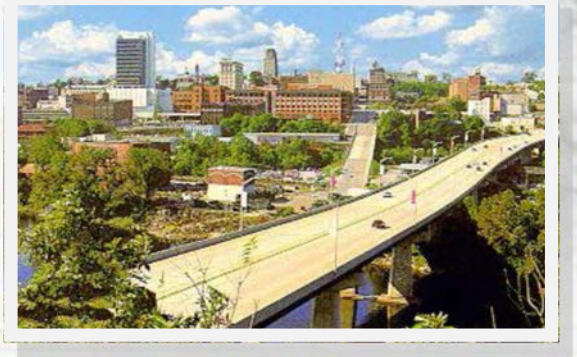
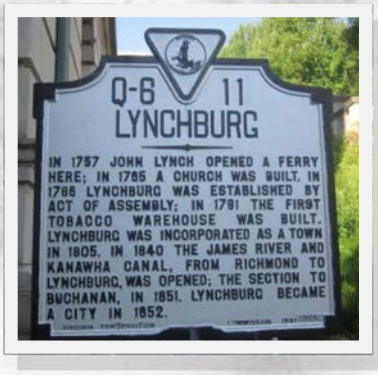
CITY OF LYNCHBURG

MS4 PERMIT NO. VAR040008

CHESAPEAKE BAY TOTAL MAXIMUM DAILY LOAD (TMDL) ACTION PLAN

MS4 GENERAL PERMIT
2013-2018 PERMIT CYCLE
SUBMITTED JUNE 30, 2015





“*When one tugs at a single thing in nature, he finds it attached to the rest of the world*” -John Muir

Table of Contents

Table of Contents

List of Tables

List of Figures

Table of Contents

Appendices

Table of Contents

List of Acronyms

ALCC	Average Land Cover Condition
BMP	Best Management Practice
CBP	Chesapeake Bay Program
CSS	Combined Sewer System
DEQ	Department of Environmental Quality
EPA	Environmental Protection Agency
ESC	Erosion and Sediment Control
IDDE	Illicit Discharge Detection and Elimination
LF	Linear Feet
MCM	Minimum Control Measure
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer System
NMP	Nutrient Management Plan
PC	Permit Cycle
POC	Pollutant of Concern
PY	Permit Year
SLAF	Stormwater Local Assistance Fund
SOP	Standard Operation Procedure
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorous
TSS	Total Suspended Solids
UNM	Urban Nutrient Management
VCWRLF	Virginia Clean Water Revolving Loan Fund
VPDES	Virginia Pollutant Discharge Elimination System
VRRM	Virginia Runoff Reduction Method
VSMH	Virginia Stormwater Management Handbook
VSMP	Virginia Stormwater Management Program
WIP	Watershed Implementation Plan

Acknowledgement

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GREELEY AND HANSEN

With support from:

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Section 1 Introduction

1.1 Purpose

The purpose of this document is to describe the City of Lynchburg's approach for achieving the reduction requirements of Section I.C of the Phase II Municipal Separate Storm Sewer System (MS4) General Permit (hereafter referred to as MS4 Permit) – Special Condition for the Chesapeake Bay TMDL. Section I.C.2.a of the MS4 Permit requires the City to, "*develop and submit [to DEQ,]… an approvable Chesapeake Bay TMDL Action Plan*" (hereafter referred to as Action Plan). This document was developed in accordance with the Chesapeake Bay TMDL Special Condition Guidance Document issued by DEQ on May 18, 2015 (hereafter referred to as TMDL Guidance Document), and describes the City's plan for meeting the Chesapeake Bay TMDL load reduction requirements in the 1st MS4 Permit cycle.
The action plan contains the following sections:

- MS4 program & legal authority review
- Pollutants of Concern (POC) load estimates
- POC reduction requirements
- Means and methods to achieve POC reduction requirements
- POC reduction costs, schedule / annual benchmarks

1.2 Public Comment

Section I.C.2.a. (12) of the MS4 Permit requires the City to provide "*an opportunity for receipt and consideration of public comment regarding the draft Chesapeake Bay TMDL Action Plan*". For compliance with this requirement, a draft version of this document was made available to the public on July 1, 2015. The public comment period will last for 1 month, concluding on July 31, 2015, after which time the comments will be compiled, reviewed, and addressed in an updated draft of this document.

1.3 Adaptive Management

As stated in Section II.F of the MS4 Permit, modifications to the TMDL Action Plan "*are expected throughout the life of this state permit as part of the iterative process to reduce the pollutant loadings and to protect water quality*". As part of the iterative process of reducing pollutant loadings, the City reserves the ability to modify its Action Plan for any reason, including, but not limited to, the following:

- Modifications to the City's MS4 area
- Documentation of credit from projects not represented in this Action Plan
- Implementation of alternative strategies (refer to Section 4.4)
- Substitution of projects or other means or methods based on cost effectiveness, site constraints, permitting or other factors

As of the date of this Action Plan, there have been no modifications to the Chesapeake Bay TMDL or the City's pollutant reduction requirements for compliance with the TMDL. There are however, several pending reports and activities that may have an impact on the City's pollutant reduction requirements in the future, including:

- Conclusion of the James River Chlorophyll-a study
- Recalibration of the Chesapeake Bay model
- Virginia's Phase III Watershed Implementation Plan (WIP)

In accordance with Section I.C.2.a.(9) of the MS4 Permit, any timely modifications to the TMDL that may result from the aforementioned items will be addressed in the City's MS4 Permit reapplication. The impact of these items, if any, on the City's requirements for compliance with the Chesapeake Bay TMDL will be addressed in the Action Plan that the City develops for subsequent permit cycles.

Section 2 MS4 Program & Legal Authority Review

2.1 Introduction

The City of Lynchburg has been operating its stormwater program under the current Phase II MS4 General Permit since July 1, 2013. Section I.C.2.a.(1) of the 2013 MS4 Permit requires the City to submit a review of the current MS4 Program and a review of its existing legal authorities as part of its Action Plan. Additionally, Section I.C.2.a.(2) requires the City to include "*the identification of any new or modified legal authorities such as ordinances, state and other permits, orders, specific contract language, and interjurisdictional agreements implemented or needing to be implemented to meet the requirements of this special condition*" in the Action Plan. A review of the City's MS4 program, existing legal authorities, and ability to ensure compliance with the special condition requirements of the MS4 Permit are provided in the following sections.

2.2 MS4 Program Review

In accordance with the requirements of the MS4 Permit, the City has developed an MS4 Program Plan that identifies its plans for compliance with the six minimum control measures (MCMs) identified in the permit. The MS4 Program Plan sufficiently addresses discharges to the MS4 and supports this TMDL Action Plan. The MS4 Program Plan is available on the City's website here.

2.3 Legal Authority Review

Based upon a review of the City's ordinances, it has been determined that the City has sufficient legal authority to meet the requirements of the MS4 Permit and to execute the compliance activities identified in this Action Plan for the 1st permit cycle.

