride levels illustrate the latent salt effects observed in September and March, presumably from the salting of road systems. These elevated chloride levels have a number of potential biological effects on the SHA restoration sites.

For sulfate, there were no exceedances of the 90th percentile at all SHA sites (Table WQ 3). Bromide values exceeded the 90th percentile at several site/date combinations, with Watkins Mill (UTSC) having the highest bromide, followed by Long Draught Branch in both the Fall and Spring sample periods. Calcium and magnesium concentrations (from many potential urban sources) exceeded the 90th percentile at four of the five sites, with Watkins Mill (UTSC) having the highest values for both calcium (71 mg/L) and magnesium (27 mg/L), while the Marbury Drive site did not exceed the 90th percentiles for either magnesium or calcium (Table WQ 3).

Although elevated at several SHA sites, copper (4.7 µg/L) exceeded the 90th percentile at only Long Draught Branch during the 22 September sampling (Table WQ 3). The same pattern was observed for zinc at Long Draught Branch where the Fall value (36.8 µg/L) exceeded the 90th percentile, and not during the Spring sampling. In contrast, zinc (also many potential urban sources) exceeded the 90th percentile at six of the seven SHA sites for either the Spring or Fall sample (or both), with Muddy Bridge Branch (39.4 µg/L) being double the 90th percentile for zinc (Table WQ 3).

Water Quality Summary: Specific conductance and ANC values for several SHA sites fell outside of the upper 90th percentile for MBSS random site data. ANC was generally elevated at all SHA sites, with Long Draught Branch having the highest ANC observed of 1713 µeq/L as well as the highest specific conductance of over 1500 µS/cm. Stream specific conductivity exceeded the 25th percentile (145 µS/cm) for the Northern Piedmont (EPA Level III) ecoregion sites by a factor of 3.2-10.8 times (Morgan et al. 2012); Muddy Bridge Branch and Marbury Drive (EPA Level III Southeastern Plains) exceeded the Southeastern Plains 25th percentile (103 µS/cm) by a factor of approximately 4.0 times. For the Northern Piedmont SHA sites, chloride exceeded the derived 25th Cl percentile (17.8 mg/L) by factors ranging from 4.7 to 21.0. For the Southeastern Plains SHA sites, chloride exceeded the derived 25th Cl percentile (10.9 mg/L) by factors ranging from 5.3 to 8.4. Elevated stream specific conductivity, ANC and chloride for the SHA restoration sites potentially reflect the urban stream syndrome (Walsh et al. 2005), and are of concern for all past, present and future SHA stream restoration projects.

Several sites SHA exceeded the TN 25th percentile estimates (Morgan et al. 2013) for the Northern Piedmont (1.6 mg/L) and Southeastern Plains (0.33 mg/L) ecoregions of Maryland for both the Fall and Spring sampling. In addition, numerous sites also exceeded the TP 25th percentile estimates (Morgan et al. 2013) for the Northern Piedmont (0.010 mg/L) and Southeastern Plains (0.016 mg/L) ecoregions of Maryland. These exceedances of derived TN and TP criteria may be a major concern for any stream restoration project since eutrophic stream conditions would not be favorable for either stream recovery or biotic recolonization over time (Morgan et al. 2013, Ashton et al. 2014).

Water Quality Recommendations: It is recommended that the MBSS chemistry be continued at all scheduled FY 16 SHA sites for both Fall and Spring site efforts, with the potential to expand the chemical analyses of transportation-linked chemicals in the future if funding allows. Successful stream restoration is dependent on a number of factors, including acceptable water quality.

Table WQ 1. Summary of total nitrogen (TN), total phosphorus (TP), total suspended solids (TSS), specific conductance (SPC), closed pH and acid neutralizing capacity (ANC) parameters for FY 15 SHA stream restoration sites (Bold = outside of 10-90th percentile range; NA = not applicable).

Sample ID/Date	TN (mg/L)	TP (mg/L)	TSS (mg/L)	SPC (µS/cm)	Closed pH (STU)	ANC (µeq/L)
10-90th Percentile Range (MBSS)	*0.29-4.6*	*0.007-0.092*	*NA*	*62-416*	*6.07-7.85*	*71-1292*
Little Paint Branch 9.29.14	0.94	0.0128	0.8	**494.6**	7.67	874.2
Marbury Drive 9.29.14	1.42	0.0060	1.2	397.3	7.58	597.1
Muddy Bridge Branch 9.29.14	0.97	0.0113	5.7	408.8	6.58	**1304.9**
Long Draught Branch 9.22.14	2.01	0.0140	1.7	**1563.6**	7.56	**1712.8**
Plumtree Run 9.22.14	2.35	0.0071	1.9	**840.5**	7.21	1149.3
Upper Little Patuxent 9.22.14	1.83	0.0181	2.9	**457.2**	7.58	**1627.3**
Watkins Mill 9.22.14	1.30	0.0119	1.9	**968.9**	7.82	990.6
Long Draught Branch 3.30.15	1.77	0.0237	2.9	**1298.6**	7.57	1240.9
Marbury Drive 3.30.15	1.43	0.0145	2.9	403.7	7.27	720.4
Watkins Mill 3.30.15	1.96	0.0149	3.0	**1419.4**	7.41	1052.9
Plumtree Run 3.31.15	2.26	0.0143	2.2	**907.3**	7.41	933.6
Upper Little Patuxent 3.31.15	1.68	0.0150	4.0	**516.0**	7.60	**1353.7**

Table WQ 2. Summary of dissolved organic carbon (DOC), orthophosphate (Ortho-PO4), ammonia-N, nitrite-N, and nitrate-N for SHA stream restoration sites (Bold = outside of 10-90th percentile range; NA = not applicable).

Sample ID/Date	DOC (mg/L)	Ortho-PO_4 (mg/L)	Ammonia-N (mg/L)	Nitrite-N (mg/L)	Nitrate-N + Nitrite-N (mg/L)	Nitrate-N (mg/L)
10 - 90th Percentile Range (MBSS)	*1.0-9.0*	*0.0007-0.023*	*0.0033-0.085*	*0.0004-0.016*	*NA*	*0.13-4.6*
Little Paint Branch 9.29.14	2.1	0.0084	0.0103	0.0021	0.82	0.74
Marbury Drive 9.29.14	2.2	0.0025	0.0144	0.0039	1.29	1.20
Muddy Bridge Branch 9.29.14	3.2	0.0018	**0.1084**	0.0044	0.75	0.68
Long Draught Branch 9.22.14	2.0	0.0079	0.0058	0.0098	1.95	1.96
Plumtree Run 9.22.14	1.3	0.0031	0.0062	0.0044	2.34	2.39
Upper Little Patuxent 9.22.14	1.4	0.0085	0.0125	0.0041	1.76	1.81
Watkins Mill 9.22.14	1.5	0.0027	0.0313	0.0111	1.19	1.17
Long Draught Branch 3.30.15	1.4	0.0027	0.0074	0.0095	1.51	1.47
Marbury Drive 3.30.15	2.8	0.0036	0.0381	0.0056	1.20	1.18
Watkins Mill 3.30.15	1.0	0.0022	0.0060	0.0061	1.78	1.73
Plumtree Run 3.31.15	1.4	0.0019	0.0057	0.0071	1.99	1.92
Upper Little Patuxent 3.31.15	1.5	0.0045	0.0134	0.0046	1.50	1.47

Table WQ 3. Summary of chloride, bromide, sulfate, magnesium, calcium, copper and zinc levels for SHA stream restoration sites (Bold = outside of 10-90th percentile range; NA = not applicable).