Section 3 Pollutant Load Estimates and Removal Requirements

3.1 Introduction

Section I.C.2.a.(4) – Section I.C.2.a.(8) (hereafter referred to as Special Conditions 4 – 8) of the MS4 Permit addresses pollutants of concern (POC) load estimation and reduction requirements. The requirements of these special conditions are summarized below:

- Special Condition 4 – POC load estimate from existing sources (i.e. constructed prior to 7/1/2009)
- Special Condition 5 – 1st permit cycle POC load reduction requirement from existing sources
- Special Condition 6 – Means and methods to meet POC load reduction requirements from existing sources
- Special Condition 7 – Means and methods to meet POC load reduction requirements from new sources (i.e. constructed between 7/1/2009 and 6/30/2014)
- Special Condition 8 – Means and methods to meet POC load reduction requirements from grandfathered projects constructed after 6/30/2014

For the 1st permit cycle, these special conditions only apply to the area served by the MS4 within the 2000 decennial census urbanized area boundary. During the next permit cycle, these special conditions will apply to the area served by the MS4 within the 2010 urbanized area boundary. The City has performed a detailed delineation of the area served by its MS4, as discussed in Section 3.2.

3.2 MS4 Delineation

An MS4 is defined as, "*a conveyance or system of conveyances otherwise known as a municipal separate storm sewer system or 'MS4,' including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains [that meet all of the following criteria]:*

1. *Owned or operated by a federal, state, city, town, county, district, association, or other public body, created by or pursuant to state law, having jurisdiction or delegated authority for erosion and sediment control and stormwater management, or a designated and approved management agency under § 208 of the CWA that discharges to surface waters;*
2. *Designed or used for collecting or conveying stormwater;*
3. *That is not a combined sewer; and*
4. *That is not part of a publicly owned treatment works"*

The City has made significant efforts to estimate the size of the drainage area served by its MS4 (hereafter referred to as MS4 service area) in a reasonably accurate manner. The City is currently in the process of conducting a field verification program to accurately map the entirety of its stormwater system and delineate the MS4 service area on an outfall-by-outfall basis. Like many other MS4 communities, much of the City's existing stormwater GIS was digitized from old maps and design drawings, and had not been field verified. At the time that this Action Plan was developed, significant progress has been made to the point that approximately half of the City's stormwater system has now been field verified. In the half of the City that has been field verified, the MS4 delineation has been completed. In the remaining half of the City where field verification is pending, a preliminary delineation was performed using the existing stormwater network information.

Some older areas of the City are served by a Combined Sewer System (CSS), where sanitary discharges and stormwater runoff are both conveyed within the same system. The City's CSS area is approximately 1,300 acres and flows to the Wastewater Treatment Plant (WWTP) where it is treated. As indicated by the State's definition on the previous page, the CSS area is not part of the City's MS4 and is therefore not regulated by the MS4 Permit. As such, the CSS area is not included in the numbers provided in Table 3-1, but is shown in Figure 3-1 for informational purposes only.

3.2.1 Delineation Results

Estimates of the acreage and land cover of the MS4 service area are provided in Table 3-1, and a map of the MS4 service area is provided in Figure 3-1. The extent of the MS4 service area and the land cover shown in this Action Plan are based upon current conditions, using the City's latest GIS information (not the July 1, 2009 condition). The City reserves the right to make future adjustments to the MS4 service area and its land cover condition as more detailed and reliable information becomes available including but not limited to the following:

- Removing areas of the MS4 service area that were created after June 30, 2009
- Adjusting the land cover condition in areas that have undergone development/redevelopment after June 30, 2009
- Refining the MS4 service area based upon data from the City's ongoing mapping efforts

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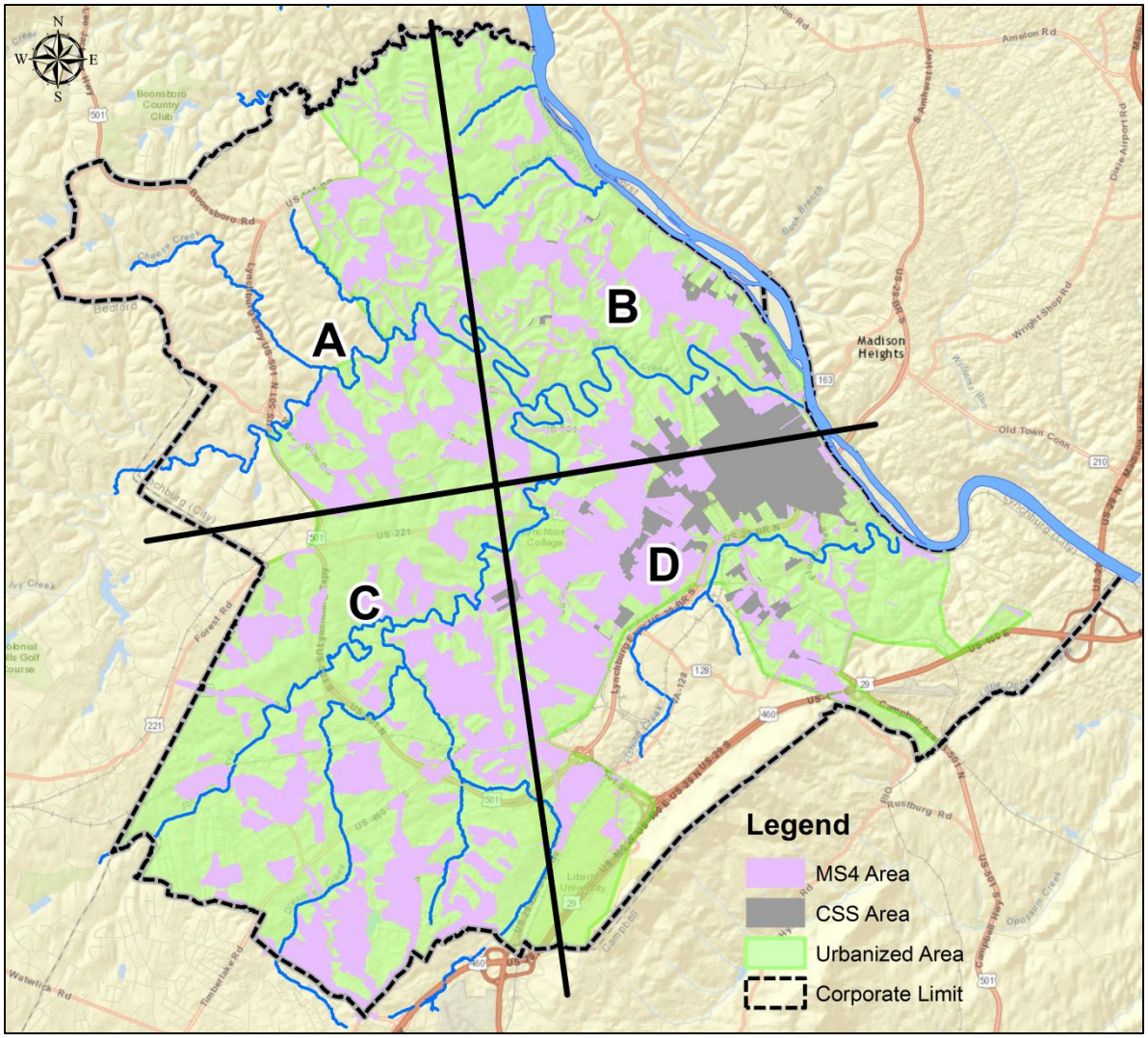
Table 3-1
Estimated MS4 Service Area

City Quadrant	Mapping Status	Total Area (acres)	Forested Area (acres) (1)	Impervious Area (acres) (2)	Pervious Area (acres) (3)
A	Verified	1,400	50	600	750
B	Unverified	1,700	100	700	900
C	Pending (4)	3,600	200	1,500	1,900
D	Unverified	2,800	150	1,200	1,450
Total (5)	**-**	**9,500**	**500**	**4,000**	**5,000**

(1) Forested area includes all regulated land within the boundaries of the City's tree canopy feature class
(2) Impervious area includes all regulated land within the boundaries of the following City feature classes: Bridges, Driveways, Parking_Paved, Roadway_Alley, Roadway_Paved, Sidewalk, and Structures (i.e. buildings)
(3) Pervious area was determined by subtracting the forested area and impervious area from the total area.
(4) Field verification is approximately 70% complete in this quadrant as of the date of this draft TMDL Action Plan
(5) Acreage estimate is based upon current conditions using the latest GIS information (not the 2009 condition)

Figure 3-1
Preliminary MS4 Delineation



3.2.2 Delineation Methodology

The City has delineated regulated and unregulated areas in GIS by drawing the contributing drainage area to each MS4 outfall or point of discharge. The delineation was performed using the following feature classes, images, and models:

- Digital Elevation Models (DEM)
- Aerial imagery
- Elevation contours – 2 foot intervals
- Stormwater network
- Curbs
- Street Centerlines
- Combined Sewer System (CSS) area
- 2000 decennial census urbanized area

The City's DEM was used in conjunction with other feature classes to perform accurate delineations in dense urban areas where stormwater infrastructure and roadways with curb and gutter alter the flow of stormwater from its natural, topographical course. The DEM was used to define the upper portion of MS4 service area boundaries, while curbs, street centerlines, and the stormwater network were used to define the lower portion of the boundaries

3.3 POC Load Estimate from Existing Sources – Special Condition 4

Special Condition 4 requires the City to provide "*an estimate of the annual POC loads discharged from the existing sources as of June 30, 2009, based on the 2009 progress run…[utilizing]…the applicable versions of Tables 2 a-d in... [the MS4 Permit]…based on the river basin to which the MS4 discharges by multiplying the total existing acres served by the MS4 on June 30 2009, and the 2009 Edge of Stream (EOS) loading rate"*. This estimate was developed by directly entering the MS4 area and land cover types (Table 3-1) into MS4 Permit Table 2a (James River Basin), as shown in Table 3-2, on the following page.

Table 3-2
Estimated POC Load (MS4 Permit Table 2a)

POC	Land Cover	MS4 Area (acres) (1), (2)	2009 EOS Loading Rate (lb/acre-yr)	Estimated Total POC Load Based on 2009 Progress Run (lb/yr)
TN	Impervious	4,000	*9.39*	37,560
	Pervious	5,000	*6.99*	34,950
	Subtotal	**9,000**	**-**	**72,510**
TP	Impervious	4,000	*1.76*	7,040
	Pervious	5,000	*0.50*	2,500
	Subtotal	**9,000**	**-**	**9,540**
TSS	Impervious	4,000	*676.94*	2,707,760
	Pervious	5,000	*101.08*	505,400
	Subtotal	**9,000**	**-**	**3,213,160**

(1) Acreage estimate is based upon current conditions using the latest GIS information (not the 2009 condition).
(2) Acreage excludes forested area.

3.4 POC Reduction Requirements

Special Conditions 6 – 8 of the MS4 Permit contain different POC reduction requirements for different sources (i.e. existing sources, new sources, and grandfathered projects). A summary of the individual requirements for these special conditions is provided in Table 3-3. The City's calculated POC reduction requirement for each of the special conditions is discussed in greater detail in the subsequent sections.

Table 3-3
POC Reduction Requirement Summary

Source	Special Condition	Time Period	POC Reduction Requirement	Compliance Dates
Existing	6	Prior to 7/1/2009	Reduce POC load by amount calculated using Table 3a of the MS4 Permit	Measures in place to achieve Table 3a POC reduction by 6/30/2018 (represents 5% of total POC reduction requirement)
New	7	7/1/2009 to 6/30/2014	Reduce incremental difference in POC load that resulted from the utilization of an average land cover condition greater than 16% for the design of post-construction stormwater management facilities for projects that disturb 1 acre of land or greater	Measures in place to achieve 5% of total POC reduction requirement by 6/30/2018
Grandfathered Projects	8	After 6/30/2014	Reduce incremental difference in POC load that resulted from the utilization of an average land cover condition greater than 16% for the design of post-construction stormwater management facilities for projects that disturb 1 acre of land or greater	Measures in place to achieve 100% of total POC reduction requirement by 6/30/2018

3.4.1 Existing Sources – Special Conditions 5 & 6

Special Condition 6 requires the City to develop a plan to meet the POC reduction requirements specified in Special Condition 5. As stated in the MS4 Permit, the City must include in its Action Plan, "*the means and methods, such as management practices and retrofit programs that will be utilized to meet the required reductions included in [Special Condition 5]*".

Special Condition 5 requires the City to make "*a determination of the total pollutant load reductions necessary … utilizing the applicable versions of Tables 3 a-d in [the MS4 Permit]… based on the river basin to which the MS4 discharges… by multiplying the total existing [urbanized] acres served by the MS4 by the first permit cycle required reduction in loading rate.*" This estimate was developed by directly entering the MS4 area and land cover types (Table 3-1) into MS4 Permit Table 3a (James River Basin), as shown in Table 3-4.

Table 3-4
POC Reduction Requirement for Existing Sources (MS4 Permit Table 3a)

POC	Land Cover	Total Existing Acres Served by MS4 Area (acres)	1st Permit Cycle Required Reduction in Loading Rate (lb/acre-yr)	1st Permit Cycle POC Reduction Requirement (lb/yr)
TN	Impervious	4,000	*0.04255*	170.20
	Pervious	5,000	*0.02097*	104.85
	Subtotal	**9,000**	**-**	**275.05**
TP	Impervious	4,000	*0.01408*	56.32
	Pervious	5,000	*0.0018125*	9.06
	Subtotal	**9,000**	**-**	**65.38**
TSS	Impervious	4,000	*6.7694*	27,078
	Pervious	5,000	*0.442225*	2,211
	Subtotal	**9,000**	**-**	**29,289**

3.4.2 New Sources – Special Condition 7

Special Condition 7 requires the City to identify "*The means and methods to offset the increased loads from new sources initiating construction between July 1, 2009, and June 30, 2014, that disturb one acre or greater as a result of the utilization of an average land cover condition greater than 16% impervious cover for the design of post-development stormwater management facilities*". The City of Lynchburg utilized an average land cover condition (ALCC) of 17% for the design of post-development stormwater management facilities on a handful of projects. According to the City's records, 3 qualifying development projects were designed using this criterion until January 1, 2014, when the City ceased to allow this higher land cover condition. Special Condition 7 requires the City to offset the incremental difference in pollutant loads, as described by the following formulas.

$$Incremental\ Difference = POC\ Load_{Actual\ Post\ Development\ Condition} - POC\ Load_{ALCC\ 16\%}$$

$$1st\ Permit\ Cycle\ POC\ Reduction\ Requirement = 5\% \times Incremental\ Difference$$