Sample ID/Date	Chloride (mg/L)	Bromide (mg/L)	Sulfate (mg/L)	Mg (mg/L)	Ca (mg/L)	Cu (µg/L)	Zn (µg/L)
10 - 90th Percentile Range (MBSS)	*3.8-68*	*0.0032-0.062*	*5.5-28*	*1.1-13*	*2.6-40*	*0.40-2.4*	*0.8-19*
Little Paint Branch 9.29.14	**99.0**	**0.071**	7.8	6.1	20.2	1.03	**21.4**
Marbury Drive 9.29.14	**85.6**	0.047	16.7	5.0	16.8	1.16	14.5
Muddy Bridge Branch 9.29.14	58.0	**0.100**	20.2	3.8	9.2	2.15	**39.4**
Long Draught Branch 9.22.14	**348.2**	**0.139**	21.8	**24.6**	**65.2**	**4.74**	**36.8**
Plumtree Run 9.22.14	**182.1**	**0.077**	25.3	**15.8**	**47.3**	1.19	11.9
Upper Little Patuxent 9.22.14	**82.8**	0.008	9.9	8.7	33.6	0.45	5.1
Watkins Mill 9.22.14	**229.2**	**0.088**	13.9	**19.3**	**59.7**	0.78	8.8
Long Draught Branch 3.30.15	**342.6**	**0.134**	15.5	**23.3**	**60.6**	2.2	14.9
Marbury Drive 3.30.15	**92.0**	0.041	17.8	5.5	17.4	1.3	**37.9**
Watkins Mill 3.30.15	**374.2**	**0.175**	17.9	**27.2**	**71.3**	2.0	**20.9**
Plumtree Run 3.31.15	**220.7**	**0.077**	23.7	**17.1**	**46.1**	1.4	**21.6**
Upper Little Patuxent 3.31.15	**113.0**	0.041	12.1	9.6	37.4	0.79	17.1

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APPENDIX A.

Basic benthic invertebrate summary sheets for all SHA restoration sites sampled in 2014-2015 throughout the Maryland Piedmont and Coastal Plain.

LDB 1. Numbers of macroinvertebrates (MBSS 100 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately ~ 1 m^2) at sites in Long Draught Branch on 22 September 2014. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Long Draught Branch Sampling Sites (100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Turbellaria				
Cura sp.	40	29	1	30
Hoplonemertea	4	6	1	4
Annelida				
Oligochaeta				
Lumbriculidae	1		5	2
Naididae	61	46		21
Enchytraeidae		1		
Hirudinae				
Glossiphoniidae			1	
Gastropoda				
Planorbidae	1	1		
Pelecypoda				
Sphaeridae	1	6	1	
Insecta				
Ephemeroptera				
Baetidae			6	5
Odonata				
Coenagrionidae				
Enallagma sp.			1	
Trichoptera				
Hydropsychidae			24	
Cheumatopsyche sp.		1	40	
Symphytopsyche sp.			3	
Philopotomatidae			1	
Chimarra sp.			1	
Coleoptera				
Elmidae				
Stenelmis sp.			1	
Hydrophilidae		1		
Diptera				
Ceratopogonidae				
Atrichopogon sp.	1		1	

LDB 1 (continued).

TAXA	Long Draught Branch Sampling Sites (100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Chironomidae		7	3	5
Tanypodinae			1	2
Thienemannimyia sp.			1	
Orthocladius sp.		2	2	4
Rheocricotopus sp.			2	
Thienemanniella sp.		2	1	2
Chironomini		1		
Micropsectra sp.			1	
Polypedilum sp.			3	
Tanytarsini	2	6	1	5
Dicrotendipes sp.	1		4	
Rheotanytarsus sp.		1		
Empididae				
Chelifera sp.				1
Hemerodromia sp.		1	8	8
Simuliidae		1	3	4
Simulium sp.			7	
Tipulidae				
Tipula sp.				1

LDB 2. Numbers of macroinvertebrates (EPA 300 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately ~ 1 m^2) at sites in Long Draught Branch on 22 September 2014. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	**Long Draught Branch Sampling Sites (300 + subsample)**			
	Alpha Control	**Beta Control**	**Lower Restoration**	**Middle Restoration**
Turbellaria				
Cura sp.	85	78	7	84
Hoplonemertea	8	20	2	10
Nematoda		2		
Annelida				
Oligochaeta				
Lumbriculidae	2	3	6	6
Naididae	165	90	5	73
Entrachidae		1		
Hirudinae				
Glossiphoniidae			1	
Gastropoda				
Ancylidae				
Ferrissia sp.				1
Planorbidae	1		1	
Pelecypoda				
Sphaeriidae	1	14	1	
Insecta				
Collembola				
Isotomidae		1		
Ephemeroptera				
Baetidae		3	22	29
Odonata				
Coenagrionidae				
Enallagma sp.			1	
Trichoptera				
Hydropsychidae		3	75	
Cheumatopsyche sp.		1	80	1
Symphytopsyche sp.			3	
Hydrophilidae				1
Philopotomatidae			1	
Chimarra sp.			1	

LDB 2 (continued).

TAXA	Long Draught Branch Sampling Sites (300 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Coleoptera				
Elmidae				
Stenelmis sp.			1	
Hydrophilidae		1		
Diptera				
Ceratopogonidae				
Atrichopogon sp.	1		1	4
Chironomidae	3	16	9	9
Diamesinae				
Potthastia sp.			1	
Tanypodinae			3	3
Thienemannimyia sp.			1	
Orthocladinae		3	2	5
Corynoneura sp.			1	
Eukiefferiella sp.			2	
Orthocladius sp.		4	6	4
Rheocricotopus sp.			3	
Thienemanniella sp.	1	6	7	5
Chironomini		2	1	1
Polypedilum sp.	2		7	2
Tanytarsini	2	23	10	14
Dicrotendipes sp.	3		9	
Rheotanytarsus sp.		1	1	1
Empididae			2	1
Hemerodromia sp.	2	3	18	15
Chelifera sp.				1
Simuliidae		2	7	8
Simulium sp.	1	3	11	5
Tipulidae				
Tipula sp.				1

LDB 3. Numbers of macroinvertebrates (MBSS 100 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately ~ 1 m^2) at sites in Long Draught Branch on 30 March 2015. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Long Draught Branch Sampling Sites (100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Turbellaria	8		2	5
Nemertea	13	11	1	4
Nematoda		1		
Annelida				
Oligochaeta				
Entrachidae				2
Lumbricidae				
Eiseniella sp.		2		5
Lumbriculidae	8	3		3
Naididae	10	3	2	3
Tubificidae	3	1	2	4
Gastropoda				
Lymnaeidae		1		3
Planorbidae	2			3
Pelecypoda				
Sphaeriidae	2	2		2
Trichoptera				
Hydropsychidae			1	1
Cheumatopsyche sp.			18	4
Hydropsyche sp.			1	
Symphytopsyche sp.			2	
Diptera				
Ceratopogonidae				
Culicoides sp.	1		2	
Dasyhelea sp.				1
Chironomidae		1		2
Tanypodinae				
Orthocladinae	1			2
Orthocladius sp.	17	14	61	37

LDB 3 (continued).

TAXA	Long Draught Branch Sampling Sites (100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Chironomini			1	
Polypedilum sp.				1
Pseudochironomus sp.	2		2	
Tanytarsini			1	
Empididae				
Chelifera sp.			1	1
Hemerodromia sp.	1		5	3
Simuliidae				
Simulium sp.		1		
Tipulidae				
Antocha sp.				1

LDB 4. Numbers of macroinvertebrates (EPA 300 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately ~ 1 m^2) at sites in Long Draught Branch on 30 March 2015. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Long Draught Branch Sampling Sites (300 + subsample)	
	Lower Restoration	**Middle Restoration**
Turbellaria	5	8
Nemertea	5	11
Annelida		
Oligochaeta		
Entrachidae	3	6
Naididae	6	5
Lumbricidae		
Eiseniella sp.		5
Lumbriculidae	9	11
Tubificidae	4	5
Gastropoda		
Lymnaeidae	1	4
Physidae	1	
Planorbidae		4
Pelecypoda		
Sphaeriidae	1	8
Physidae	1	
Insecta		
Trichoptera		
Hydropsychidae	7	2
Cheumatopsyche sp.	60	7
Hydropsyche sp.	3	
Symphytopsyche sp.	9	
Diptera		
Ceratopogonidae		
Culicoides sp.	2	
Dasyhelea sp.		1

LDB 4 (continued).

TAXA	Long Draught Branch Sampling Sites (300 + subsample)	
	Lower Restoration	**Middle Restoration**
Chironomidae	2	5
Diamesinae		
Tanypodinae	1	1
Orthocladinae		2
Orthocladius sp.	188	79
Chironomini	1	
Pseudochironomus sp.	5	2
Tanytarsini	3	
Empididae		
Chelifera sp.	5	1
Hemerodromia sp.	10	5
Tipulidae		
Antocha sp.	4	1

Table MAR 1. Numbers of macroinvertebrates (MBSS 100 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately ~ 1 m^2) at sites on Marbury Drive (UT) on 15 September 2014. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Marbury Drive Sampling Sites (100 + subsample)				
	Alpha Control	**Beta control**	**Lower Restoration**	**Middle Restoration #1**	**Middle Restoration #2**
Turbellaria					
Cura sp.			2		1
Nematoda				1	
Annelida					
Oligochaeta					
Lumbriculidae	7	11	1	2	9
Naididae		8			
Hirudinae					
Glossiphoniidae			4		
Gastropoda					
Ancylidae		1			
Lymnaeidae		1		1	
Physidae			1		1
Insecta					
Ephemeroptera					
Baetidae	11	4	17	4	17
Baetis sp.					1
Heptageniidae					
Odonata			1		
Hydropsychidae	9	11	8	10	10
Cheumatopsyche sp.	1	2	11	8	8
Hydropsyche sp.	13	8	25	12	13
Symphytopsyche sp.	5	7	42	16	
Philopotomatidae					
Chimerra sp.		1	1	1	2
Coleoptera					
Elmidae					
Stenelmis sp.		1	2		
Hydrophilidae					
Enchorus sp.			2		

MAR 1 (continued).

TAXA	Marbury Drive Sampling Sites (100 + subsample)				
	Alpha Control	Beta control	Lower Restoration	Middle Restoration #1	Middle Restoration #2
Diptera					
Ceratopogonidae					
Culicoides sp.					1
Chironomidae	11	6		2	16
Tanypodinae	5	1	2	3	1
Ablabesmyia sp.				2	
Zavrelimyia sp.	1		1		
Thienemannimyia sp.	1	1	1	2	
Orthocladinae		1			6
Corynoneura sp.	1	1			
Eukiefferiella sp.		3			1
Orthocladius sp.	4	1	3	10	21
Parametriocnemus sp.		1			
Rheocricotopus sp.	4	13		5	3
Thienemanniella sp.			1	4	8
Chironomini	4			1	2
Apedilum sp.	1		1	3	1
Crypytochironomus sp.	2	1		3	
Polypedilum sp.	10	6	1	3	3
Pseudochironomus sp.	3	3	1	6	1
Tanytarsini	9	3	1	1	2
Dicrotendipes sp.				9	1
Micropsectra sp.	4			1	1
Rheotanytarsus sp.		2			
Empididae			2		
Chelifera sp.		2			
Hemerodromia sp.	4	5	4	2	1
Simuliidae					
Simulium sp.		3			
Syrphidae					
Chrysogaster sp.			1		
Tipulidae					
Hexatoma sp.		2			
Pseudolimnophila sp.	2				
Tipula sp.	2	6	2	2	2

Table MAR 2. Numbers of macroinvertebrates (EPA 300 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately ~ 1 m^2) at sites on Marbury Drive (UT) on 15 September 2014. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Marbury Drive Sampling Sites (300 + subsample)				
	Alpha Control	**Beta Control**	**Lower Restoration**	**Middle Restoration #1**	**Middle Restoration #2**
Turbellaria					
Cura sp.			2		1
Nematoda				2	
Hoplonemertea		1			
Annelida					
Oligochaeta					
Lumbriculidae	16	16	4	7	25
Naididae	1	12	1		
Hirudinae					
Glossiphoniidae			8		
Gastropoda					
Ancylidae		1			
Lymnaeidae		1		1	
Physidae	3		1	2	2
Insecta					
Ephemeroptera					
Baetidae	26	7	57	17	40
Baetis sp.					1
Odonata			1		
Trichoptera					
Hydropsychidae	27	17	24	33	35
Cheumatopsyche sp.	1	5	20	23	35
Hydropsyche sp.	21	10	51	59	30
Symphytopsyche sp.	17	10	85	42	14
Philopotomatidae	1	1			
Chimerra sp.		1	1	3	2
Coleoptera					
Elmidae					
Stenelmis sp.		1	2		
Hydrophilidae					
Enchorus sp.			2		

MAR 2 (continued).