POC loads for both actual post-development conditions and an ALCC of 16% were calculated using the Simple Method, as described in the Virginia Stormwater Management Handbook (VSMH). This method was selected for consistency with the BMP POC removal figures on the VSMH calculation worksheets submitted during design. Since the VSMH worksheets focus solely on total phosphorous (TP), POC removal for total nitrogen (TN) and total suspended solids (TSS) had to be estimated. Prior to the issuance of the finalized Guidance Document on May 18, 2015, the City developed a method for estimating the TN and TSS removal for each redevelopment project on an aggregate BMP basis. The method utilized the total TP removal from BMPs installed during the development project (as reported on the VSMH calculation worksheets), the POC loading rate ratios provided in Table 4 of the MS4 Permit, and the ratio of the POC removal efficiencies from the retrofit removal adjustor curves from the "*Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects*" report (hereafter referred to as the Expert Panel Report on Retrofit Projects) for a water treatment depth of ½-inch. The formulas used to estimate the BMP pollutant removal for TN and TSS are shown in the formulas below.

$$TN\ Removal_{BMP(s)} = TP\ Removal_{BMP(s)} \times Loading\ Rate\ Ratio_{TN/TP} \times Retrofit\ Curve\ Efficiency\ Ratio_{TN/TP}$$

$$TSS\ Removal_{BMP(s)} = TP\ Removal_{BMP(s)} \times Loading\ Rate\ Ratio_{TSS/TP} \times Retrofit\ Curve\ Efficiency\ Ratio_{TSS/TP}$$

Multiplying the TP removal from the BMP(s) by the loading rate ratio results in a POC removal for TN or TSS at the same efficiency for TP (i.e. results reflect equal efficiency for all 3 POCs). Multiplying by the retrofit curve efficiency ratio adjusts the removal for TN and TSS to more accurately reflect the differences in removal efficiencies between the 3 POCs, based upon a composite average of BMPs commonly used in development. The ratios were calculated by averaging the efficiencies from the runoff reduction (RR) and stormwater treatment (ST) retrofit removal adjustor curves for a water treatment depth of ½-inch. The ratio for TN was 0.7576 and the ratio for TSS was 1.1721. This methodology was deemed to be the most accurate means available for estimating TN and TSS load removal from development projects on an aggregate BMP basis.

Although this methodology differs from the suggested methodology in the finalized Guidance Document, it was used because it is believed to be both accurate and conservative, it had been developed prior to the issuance of the finalized guidance, and data was not readily available to utilize the suggested methodology in the finalized Guidance Document. The total POC reduction requirement for Special Condition 7 is provided in Table 3-5.

Table 3-5
POC Reduction Requirement for New Sources

Development Name [1]	Area (acres)	Land Cover Condition (% Impervious)		Chesapeake Bay Default POC Load (lb/yr) [2]			Post-Development POC Load (lb/yr)									Incremental Difference in POC Load Discharged to MS4 (lb/yr) [5]			1st Permit Cycle POC Reduction Requirement (lb/yr) [6]		
							Land Cover Load [2]			New BMP(s) POC Removal [3]			POC Load Discharged to MS4 [4]								
		Chesapeake Bay Default	*Post-Development*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*
Victoria Ridge	3.08	16%	31.16%	**7.08**	**1.36**	**573**	12.06	2.32	976	4.18	1.06	523	**7.88**	**1.26**	**453**	**0.80**	**0.00**	**0**	***0.04***	***0.00***	***0***
Dodson Exterminating	3.74	16%	36%	**8.60**	**1.65**	**696**	16.58	3.19	1,342	5.91	1.50	740	**10.67**	**1.69**	**602**	**2.07**	**0.03**	**0**	***0.10***	***0.00***	***0***
Kendal Square Apartments	3.88	16%	36%	**8.92**	**1.72**	**722**	26.31	5.06	2,130	14.73	3.74	1,845	**11.58**	**1.32**	**285**	**2.65**	**0.00**	**0**	***0.13***	***0.00***	***0***
Total	**10.70**	**-**	**-**	**24.61**	**4.73**	**1,992**	*54.96*	*10.57*	*4,448*	*24.82*	*6.30*	*3,108*	**30.14**	**4.27**	**1,340**	**5.53**	**0.03**	**0**	***0.28***	***0.00***	***0***

(1) The development site is located within the MS4 service area
(2) Values for TP were calculated using the Simple Method (POC Load = {0.05 + [0.9 * Land Cover Condition]} * Area * 2.28). Values for TN and TSS were calculated by multiplying the calculated TP load by the Loading Rate Ratios from Table 4 of the MS4 Permit.
(3) Values for TP were entered directly from VSMH worksheets submitted with design documents. Values for TN & TSS were calculated by multiplying the documented TP removal from the BMP(s) by the Loading Rate Ratios from Table 4 of the MS4 Permit and a Retrofit Curve Efficiency Ratio (TN/TP = 0.7576; TSS/TP = 1.1721).
(4) Quantity = Land Cover POC Load - BMP(s) POC Removal
(5) Quantity = Post-Development POC Load Discharged to MS4 - Chesapeake Bay Default POC Load Discharged to MS4. Values less than zero are reported as zero.
(6) 5% of Incremental Difference in POC Load Discharge to MS4

3.4.3 Grandfathered Projects – Special Condition 8

Special Condition 8 requires the City to identify "*the means and methods to offset the increased loads from projects as grandfathered in accordance with 9VAC25-870-48, that disturb one acre or greater that begin construction after July 1, 2014, where the project utilizes an average land cover condition greater than 16% impervious cover in the design of post-development stormwater management facilities*". The only project in the City that was grandfathered used a land cover condition of 16% for the design of post-development stormwater management facilities. As such, the City is not required to provide any pollutant load offsets for compliance with Special Condition 8.

Although no pollutant load offsets are required, the MS4 Permit does require the City to provide information on its grandfathered projects. The required information is provided in Table 3-6, below.

Table 3-6
List of Future Grandfathered Projects

Project Name	Size (acres) (1)
Liberty University Master Plan	945

(1) Quantity represents the total drainage area of the sites identified in the "Liberty University Stormwater Management Plan for Land Disturbing Activities". This quantity will be revised as the projects implemented under this plan are designed and approved.

3.4.4 POC Reduction Requirements for the First Permit Cycle

The table below summarizes the City's POC reduction requirements for the 1st permit cycle for compliance with Special Conditions 6, 7, & 8.

Table 3-7
Total POC Reduction Requirement – All Sources

Special Condition	Source	1st Permit Cycle POC Reduction Requirement (lb/yr)		
		TN	TP	TSS
6	Existing	275.05	65.38	29,289
7	New	0.28	0.00	0
8	Grandfathered Projects	0	0	0
Total		**275.33**	**65.38**	**29,289**

Section 4 Chesapeake Bay TMDL Compliance Plan

4.1 Introduction

As previously discussed in Section 4, Special Conditions 6, 7, & 8 of the MS4 Permit require the City to identify the "*means and methods… to meet the required reductions…[and]…offset the increased loads*". "Means and methods" refer to the best management practices (BMPs) identified in the Action Plan. Part III of the TMDL Guidance Document explains that "*the means and methods provided to the Department [DEQ] must show that, based on the information available at the time the Action Plan is approved, the BMPs implemented by the permittee will meet the reductions required by the Special Condition [6, 7, & 8] for the Chesapeake Bay TMDL for this [1st] permit cycle*". The sum of the City's pollutant load reduction requirements to address these special conditions is provided in Table 3-7 on the previous page.

The City's approach to achieving the pollutant reduction goals in the MS4 Permit include:

- TMDL credits from existing projects;
- Additional (new) means and methods, to the extent necessary

Though not planned at this time, pollutant trading is reserved as a compliance option under this plan in accordance with the permit.

4.2 TMDL Credits from Existing Projects

Consistent with Parts III and IV of the TMDL Guidance Document, this plan includes credit for reductions in pollutant loading from a variety of sources, including redevelopment projects, projects with stricter development requirements, oversized BMPs, newly installed BMPs (not associated with development), development BMPs, and historical BMPs. A summary of the TMDL credits from these sources is provided in Table 4-1. Additional detail is provided in the subsequent sections.

Table 4-1
TMDL Credits from Existing Projects

TMDL Credit Source	Estimated TMDL Credit (lb/yr)		
	TN	TP	TSS
Newly Installed BMPs	321.80	58.58	23,507
Redevelopment	14.62	4.63	2,493
Development BMPs	2.03	0.31	338
Stricter Development Requirements	3.56	0.74	319
Oversized BMPs (1)	-	-	-
Historical BMPs (1)	-	-	-
Total	**342.02**	**64.26**	**26,658**

(1) Documentation was not available at the time this plan was developed to calculate credit from these sources. The above TMDL credit calculations may be updated to include credit from these sources if and when sufficient documentation is compiled to support the credit.

4.2.1 Newly Installed BMPs

Consistent with Part III of the TMDL Guidance Document, any BMPs (other than those installed to meet the VSMP requirements) installed after June 30, 2009 that receive discharges from the MS4 service area are eligible for TMDL credits towards meeting the POC load reduction requirements for the 1st permit cycle. Since this date, the City has installed 34 BMPs that meet these criteria, mostly all of which were part of the City's combined sewer system (CSS) separation efforts. Since the MS4 service area reported in this document is based upon the latest GIS information (not the 2009 condition) and includes areas that were previously part of the CSS, the City's plan includes calculating credit for the BMPs installed as part of its recent CSS separation efforts.

The TMDL Credit was calculated by multiplying the pollutant load to each BMP by its pollutant removal efficiency. Pollutant load calculations were performed using the loading rates in Table 2a of the MS4 Permit. BMP efficiencies were determined using the retrofit removal adjustor curves from the Expert Panel Report on Retrofit Projects. All of the newly installed BMPs are located within the MS4 area, so no baseline reductions were required. This methodology for calculating TMDL credit complies with the guidance provided in the TMDL Guidance Document. The total TMDL credit for these newly installed BMPs is provided in Table 4-2.

Table 4-2
TMDL Credit for Newly Installed BMPs

Location	BMP Type	BMP Classification (1)	Contributing Drainage Area (2)			Pollutant Load (lb/yr)			WQ Depth	BMP Efficiency (%)			Pollutant Removal (lb/yr)		
			Total	Impervious	Pervious	TN	TP	TSS		TN	TP	TSS	TN	TP	TSS
City Stadium	Bio-filter	RR	1.6	0.71	0.89	12.89	1.69	571	1”	60%	70%	75%	7.70	1.18	427
2103 Columbia Ave	Bio-filter	RR	1.08	0.21	0.87	8.05	0.80	230	1”	60%	70%	75%	4.81	0.56	172
Parkland Ave. / Quarry Rd Intx.	Rain Garden	RR	1.15	0.3	0.85	8.76	0.95	289	1”	60%	70%	75%	5.23	0.67	216
400 Block Elmwood Ave	Rain Garden	RR	1.45	0.55	0.9	11.46	1.42	463	1”	60%	70%	75%	6.84	0.99	347
1147 Ardmore Drive	Bioretention	RR	0.77	0.77	0	7.23	1.36	521	1”	60%	70%	75%	4.32	0.95	390
1667 Shaffer Street	Filterra (MTD)	ST	0.09	0.09	0	0.85	0.16	61	1”	35%	55%	70%	0.30	0.09	43
1741 Shaffer Street	Filterra (MTD)	ST	0.07	0.07	0	0.66	0.12	47	1”	35%	55%	70%	0.23	0.07	33
1808 Shaffer Street	Filterra (MTD)	ST	0.13	0.11	0.02	1.17	0.20	76	1”	35%	55%	70%	0.41	0.11	53
2132 Rivermont Ave	Filterra (MTD)	ST	1.1	0.34	0.76	8.51	0.98	307	1”	35%	55%	70%	2.97	0.54	215
2131 Rivermont Ave	Filterra (MTD)	ST	0.56	0.26	0.3	4.54	0.61	206	1”	35%	55%	70%	1.59	0.33	144
2214 Rivermont Avenue	Filterra (MTD)	ST	0.64	0.25	0.39	5.07	0.64	209	1”	35%	55%	70%	1.77	0.35	146
2212 Rivermont Ave	Filterra (MTD)	ST	0.52	0.2	0.32	4.11	0.51	168	1”	35%	55%	70%	1.44	0.28	117
Wythe Road (Banker Steel)	CDS (MTD)	ST	4.35	2.44	1.91	36.26	5.25	1,845	½”	26%	41%	52%	9.48	2.16	964
James Street @ Expressway Ramp	CDS (MTD)	ST	11.64	3.00	8.64	88.56	9.60	2,904	½”	26%	41%	52%	23.14	3.94	1,518
Gordon Street & Aragon Street Intx.	CDS (MTD)	ST	13.77	3.05	10.72	103.57	10.73	3,148	½”	26%	41%	52%	27.06	4.41	1,645
2255 Carroll Ave	CDS (MTD)	ST	3.83	1.28	2.55	29.84	3.53	1,124	½”	26%	41%	52%	7.80	1.45	588
Loudon St & Columbia Avenue Intx.	CDS (MTD)	ST	4.68	1.1	3.58	35.35	3.73	1,107	½”	26%	41%	52%	9.24	1.53	578
2301 Columbia Avenue	CDS (MTD)	ST	5.85	1.49	4.36	44.47	4.80	1,449	½”	26%	41%	52%	11.62	1.97	758
2101 Bedford Avenue	CDS (MTD)	ST	7.01	2.29	4.72	54.50	6.39	2,027	½”	26%	41%	52%	14.24	2.62	1,060
3900 Block Royal Blvd	CDS (MTD)	ST	4.76	0.81	3.95	35.22	3.40	948	½”	26%	41%	52%	9.20	1.40	495
3900 Block Royal Blvd	CDS (MTD)	ST	0.85	0.14	0.71	6.28	0.60	167	½”	26%	41%	52%	1.64	0.25	87
1800 Parkland Dr	CDS (MTD)	ST	0.57	0.1	0.47	4.22	0.41	115	½”	26%	41%	52%	1.10	0.17	60
100 Block Norfolk Ave	CDS (MTD)	ST	11.52	3.46	8.06	88.83	10.12	3,157	½”	26%	41%	52%	23.21	4.16	1,650
100 Block Norfolk Ave	CDS (MTD)	ST	0.75	0.23	0.52	5.79	0.66	208	½”	26%	41%	52%	1.51	0.27	109
400 Block Elmwood Ave	CDS (MTD)	ST	4.56	2.1	2.46	36.91	4.93	1,670	½”	26%	41%	52%	9.65	2.02	873
Kensington Ave	CDS (MTD)	ST	10.14	3.24	6.9	78.65	9.15	2,891	½”	26%	41%	52%	20.55	3.76	1,511
480 Rivermont Ave	CDS (MTD)	ST	7.88	3.86	4.02	64.35	8.80	3,019	½”	26%	41%	52%	16.81	3.62	1,578
300 Block Blackford St	CDS (MTD)	ST	7.88	3.75	4.13	64.08	8.67	2,956	½”	26%	41%	52%	16.74	3.56	1,545
706 Byrd	CDS (MTD)	ST	2.55	1.15	1.4	20.58	2.72	920	½”	26%	41%	52%	5.38	1.12	481
400 Botetourt St	CDS (MTD)	ST	11.34	2.27	9.07	84.71	8.53	2,453	½”	26%	41%	52%	22.14	3.50	1,282
300 Block Willow St	CDS (MTD)	ST	3.14	0.63	2.51	23.46	2.36	680	½”	26%	41%	52%	6.13	0.97	356
300 Block Willow St	CDS (MTD)	ST	5.69	1.14	4.55	42.51	4.28	1,232	½”	26%	41%	52%	11.11	1.76	644
400 Main St.	CDS (MTD)	ST	12.07	3.62	8.45	93.06	10.60	3,305	½”	26%	41%	52%	24.32	4.35	1,727
2300 Block Bedford Ave	Storm Filter (MTD)	ST	5	4.75	0.25	46.35	8.49	3,241	½”	26%	41%	52%	12.11	3.48	1,694
Total			**148.99**	**49.76**	**99.23**	**1,160.86**	**137.19**	**43,715**	**-**	**-**	**-**	**-**	**321.80**	**58.58**	**23,507**