TAXA	Marbury Drive Sampling Sites (300 + subsample)				
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration #1	Middle Restoration #2
Diptera					
Ceratopogonidae					
Atrichopogon sp.	2				
Culicoides sp.					1
Chironomidae	20	13		15	37
Tanypodinae	10	2	3	5	5
Ablabesmyia sp.				2	
Larisa sp.				2	
Zavrelimyia sp.	2	1	1		1
Thienemannimyia sp.	3	1	4	4	3
Orthocladinae	7	4			7
Brillia sp.		1			
Corynoneura sp.	16	2			8
Eukiefferiella sp.	6	3		2	1
Orthocladius sp.	41	1	2	45	88
Paracladopelma sp.	3				
Parametriocnemus sp.		1			
Rheocricotopus sp.	10	18		10	11
Thienemanniella sp.	9		1	14	16
Chironomini	13	1		1	6
Apedilum sp.	1		1	9	1
Crypytochironomus sp.	11	1		12	
Phaenopsectra sp.					2
Polypedilum sp.	26	8	5	6	10
Pseudochironomus sp.	12	3	1	17	
Tanytarsini	16	5	5	6	11
Dicrotendipes sp.				21	4
Micropsectra sp.	18		2	3	1
Paratendipes sp.					3
Rheotanytarsus sp.		2			1
Tanytarsus sp.				1	5
Empididae	1		2		
Chelifera sp.		2			1
Hemerodromia sp.	12	7	15	8	6

MAR 2 (continued).

TAXA	Marbury Drive Sampling Sites (300 + subsample)				
	Alpha Control	**Beta Control**	**Lower Restoration**	**Middle Restoration #1**	**Middle Restoration #2**
Simuliidae	1	2			
Simulium sp.	1	5			
Syrphidae					
Chrysogaster sp.			1		
Tipulidae					
Antocha sp.					
Hexatoma sp.		2			
Pseudolimnophila sp.	4				
Tipula sp.	8	6	5	8	6

Table MAR 3. Numbers of macroinvertebrates (MBSS 100 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately ~ 1 m^2) at sites on Marbury Drive (UT) on 30 March 2015. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Marbury Drive Site Sampling Stations (MBSS 100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Turbellaria			1	
Nematoda	2		2	
Hoplonemertea	3			1
Annelida				
Oligochaeta				
Enchytraeidae		2		7
Naididae		2	3	1
Lumbricidae				
Eiseniella sp.	1	1	1	1
Lumbriculidae	7	3		
Tubificidae	1		13	6
Gastropoda				
Lymnaeidae				3
Physidae				2
Insecta				
Odonata				
Coenagrionidae				
Argia sp.			1	
Trichoptera				
Hydropsychidae		1	6	3
Cheumatopsyche sp.	1		4	3
Hydropsyche sp.	29	4	25	13
Symphytopsyche sp.	1		1	4
Diptera				
Chironomidae	8	3		10
Tanypodinae		1	1	1
Thienemannimyia grp.		2		
Orthocladinae	1	2		2
Eukiefferiella sp.		1		
Limnophyes sp.			4	
Orthocladius sp.	23	12	31	19
Smittia sp.				1

MAR 3 (continued).

TAXA	Marbury Drive Site Sampling Stations (MBSS 100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Chironomini	5	5		1
Crypytochironomus sp.		2		
Dicrotendipes sp.	1	1	1	5
Polypedilum sp.	3	3	2	2
Pseudochironomus sp.	2	2	1	3
Tanytarsini	1			
Empididae	1			
Chelifera sp.	1			1
Hemerodromia sp.	10	4	5	3
Tipulidae				
Antocha sp.		1		
Tipula sp.	7	6	3	5

Table MAR 4. Numbers of macroinvertebrates (EPA 300 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately ~ 1 m^2) at sites on Marbury Drive (UT) on 30 March 2015. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Marbury Drive Site Sampling Stations (300 + subsample)	
	Lower Restoration	Middle Restoration
Turbellaria	1	
Nematoda	2	
Hoplonemerta		2
Annelida		
Oligochaeta		
Enchytraeidae		11
Lumbricidae		
Eiseniella sp.	1	2
Lumbriculidae	5	
Naididae	3	3
Tubificidae	19	11
Gastropoda		
Lymnaeidae	1	6
Physidae		4
Insecta		
Odonata		
Coenagrionidae		
Argia sp.	1	1
Trichoptera		
Hydropsychidae	8	12
Cheumatopsyche sp.	6	3
Hydropsyche sp.	42	23
Symphytopsyche sp.	4	6
Diptera		
Chironomidae	3	10
Tanypodinae	1	2
Thienemannimyia grp.		2
Orthocladinae	1	5
Limnophyes sp.	4	
Orthocladius sp.	41	53
Smittia sp.		1

MAR 4 (continued).

TAXA	Marbury Drive Site Sampling Stations (300 + subsample)	
	Lower Restoration	**Middle Restoration**
Chironomini		
Crypytochironomus sp.		1
Dicrotendipes sp.	1	8
Polypedilum sp.	4	6
Pseudochironomus sp.	1	6
Empididae		
Chelifera sp.		4
Hemerodromia sp.	5	9
Tipulidae		
Tipula sp.	3	8

Table PTR 1. Numbers of macroinvertebrates (MBSS 100 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately 1 m^2) at sites in Plumtree Run on 22 September 2014. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Plumtree Run Sampling Sites (100 + subsample)					
	Alpha Control	Beta Control	Gamma Control	Delta Control	Lower Restoration	Middle Restoration
Turbellaria						
Cura sp.	1					1
Nematoda						
Annelida						
Oligochaeta						
Lumbriculidae		1		1		
Naididae						
Entrachidae		1				
Tubificidae						
Gastropoda						
Physidae						1
Crustacea						
Amphipoda					1	
Crangonyctidae						8
Synurella sp.				1		
Isopoda					1	
Aesilidae						
Caecidotea sp.		1				1
Decapoda						
Cambridae						
Orconectes sp.		1	1			
Insecta						
Ephemeroptera						
Baetidae	2	2	15	3	10	4
Acentrella sp.					1	
Baetis sp.		1	2			
Hemiptera						
Gerridae						
Trepobates sp.		1				

PTR 1 (continued).

TAXA	Plumtree Run Sampling Sites (100 + subsample)					
	Alpha Control	Beta Control	Gamma Control	Delta Control	Lower Restoration	Middle Restoration
Trichoptera						
Hydropsychidae	7	9	4	7	8	9
Cheumatopsyche sp.	29	4	8	10	23	24
Hydropsyche sp.	7	3	3	6	10	14
Symphytopsyche sp.	3	3	14	9	14	7
Philopotomatidae	5	2	4	3	1	5
Chimerra sp.	35	29	57	58	40	24
Coleoptera						
Elmidae						
Oulimnius sp.						
Stenelmis sp.	10		1	2	3	1
Psephenidae						
Psephenus sp.	4		1		1	
Diptera						
Culicoides sp.						
Chironomidae	1	4	5	2		1
Tanypodinae	1	1				
Thienemannimyia sp.		1	1		1	3
Larsia sp.				1		
Orthocladinae					1	
Corynoneura sp.		5			1	
Eukiefferiella sp.	2		1	1		2
Orthocladius sp.	3		2		1	6
Parametriocnemus sp.		1		1	1	
Rheocricotopus sp.	1				1	
Thienemanniella sp.	2	2				1
Tvetenia sp.				1		
Chironomini		4	5	4	1	
Crypytochironomus sp.						1
Dicrotendipes sp.						
Polypedilum sp.		2	3		1	2
Pseudochironomus sp.		5	1		1	

PTR 1 (continued).

TAXA	Plumtree Run Sampling Sites (100 + subsample)					
	Alpha Control	**Beta Control**	**Gamma Control**	**Delta Control**	**Lower Restoration**	**Middle Restoration**
Tanytarsini	1				1	2
Micropsectra sp.						1
Rheotanytarsus sp.	1					
Empididae						
Chelifera sp.						1
Clinocera sp.		2	1			
Hemerodromia sp.						
Simuliidae		2				
Simulium sp.	3	2	15		1	
Tipulidae						
Antocha sp.	2					1
Hexatoma sp.		5				
Tipula sp.						1

Table PTR 2. Numbers of macroinvertebrates (EPA 300 organism sample) collected in benthic samples by combining 9 D-frame aquatic net samplings (total sampling area approximately 1 m^2) at sites in Plumtree Run on 22 September 2014. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Plumtree Run Sampling Sites (300 + subsample)					
	Alpha Control	Beta Control	Gamma Control	Delta Control	Lower Restoration	Middle Restoration
Turbellaria						
Cura sp.	1			3		7
Nematoda						
Annelida						
Oligochaeta						
Lumbriculidae		2		1		
Naididae		2				3
Entrachidae		2				
Tubificidae					1	
Gastropoda						
Ancylidae						
Ferrissia sp.				1		
Physidae						1
Crustacea						
Amphipoda	1	1	1		2	
Crangonyctidae					1	16
Synurella sp.		2		2		
Isopoda					1	
Aesilidae						
Caecidotea sp.		1			1	3
Decapoda						
Cambridae						
Orconectes sp.		1	1			
Insecta						
Collembola						
Isotomidae						
Semicerura sp.		1				
Ephemeroptera						
Baetidae	13	15	56	14	21	20
Acentrella sp.			2		1	
Baetis sp.	1	1	7			2

PTR 2 (continued).

TAXA	Plumtree Run Sampling Sites (300 + subsample)					
	Alpha Control	Beta Control	Gamma Control	Delta Control	Lower Restoration	Middle Restoration
Odonata						
Aeshnidae	1					
Calyopterygidae						
Calyopteryx sp.		1				
Hemiptera						
Gerridae						
Trepobates sp.		1				
Veliidae						
Microvelia sp.			3			
Rhagovelia sp.			1	1		
Trichoptera						
Hydropsychidae	24	23	41	27	47	47
Cheumatopsyche sp.	72	23	32	32	71	64
Hydropsyche sp.	35	12	12	24	24	25
Symphytopsyche sp.	14	10	37	44	42	27
Hydrophilidae						
Hydroptila sp.						1
Philopotomatidae	14	10	10	10	15	7
Chimerra sp.	127	93	151	187	105	61
Psychomyidae						1
Psychomyia sp.	1		1			
Coleoptera						
Elmidae				1		
Oulimnius sp.						
Stenelmis sp.	33	3	4	9	9	4
Psephenidae						
Psephenus sp.	10		15	1	2	1
Diptera						
Ceratopogonidae						1
Atrichopogon sp.	1					1
Culicoides sp.						

PTR 2 (continued).

TAXA	Plumtree Run Sampling Sites (300 + subsample)					
	Alpha Control	Beta Control	Gamma Control	Delta Control	Lower Restoration	Middle Restoration
Chironomidae	8	9	13	6	2	7
Tanypodinae	1	4	1		1	2
Thienemannimyia sp.		3	3		1	8
Larsia sp.				1		
Orthocladinae	1	1		2	6	2
Brillia sp.						
Corynoneura sp.		9	4		8	1
Eukiefferiella sp.	13	13	2	1	1	4
Orthocladius sp.	16	4	5		2	8
Parametriocnemus sp.	8	7	2	2	3	4
Rheocricotopus sp.	1	4	1		2	
Thienemanniella sp.	6	15	3		2	3
Tvetenia sp.				1		
Xylotopus sp.		1				
Chironomini	3	7	8	7	1	2
Apedilum sp.						1
Crypytochironomus sp.						3
Dicrotendipes sp.						
Polypedilum sp.	3	8	5	6	6	6
Pseudochironomus sp.		11	9	2	1	1
Tanytarsini		4	11	5	1	4
Micropsectra sp.		2				1
Rheotanytarsus sp.	4	1				
Empididae						1
Chelifera sp.	2				1	1
Clinocera sp.	1	6	2	2		
Hemerodromia sp.					2	
Simuliidae		4	6	4	2	1
Simulium sp.	11	5	39	3	9	1
Tipulidae		1	1			
Antocha sp.	9		3	1		2
Hexatoma sp.	4	14				
Limonia sp.			1			
Tipula sp.		1	1			3

Table PTR 3. Numbers of macroinvertebrates (MBSS 100 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately 1 m^2) at sites in Plumtree Run on 31 March 2015. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Plumtree Run Sampling Sites (100+ subsample)					
	Alpha Control	Beta Control	Gamma Control	Delta Control	Lower Restoration	Middle Restoration
Turbellaria						1
Hoplonemertea					1	
Annelida						
Oligochaeta						
Entrachidae		2				
Lumbricidae						
Eiseniella sp.		3				
Lumbriculidae		1				
Naididae		1				2
Tubificidae		2				
Crustaceae						
Isopoda						
Aesilidae						1
Insecta						
Trichoptera						
Hydropsychidae		1			1	1
Cheumatopsyche sp.	3		8	2	8	4
Hydropsyche sp.	5			1	2	3
Symphytopsyche sp.		2			3	2
Philopotomatidae						
Chimarra sp.	4	2	4		9	6
Coleoptera						
Elmidae					1	
Stenelmis sp.	4	1	1			
Psephenidae						
Psephenus sp.	1					
Diptera						
Chironomidae	2	6	4	2	3	3
Diamesinae						
Diamesa sp.	3		3	3	3	

PTR 3 (continued).