(1) RR = Runoff Reduction; ST = Stormwater Treatment (refer to Expert Panel Report on Retrofit Projects)

4.2.2 Redevelopment

Consistent with Appendix V.J of the TMDL Guidance Document, credit is calculated for redevelopment projects within the MS4 area that initiated construction after June 30, 2009 and resulted in a decrease in POC loads compared to existing conditions (i.e. pre-development). There have been 4 redevelopment projects in the City that meet these criteria. The TMDL credit for these projects was calculated by subtracting the post-development pollutant load from the pre-development pollutant load, as shown in the formula below.

$$TMDL\ Credit = \left[Land\ Cover\ POC\ Load_{Pre-development} - POC\ Removal_{Existing\ BMP(s)}\right] - \left[Land\ Cover\ POC\ Load_{Post-development} - POC\ Removal_{New\ BMP(s)}\right]$$

Pre-development and post-development land cover POC loads were calculated on a project-by-project basis using the Simple Method, as described in the Virginia Stormwater Management Handbook (VSMH). This method was selected for consistency with the BMP POC removal figures on the VSMH calculation worksheets submitted during design. Since the VSMH worksheets focus solely on total phosphorous (TP), POC removal for total nitrogen (TN) and total suspended solids (TSS) had to be estimated. Prior to the issuance of the finalized Guidance Document, the City developed a method for estimating the TN and TSS removal for each redevelopment project on an aggregate BMP basis. The method utilized the total TP removal from BMPs installed during the redevelopment project (as reported on the VSMH calculation worksheets), the POC loading rate ratios provided in Table 4 of the MS4 Permit, and the ratio of the POC removal efficiencies from the retrofit removal adjustor curves from the Expert Panel Report on Retrofit Projects for a water treatment depth of ½-inch, as shown in the formulas below.

$$TN\ Removal_{BMP(s)} = TP\ Removal_{BMP(s)} \times Loading\ Rate\ Ratio_{TN/TP} \times Retrofit\ Curve\ Efficiency\ Ratio_{TN/TP}$$

$$TSS\ Removal_{BMP(s)} = TP\ Removal_{BMP(s)} \times Loading\ Rate\ Ratio_{TSS/TP} \times Retrofit\ Curve\ Efficiency\ Ratio_{TSS/TP}$$

Multiplying the TP removal from the BMP(s) by the loading rate ratio results in a POC removal for TN or TSS at the same efficiency for TP (i.e. results reflect equal efficiency for all 3 POCs). Multiplying by the retrofit curve efficiency ratio adjusts the removal for TN and TSS to more accurately reflect the differences in removal efficiencies between the 3 POCs, based upon a composite average of BMPs commonly used in development. The ratios were calculated by averaging the efficiencies from the runoff reduction (RR) and stormwater treatment (ST) retrofit removal adjustor curves for a water treatment depth of ½-inch. The ratio for TN was 0.7576 and the ratio for TSS was 1.1721. This methodology was deemed to be the most accurate means available for estimating TN and TSS load removal from redevelopment projects on an aggregate BMP basis.

Although this methodology differs from the suggested methodology in the finalized Guidance Document, it was used because it is believed to be both accurate and conservative, it had been developed prior to the issuance of the finalized guidance, and data was not readily available to utilize the suggested methodology in the finalized Guidance Document. A summary of the TMDL credit for redevelopment projects is provided in Table 4-3.

Table 4-3
TMDL Credit for Redevelopment Projects

Development Name (1)	Area (acres)	Land Cover Condition (% Impervious)		Pre-Development POC Load (lb/yr)									Post-Development POC Load (lb/yr)									TMDL Credit (lb/yr) (5)		
				Land Cover Load (2)			Existing BMP(s) POC Removal (3)			POC Load Discharged to MS4 (4)			Land Cover Load (2)			New BMP(s) POC Removal (3)			POC Load Discharged to MS4 (4)					
		Pre-Development	*Post-Development*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*
Kroger	10.95	61%	70%	77.76	14.95	6,294	0.00	0.00	0	**77.76**	**14.95**	**6,294**	88.28	16.98	7,146	19.70	5.00	2,467	**68.58**	**11.98**	**4,679**	***9.18***	***2.98***	***1,616***
CVS	1.88	43%	67%	9.74	1.87	788	0.00	0.00	0	**9.74**	**1.87**	**788**	14.55	2.80	1,178	4.96	1.26	622	**9.59**	**1.54**	**557**	***0.15***	***0.33***	***232***
Slocum Building	1.98	83%	89%	18.71	3.60	1,514	0.00	0.00	0	**18.71**	**3.60**	**1,514**	19.98	3.84	1,617	3.66	0.93	459	**16.31**	**2.91**	**1,158**	***2.40***	***0.69***	***356***
GLTC Transfer Station	3.10	80.7%	75.7%	28.53	5.49	2,309	0.00	0.00	0	**28.53**	**5.49**	**2,309**	26.88	5.17	2,176	1.24	0.32	155	**25.64**	**4.85**	**2,020**	***2.89***	***0.63***	***289***
Total	**17.91**	**-**	**-**	*134.75*	*25.91*	*10,907*	*0.00*	*0.00*	*0*	**134.75**	**25.91**	**10,907**	*149.69*	*28.79*	*12,116*	*29.57*	*7.51*	*3,702*	**120.12**	**21.28**	**8,414**	***14.62***	***4.63***	***2,493***

(1) The development site is located within the MS4 service area
(2) Values for TP were calculated using the Simple Method (POC Load = {0.05 + [0.9 * Land Cover Condition]} * Area * 2.28). Values for TN and TSS were calculated by multiplying the calculated TP load by the Loading Rate Ratios from Table 4 of the MS4 Permit.
(3) Values for TP were entered directly from VSMH worksheets submitted with design documents. Values for TN & TSS were calculated by multiplying the documented TP removal from the BMP(s) by the Loading Rate Ratios from Table 4 of the MS4 Permit and a Retrofit Curve Efficiency Ratio (TN/TP = 0.7576; TSS/TP = 1.1721).
(4) Quantity = Land Cover POC Load - BMP(s) POC Removal
(5) Quantity = Post-Development POC Load Discharged to MS4 – Pre-Development POC Load Discharged to MS4. Values less than zero are reported as zero.