TAXA	Plumtree Run Sampling Sites (100+ subsample)					
	Alpha Control	Beta Control	Gamma Control	Delta Control	Lower Restoration	Middle Restoration
Tanypodinae		1				1
Thienemannimyia grp.						1
Orthocladinae		5	4			1
Eukiefferiella sp.	4	8			4	5
Orthocladius sp.	65	50	66	82	61	63
Parametriocnemus sp.	4	2				
Chironomini	1		3		1	5
Apedilum sp.					3	
Crypytochironomus sp.						1
Polypedilum sp.		1			1	1
Pseudochironomus sp.	1	1	2	2	1	1
Tanytarsini	1	2	1		3	3
Micropsectra sp.					1	
Empididae						
Chelifera sp.	1	2	1			
Clinocera sp.						
Hemerodromia sp.			1	1		2
Tipulidae						
Antocha sp.	9	4	4	3		2

Table PTR 4. Numbers of macroinvertebrates (EPA 300 organism sample) collected in benthic samples by combining 9 D-frame aquatic net samplings (total sampling area approximately 1 m^2) at sites in Plumtree Run on 31 March 2015. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Plumtree Run Sampling Sites (RBP III 300+ subsample)					
	Alpha Control	Beta Control	Gamma Control	Delta Control	Lower Restoration	Middle Restoration
Turbellaria	1					1
Hoplonemertea		1			2	1
Annelida						
Oligochaeta						
Entrachidae	2	3				
Lumbricidae						
Eiseniella sp.		8		1		
Lumbriculidae		1				
Naididae		1				2
Tubificidae		6				1
Gastropoda						
Physidae		1				
Crustacea						
Isopoda						
Aesilidae						1
Caecidotea sp.			2			
Insecta						
Trichoptera						
Hydropsychidae	2	1	2		3	6
Cheumatopsyche sp.	4	3	20	3	12	17
Hydropsyche sp.	8	3		2	5	5
Symphytopsyche sp.	2	2	4		9	5
Hydrophilidae						
Leucotrichia sp.			1			
Philopotomatidae					1	
Chimarra sp.	11	5	9	2	24	20
Psychomyidae						
Psychomyia sp.	2				1	1

PTR 3 (continued).

TAXA	Plumtree Run Sampling Sites (RBP III 300 + subsample)					
	Alpha Control	Beta Control	Gamma Control	Delta Control	Lower Restoration	Middle Restoration
Coleoptera						
Elmidae					1	
Stenelmis sp.	7	4	2			1
Psephenidae						
Psephenus sp.	1				1	
Diptera						
Chironomidae	5	11	15	8	12	7
Diamesinae						
Diamesa sp.	13		14	6	4	2
Tanypodinae	1	1	1		2	1
Thienemannimyia grp.	1	1			3	2
Orthocladinae	3	9	7	1		2
Brillia sp.					1	
Eukiefferiella sp.	4	8	2		4	14
Orthocladius sp.	234	141	231	244	186	184
Parametriocnemus sp.	4	9		5		4
Thienemanniella sp.		1			1	
Chironomini	1		6		2	8
Apedilum sp.					10	3
Crypytochironomus sp.		1	1		1	2
Pseudochironomus sp.	2	8	3	8	7	12
Tanytarsini	6	9	8	2	5	9
Micropsectra sp.					1	1
Empididae						
Chelifera sp.	2	3	2		1	
Clinocera sp.			1	1		
Hemerodromia sp.	1	1	2	3		
Simuliidae						
Simulium sp.					1	
Tipulidae						
Antocha sp.	16	5	6	5	5	8
Tipula sp.					1	

Table ULPR 1. Numbers of macroinvertebrates (MBSS 100 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately 1 m^2) at sites on the Upper Little Patuxent River on 22 September 2014. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Upper Little Patuxent River Sites (100+ subsample)			
	Alpha Control	**Beta Control**	**Lower Restoration**	**Middle Restoration**
Turbellaria				
Cura sp.				2
Nematoda		1		1
Hoplonemertea	2			
Annelida				
Oligochaeta				
Lumbriculidae				2
Naididae		2		1
Tubificidae			1	
Pelecypoda				
Sphaeriidae	2	2	7	3
Insecta				
Ephemeroptera				
Baetidae	5	3	16	12
Baetis sp.	3			3
Heptageniidae	1			
Odonata				
Aeshnidae				
Boyeria sp.	1			
Hemiptera				
Veliidae				
Rhagovelia sp.		3		1
Megaloptera				
Corydalidae				
Nigronia sp.	1	4		1
Trichoptera				
Glossosomatidae				
Glossosoma sp.			1	2
Hydropsychidae	20	3	9	8
Cheumatopsyche sp.	24	11	4	16
Hydropsyche sp.	17	4	1	1
Symphytopsyche sp.	14	20	5	11

ULPR 1 (continued).

TAXA	Upper Little Patuxent Sites (100+ subsample)			
	Alpha Control	**Beta Control**	**Lower Restoration**	**Middle Restoration**
Hydrophilidae				
Hydroptila sp.			1	
Philopotomatidae	2			
Chimerra sp.	15	28		4
Coleoptera				
Elmidae				
Optioservus sp.		2		
Stenelmis sp.	1	6		
Diptera				
Chironomidae	1		7	2
Tanypodinae	1			
Nilotanypus sp.				1
Thienemannimyia sp.	2	2		
Orthocladinae	1		2	
Corynoneura sp.			1	1
Eukiefferiella sp.	1			1
Orthocladius sp.			2	2
Parametriocnemus sp.				1
Rheocricotopus sp.		1		
Thienemanniella sp.			1	5
Chironomini	1		4	
Apedilum sp.			3	
Polypedilum sp.	4	2	20	4
Tanytarsini	8	5	9	8
Micropsectra sp.		2		1
Rheotanytarsus sp.	2			
Chelifera sp.				
Hemerodromia sp.			1	
Simuliidae	5	1		2
Simulium sp.	1	1		
Tipulidae				
Antocha sp.	3			1
Hexatoma sp.			1	
Tipula sp.			1	

Table ULPR 2. Numbers of macroinvertebrates (EPA 300 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately 1 m^2) at sites on the Upper Little Patuxent River on 22 September 2014. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Upper Little Patuxent River Sampling Sites (300 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Turbellaria				
Cura sp.	1		1	2
Nematoda		1		1
Hoplonemertea	3	5		
Annelida				
Oligochaeta				
Lumbriculidae				2
Naididae		2		1
Tubificidae			2	1
Pelecypoda				
Sphaeriidae	3	2	14	3
Insecta				
Ephemeroptera				
Baetidae	13	12	53	56
Baetis sp.	7			3
Heptageniidae	1	1		
Odonata				
Aeshnidae				
Boyeria sp.	1			
Calyopterygidae				
Calopteryx sp.		1		
Gomphidae				1
Hemiptera				
Veliidae				
Microvelia sp.			3	
Rhagovelia sp.	3	6		1
Megaloptera				
Corydalidae				
Nigronia sp.	3	6		1

ULPR 2 (continued).

TAXA	Upper Little Patuxent River Sampling Sites (300 + subsample)			
	Alpha Control	**Beta Control**	**Lower Restoration**	**Middle Restoration**
Trichoptera				
Glossosomatidae				
Glossosoma sp.	1	1	1	2
Hydropsychidae	75	12	30	21
Cheumatopsyche sp.	52	41	17	36
Hydropsyche sp.	23		2	4
Symphytopsyche sp.	41	47	23	37
Hydrophilidae		29		
Hydroptila sp.			1	
Leucotrichia sp.				
Philopotomatidae	9	3		3
Chimerra sp.	31	75	2	14
Coleoptera				
Elmidae				
Macronychus sp.	1			
Optioservus sp.		2		
Stenelmis sp.	4	14	2	1
Diptera				
Chironomidae	7	1	15	10
Tanypodinae	1			
Nilotanypus sp.				1
Thienemannimyia sp.	2	2	1	2
Orthocladinae	4		3	3
Corynoneura sp.			3	2
Eukiefferiella sp.	5	4	1	2
Orthocladius sp.			6	5
Parametriocnemus sp.				2
Rheocricotopus sp.		1		3
Thienemanniella sp.	1		5	10

ULPR 2 (continued).

TAXA	Upper Little Patuxent River Sampling Sites (300 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Chironomini	2		5	1
Apedilum sp.			8	
Crypytochironomus sp.			15	1
Phaenopsectra sp.			1	
Polypedilum sp.	10	5	49	15
Pseudochironomus sp.			27	
Tanytarsini	18	16	15	
Dicrotendipes sp.				1
Micropsectra sp.	2	4		3
Rheotanytarsus sp.	4	1		3
Empididae				3
Chelifera sp.				1
Hemerodromia sp.			2	6
Simuliidae	6	1		4
Simulium sp.	4	2		3
Tipulidae	1			
Antocha sp.	5	3	1	3
Hexatoma sp.			1	
Tipula sp.			3	

Table ULPR 3. Numbers of macroinvertebrates (MBSS 100 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately 1 m^2) at sites on the Upper Little Patuxent River on 31 March 2015. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Upper Little Patuxent Sampling Sites (MBSS 100 + subsample)			
	Alpha Control	Beta control	Lower Restoration	Middle Restoration
Nematoda			1	
Annelida				
Oligochaeta				
Tubificidae				4
Insecta				
Ephemeroptera				
Heptageniidae				
Stenonema sp.		1		
Trichoptera				
Hydropsychidae	4			
Cheumatopsyche sp.	32	11	4	
Hydropsyche sp.	7			
Symphytopsyche sp.	21		1	
Philopotomatidae				
Chimarra sp.	17	4	2	
Coleoptera				
Elmidae				
Optioservus sp.				1
Stenelmis sp.			1	
Diptera				
Chironomidae	2		9	3
Diamesinae				
Diamesa sp.		1		
Tanypodinae		1		
Thienemannimyia grp.	1			
Orthocladinae	2	2		
Corynoneura sp.	1			
Eukiefferiella sp.	1	1		
Orthocladius sp.	13	76	68	71
Parametriocnemus sp.				
Psectrocladius sp.		4		
Thienemanniella sp.			5	

ULPR 3 (continued).

TAXA	Upper Little Patuxent Sampling Sites (MBSS 100+ subsample)			
	Alpha Control	**Beta control**	**Lower Restoration**	**Middle Restoration**
Chironomini	1		3	6
Apedilum sp.		2	2	2
Crypytochironomus sp.				1
Polypedilum sp.	1		6	5
Pseudochironomus sp.			2	
Tanytarsini			2	
Dicrotendipes sp.			2	1
Micropsectra sp.				
Rheotanytarsus sp.	1			1
Chelifera sp.	1		3	
Clinocera sp.			2	2
Hemerodromia sp.			1	
Simuliidae				
Prosimulium sp.			1	
Tipulidae				
Antocha sp.	4			1
Dicranota sp.				1

Table ULPR 4. Numbers of macroinvertebrates (EPA RBP III 300 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately 1 m^2) at sites on the Upper Little Patuxent River on 31 March 2015. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Upper Little Patuxent River Sampling Sites (300 + subsample)		
	Alpha Control	Beta control	Lower Restoration
Nematoda			1
Annelida			
Oligochaeta			
Lumbricidae			
Eiseniella sp.		1	
Naididae		3	
Tubificidae			
Gastropoda			
Ancylidae		2	
Pelecypoda			
Sphaeriidae	4	2	
Crustacea			
Cambridae			
Orconectes sp.		1	
Insecta			
Ephemeroptera			
Heptageniidae			
Stenonema sp.		1	1
Aeshnidae			
Aeshna sp.		2	
Megaloptera			
Corydalidae			
Nigronia sp.	1	1	
Trichoptera			
Glossosomatidae			
Glossosoma sp.			1
Hydropsychidae	18	4	1
Cheumatopsyche sp.	110	24	9
Hydropsyche sp.	30	2	1
Symphytopsyche sp.	62	6	7

ULPR 4 (continued).

TAXA	Upper Little Patuxent River Sampling Sites (300 + subsample)		
	Alpha Control	Beta control	Lower Restoration
Philopotomatidae			
Chimarra sp.	61	12	6
Polycentropidae			
Polycentropus sp.			1
Coleoptera			
Elmidae			
Promoresia sp.			1
Stenelmis sp.	1	2	4
Diptera			
Ceratopogonidae			
Culicoides sp.		1	
Chironomidae	7	13	17
Diamesinae			
Diamesa sp.	4	3	12
Tanypodinae		1	1
Potthastia sp.		1	
Thienemannimyia grp.	1	1	1
Orthocladinae	2	3	2
Brillia sp.			5
Corynoneura sp.	1		
Eukiefferiella sp.	1	6	
Orthocladius sp.	57	232	213
Parametriocnemus sp.			
Psectrocladius sp.		4	
Thienemanniella sp.		1	14
Chironomini	1	1	6
Apedilum sp.	1	2	4
Crypytochironomus sp.		1	
Polypedilum sp.	6	2	13
Pseudochironomus sp.	1	4	7
Tanytarsini	2	2	5
Dicrotendipes sp.		2	4
Micropsectra sp.			1
Rheotanytarsus sp.	1		

ULPR 4 (continued).

TAXA	Upper Little Patuxent River Sampling Sites (300 + subsample)		
	Alpha Control	Beta control	Lower Restoration
Empididae			
Chelifera sp.	2	3	7
Clinocera sp.		4	8
Hemerodromia sp.	2	1	3
Simuliidae			
Prosimulium sp.			1
Tipulidae			
Antocha sp.	17	6	
Dicranota sp.			1
Tipula sp.			2

Table UTSC 1. Numbers of macroinvertebrates (MBSS 100 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately 1 m^2) at sites on an unnamed tributary to Seneca Creek (Watkins Mill Road) on 22 September 2014. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	UTSC Sites (MBSS 100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Turbellaria				
Cura sp.	1		1	
Nemertea				2
Annelida				
Oligochaeta				
Lumbriculidae	28	10	7	16
Entrachidae	3			
Hirudinae				
Glossiphoniidae		1		
Gastropoda				
Physidae		3		
Insecta				
Ephemeroptera				
Baetidae	1		6	3
Hemiptera				
Mesoveliidae				
Mesovelia sp.	1			
Trichoptera				
Hydropsychidae	7	8	4	8
Cheumatopsyche sp.	20	29	11	21
Hydropsyche sp.		4	7	2
Symphytopsyche sp.	3	1		3
Philopotomatidae	4		3	2
Chimarra sp.	3	2	50	28
Coleoptera				
Elmidae				
Stenelmis sp.			4	
Diptera				
Chironomidae		2	1	1

UTSC 1 (continued).