4.2.3 Development BMPs

Appendix V.L of the TMDL Guidance Document, states that, "*permittees may receive credit for redevelopment projects if the pre-development pollutant load is reduced, regardless of the initial land use condition*". This same concept can be applied to new development projects with BMPs that treat POC loads discharged from the MS4 area that were previously untreated. There has been 1 project in the City that meets this criterion.
The TMDL credit for this project was calculated as shown in the formula below. The calculated TMDL credit is provided in Table 4-4.

$$TMDL\ Credit = [POC\ Discharged\ from\ MS4\ Service\ Area_{Post-development} - POC\ Discharged\ from\ MS4\ Service\ Area_{Pre-development}]$$

Table 4-4
TMDL Credit for Development BMPs

Location	BMP Type	Contributing Drainage Area (1)			Pre-Development POC Load (lb/yr) (2)			BMP Efficiency (%) (3)			BMP Pollutant Removal (lb/yr) (4)			Post-Development POC Load (5)			TMDL Credit (lb/yr) (6)		
		Total	*Impervious*	*Pervious*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*
1 Ivy Crescent	Extended Detention	1.19	0.77	0.42	10.17	1.57	564	20%	20%	60%	2.03	0.31	338	8.13	1.25	225	2.03	0.31	338
Total	**-**	**1.19**	**0.77**	**0.42**	**10.17**	**1.57**	**564**	**-**	**-**	**-**	**2.03**	**0.31**	**338**	**8.13**	**1.25**	**225**	**2.03**	**0.31**	**338**

(1) Quantity represents MS4 area only
(2) POC loads were calculated using the loading rates in Table 2a of the MS4 Permit
(3) Values were taken from the Chesapeake Bay Program published efficiencies
(4) BMP Pollutant Removal = Pre-Development POC Load * BMP Efficiency
(5) Post-Development POC Load = Pre-Development POC Load – BMP Pollutant Removal
(6) TMDL Credit = Post-Development POC Load – Pre-Development POC Load

4.2.4 Stricter Development Requirements

Consistent with Part III, Section 3.2 of the TMDL Guidance Document, credit is calculated for projects with stricter development requirements. Prior to July 1, 2014, the City required post-construction stormwater management for projects that disturbed greater than 5,000 square feet. This local requirement was stricter than the State's 1 acre threshold for post-construction stormwater management. As such, the entire POC reductions achieved through post-construction stormwater management are eligible for TMDL credit.

Credit was calculated by multiplying the pollutant load to each BMP by its pollutant removal efficiency. Pollutant load calculations were performed using the loading rates in Table 2a of the MS4 Permit. BMP efficiencies were determined using the retrofit removal adjustor curves from the Expert Panel Report on Retrofit Projects. All of the newly installed BMPs are located within the MS4 area, so no baseline reductions were required. This methodology for calculating TMDL credit complies with the guidance provided in the TMDL Guidance Document. A summary of the TMDL credit for projects with stricter development requirements is provided in Table 4-5.

Table 4-5
TMDL Credit for Projects with Stricter Development Requirements

Development Site [1]	BMP Type	BMP Classification [2]	Contributing Drainage Area			POC Load (lb/yr) [3]			WQ Depth (in) [4]	BMP Efficiency [5]			TMDL Credit (lb/yr) [6]		
			Total	*Impervious*	*Pervious*	*TN*	*TP*	*TSS*		*TN*	*TP*	*TSS*	*TN*	*TP*	*TSS*
Mt. Carmel Baptist Church	Bioretention	RR	0.61	0.28	0.33	4.94	0.66	223	0.5	45%	52%	56%	2.21	0.34	125
Wegmann USA	Filterrra	ST	0.55	0.55	0.00	5.16	0.97	372	0.5	26%	41%	52%	1.35	0.40	195
Total			**1.16**	**0.83**	**0.33**	**10.10**	**1.63**	**595**	**-**	**-**	**-**	**-**	**3.56**	**0.74**	**319**

(1) The development site is located within the MS4 service area
(2) RR = Runoff Reduction; ST = Stormwater Treatment (refer to Expert Panel Report on Retrofit Practices)
(3) Quantity Calculated using POC loading rates from Table 2a of the MS4 Permit
(4) Assumed water quality depth of 0.5 inches for conservatism
(5) Values calculated using retrofit curves
(6) Quantity = Pollutant Load * BMP Efficiency

4.2.5 Oversized BMPs

Consistent with Part II, Section 3.3 of the TMDL Guidance Document, credit is available for the capacity provided by oversized BMPs, provided that, "*the excess capacity has not been utilized to offset additional development"*. At the time this Action Plan was developed, documentation was not available to support TMDL credit for oversized BMPs. TMDL credit calculations of this Action Plan may be updated to incorporate credit from oversized BMPs if and when sufficient documentation is compiled to support the credit.

4.2.6 Historical BMPs

Consistent with Part IV Section 2 of the TMDL Guidance Document, historical BMPs are eligible for TMDL credits if they were "*initially installed on or after January 1, 2006 and prior to July 1, 2009 and constructed to address water quality within the permittee's regulated service area*". The City is currently compiling information on its historical BMPs and will amend this action plan to incorporate TMDL credit from these facilities.

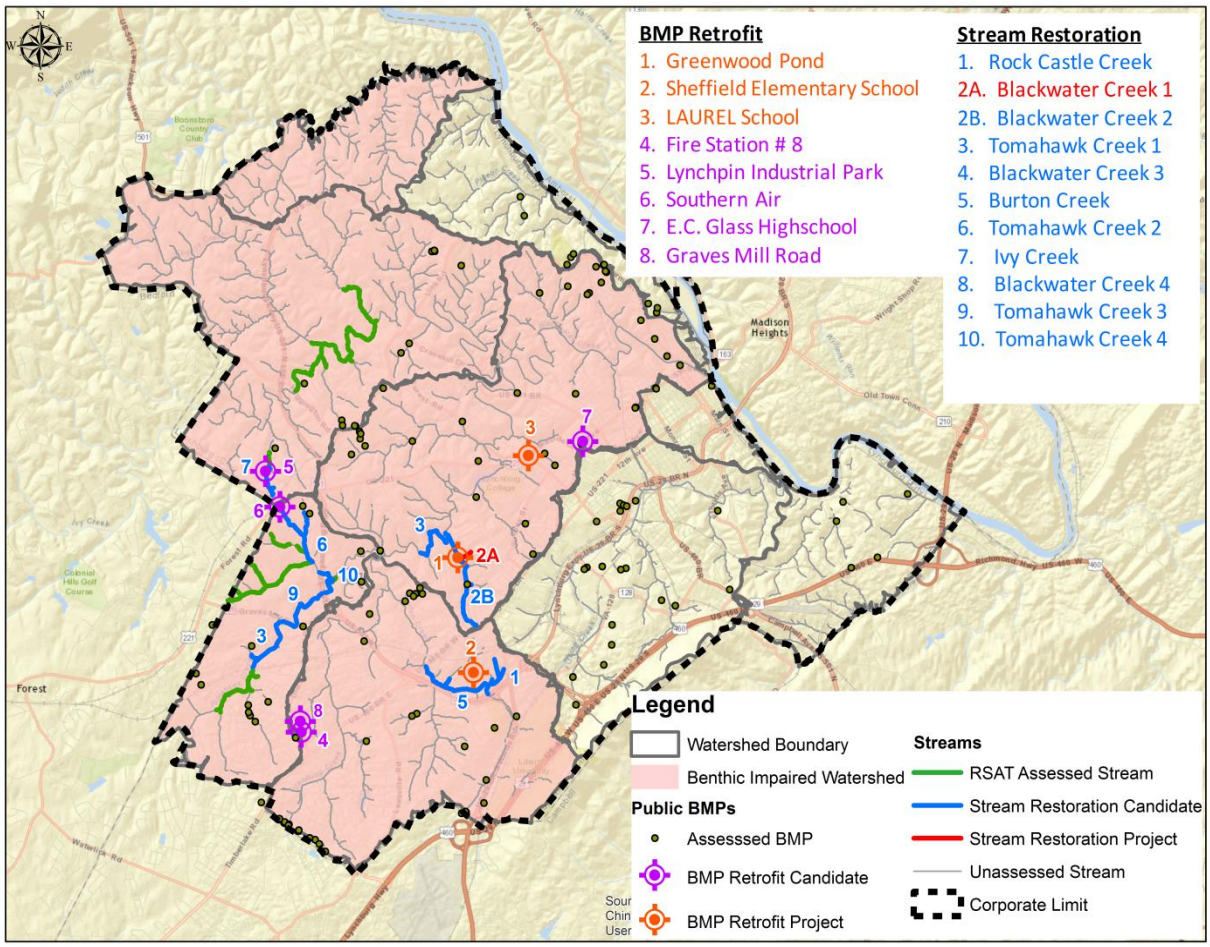
4.3 New Projects to Achieve 1st Permit Cycle Reduction Goals