TAXA	UTSC Sites (MBSS 100 + subsample)			
	Alpha Control	**Beta Control**	**Lower Restoration**	**Middle Restoration**
Tanypodinae	1	6		
Thienemannimyia sp.	12	9	1	3
Zavrelimyia sp.	2			
Orthocladinae			1	
Thienemanniella sp.				
Chironomini			1	
Chironomus sp.	1			
Pseudochironomus sp.			1	1
Polypedilum sp.	1	5	4	3
Tanytarsini				
Micropsectra sp.			1	
Empididae				
Hemerodromia sp.	1	5		
Simuliidae	1			1
Simulium sp.	5	13	2	2
Tipulidae				
Pseudolimnophila sp.		1		
Tipula sp.	1	1	1	

Table UTSC 2. Numbers of macroinvertebrates (RBP III 300 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately 1 m^2) at sites on an unnamed tributary to Seneca Creek (Watkins Mill Road) on 22 September 2014. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Watkins Mill Sampling Sites (300 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Turbellaria				
Cura sp.	2		1	1
Nemertea	4		4	6
Annelida				
Oligochaeta				2
Lumbriculidae	52	25	24	30
Naididae		1		
Tubificidae	1	1		
Entrachidae	3			
Hirudinae				
Glossiphoniidae		1		
Gastropoda				
Physidae	5	12		
Planorbidae				
Insecta				
Ephemeroptera				
Baetidae	2		28	8
Baetis sp.			1	2
Odonata				
Coenagrionidae		1		
Ischnura sp.		1		
Hemiptera				
Mesoveliidae				
Mesovelia sp.	1			
Trichoptera				
Hydropsychidae	18	16	10	23
Cheumatopsyche sp.	61	91	25	74
Hydropsyche sp.	1	10	12	4
Symphytopsyche sp.	9	7	4	3
Hydrophilidae		2		
Hydroptila sp.		1		
Philopotomatidae	9	1	15	18
Chimarra sp.	8	2	123	114

UTSC 2 (continued).

TAXA	Watkins Mill Sampling Sites (300 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Coleoptera				
Elmidae				
Stenelmis sp.			9	
Diptera				
Ceratopogonidae				
Atrichopogon sp.			1	
Chironomidae		5	5	2
Tanypodinae	3	11	1	2
Thienemannimyia sp.	38	18	6	7
Zavrelimyia sp.		1		
Orthocladinae	1	1	1	
Corynoneura sp.				2
Eukiefferiella sp.		1		2
Orthocladius sp.	1	2		
Paracladopelma sp.		1		
Rheocricotopus sp.				1
Thienemanniella sp.	1		6	3
Chironomini			1	
Chironomus sp.	1			
Pseudochironomus sp.	3	1	5	13
Polypedilum sp.	17	11	9	11
Tanytarsini			1	
Micropsectra sp.			2	
Rheotanytarsus sp.			1	1
Culicidae		1		
Empididae				
Chelifera sp.	2	1		1
Clinocera sp.				2
Hemerodromia	3	12		4
Simuliidae	1	1	1	2
Simulium sp.	13	22	9	12
Tipulidae				
Pseudolimnophila sp.	2	2		
Tipula sp.	5	4	1	

Table UTSC 3. Numbers of macroinvertebrates (MBSS 100 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately 1 m^2) at sites on an unnamed tributary to Seneca Creek (Watkins Mill Road) on 30 March 2015. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Watkins Mill Sampling Sites (MBSS 100 + subsample)			
	Alpha Control	Beta Control	Lower Restoration	Middle Restoration
Turbellaria				1
Annelida				
Oligochaeta				
Entrachidae		6		1
Lumbricidae				
Eiseniella sp.				1
Lumbriculidae		2	2	3
Naididae			3	1
Tubificidae	1	1	1	
Insecta				
Trichoptera				
Hydropsychidae		2	2	4
Cheumatopsyche sp.	36	26	31	24
Diplectrona sp.			1	
Hydropsyche sp.	4	4	6	4
Symphytopsyche sp.	1		4	3
Philopotomatidae				
Chimarra sp.	1		22	10
Diptera				
Chironomidae	1	1	2	2
Tanypodinae		9	2	3
Thienemannimyia grp.	30	8	4	4
Orthocladinae	2			1
Orthocladius sp.	25	16	16	24
Eukiefferiella sp.			2	3
Parametriocnemus sp.				2
Chironomini				1
Pseudochironomus sp.		1	1	1
Polypedilum sp.				1
Tanytarsini				1
Empididae				
Chelifera sp.	3	2	1	1
Hemerodromia sp.	6	1	2	7

UTSC 3 (continued).

TAXA	Watkins Mill Sampling Sites (MBSS 100 + subsample)			
	Alpha Control	**Beta Control**	**Lower Restoration**	**Middle Restoration**
Simuliidae				
Simulium sp.				
Tipulidae				
Tipula sp.	5		2	

Table UTSC 4. Numbers of macroinvertebrates (EPA RBP III 300 organism sample) collected in benthic samples by combining 9-15 D-frame aquatic net samplings (total sampling area approximately 1 m^2) at sites on an unnamed tributary to Seneca Creek (Watkins Mill Road) on 30 March 2015. Insect quantities represent numbers of larvae or nymphs unless designated otherwise by a P for pupa or A for adult.

TAXA	Watkins Mill Sampling Sites (300 + subsample)	
	Lower Restoration	**Middle Restoration**
Turbellaria		1
Annelida		
Oligochaeta		
Entrachidae	1	1
Lumbricidae		
Eiseniella sp.		2
Lumbriculidae	4	5
Naididae	3	6
Tubificidae	2	
Gastropoda		
Physidae		1
Crustacea		
Procambarus/Orconectes sp.		1
Insecta		
Megaloptera		
Corydalidae		
Corydalis sp.		1
Trichoptera		
Hydropsychidae	10	8
Cheumatopsyche sp.	101	56
Diplectrona sp.	3	1
Hydropsyche sp.	23	17
Symphytopsyche sp.	14	10
Philopotomatidae	1	
Chimarra sp.	60	41
Coleoptera		
Elmidae		
Stenelmis sp.	2	2
Diptera		
Chironomidae	4	5
Tanypodinae	3	9
Thienemannimyia grp.	9	7

UTSC 4 (continued).

TAXA	Watkins Mill Sampling Sites (300 + subsample)	
	Lower Restoration	Middle Restoration
Orthocladinae		4
Corynoneura sp.		
Eukiefferiella sp.	2	7
Orthocladius sp.	16	53
Parametriocnemus sp.		6
Chironomini		1
Pseudochironomus sp.	2	7
Polypedilum sp.		1
Tanytarsini		1
Empididae		
Chelifera sp.	5	6
Hemerodromia sp.	9	13
Simuliidae		
Simulium sp.	2	
Tipulidae		
Tipula sp.	3	