The City conducted a field investigation program to identify BMP projects to meet its pollutant load reduction requirement for the Chesapeake Bay TMDL. The program consisted of assessing accessible public and private BMPs as well as more than 15 miles of selected streams. The findings of these investigations are described in the subsequent sections. A map of the assessed areas and the projects selected to be implemented under the Chesapeake Bay TMDL Action Plan for the 1st permit cycle is provided in Figure 4-1.

Projects were evaluated and selected based upon a number of criteria including:

- Pollutant reduction cost effectiveness (i.e. $/lb. removed)
- Potential to address local water quality impairments (i.e. benthic impairments)
- Asset condition
- Educational opportunities
- Feasibility / accessibility

Figure 4-1
Field Investigation & Project Evaluation



4.3.1 Retrofit of Existing BMPs

The City assessed 61 public BMPs and 165 private BMPs in the spring of 2014 in order to identify existing facilities with good retrofit potential, among other objectives. "BMP Retrofit" can refer to new facilities or the enhancement of an existing practice, the conversion of a practice from one type to another or the restoration of an existing practice. Conversion, enhancement, and restoration of BMPs are widely viewed as a more cost effective practice than installation of new facilities, and provide the opportunity to address design deficiencies, maintenance headaches, and other undesirable aspects of older facilities. The findings of this assessment were documented in a technical memorandum entitled "BMP Condition Assessment – City of Lynchburg".

In total, eight (8) existing public BMPs were identified as having good retrofit potential. Of the 8 identified BMPs, the top three (3) candidates were selected for implementation under the City's Chesapeake Bay TMDL Action Plan for the 1st permit cycle (see Table 4-6). These projects were selected primarily based upon their pollutant removal cost effectiveness and their potential to address local water quality impairments, as well as opportunities for public educational activities. Detailed descriptions of these projects are provided in Appendix A.

Table 4-6
BMP Retrofit Projects

Location	Project Description	Preliminary Cost Estimate	Receiving Stream	Educational Opportunity
Selected Projects				
Greenwood Pond	Convert detention pond to constructed wetland	$398,000	Blackwater Creek	High
Sheffield Elementary School	Convert dry pond to bioretention basin	$100,300	Rock Castle Creek	High
LAUREL School	Relocate bioretention basin with expanded treatment area	$115,700	Blackwater Creek	High
Alternative Projects				
Graves Mill Road	Enhance level spreader with bioretention	$56,000	Dreaming Creek	None
Fire Station #8	Enhance level spreader with bioretention	$58,000	Dreaming Creek	Some
Lynchpin Industrial Park	Convert dry pond to constructed wetland and add upstream dry swale	$61,000	Ivy Creek	Little
Southern Air	Convert dry pond to constructed wetland	$12,000	Blackwater Creek	None
E.C. Glass High School	Convert dry ponds into dry swale	$52,000	Blackwater Creek	High

The City may update and adjust its project selection as it continues to evaluate these and any other BMP opportunities, such as new retrofit facilities. As such, the selected projects shown in Table 4-6 may change. Although new retrofit facilities were not the focus of the initial field investigation program, they may be evaluated in greater detail during the 2nd permit cycle.

4.3.2 Stream Restoration

The City identified more than 15 miles of stream for assessment using the Rapid Stream Assessment Technique (RSAT). Streams were selected for assessment based upon departmental knowledge of stream bank conditions and the feasibility of potential stream restoration (i.e. accessibility, land ownership, etc.). The RSAT methodology evaluates streams based upon the following categories:

- Channel stability
- Channel scouring / deposition
- Physical in-stream habitat
- Water quality
- Riparian habitat conditions
- Biological indicators

Based upon the findings of the RSAT assessment, approximately nine (9) miles of stream segments were selected for TMDL crediting assessment using the protocols from the "*Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects*", January 2014 (hereafter referred to as the Stream Restoration Expert Panel Report). Stream segments were assessed using the Bank Assessment for Non-point source Consequence of Sediment (BANCS) method which utilizes the Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) to estimate stream bank erosion rates. Assessed stream reaches were prioritized based upon these estimated erosion rates and grouped into ten (10) potential stream restoration projects, as shown in Figure 4-1. The findings of these assessments were submitted in a technical memorandum entitled "Analysis of Total Maximum Daily Load (TMDL) Pollutant Removal Credit from Stream Restoration".

The projects were prioritized, as shown in Table 4-7, primarily based upon stream condition and pollutant removal cost effectiveness, as well as feasibility, accessibility, and location. Of the ten (10) potential stream restoration projects, the City plans to implement the two (2) highest priority projects during the 1st permit cycle. Blackwater Creek (Project 2A) is included in the City's TMDL Action Plan for the 1st permit cycle, whereas Rock Castle Creek (Project 1) will be implemented separately, since the City can meet its POC reduction requirement for the 1st permit cycle without this project (see Table 4-8). Detailed descriptions of these projects are provided in Appendix A.

Table 4-7
Stream Restoration Projects

Stream Name	Length (LF)	Preliminary Cost Estimate
Selected Projects		
Rock Castle Creek (1)	2,570	$2,037,050
Blackwater Creek 1	900	$759,500
Alternative Projects		
Blackwater Creek 2	6,230	$4,944,500
Tomahawk Creek 1	11,120	$11,120,000
Blackwater Creek 3	460	$368,000
Burton Creek	5,860	$5,626,000
Tomahawk Creek 2	6,620	$5,296,000
Ivy Creek	1,930	$996,000
Blackwater Creek 4	4,310	$4,310,000
Tomahawk Creek 3	6,045	$6,045,000
Tomahawk Creek 4	2,815	$2,815,000

(1) The City intends to implement this project during the 1st permit cycle, but it is not part of the TMDL Action Plan (refer to Section 4.3.3 below for more detail).

4.3.3 Project Costs & POC Reduction

As discussed in the previous sections, 3 BMP retrofit projects and 1 stream restoration project were selected for inclusion in the City's Chesapeake Bay TMDL Action Plan for the 1st permit cycle. These projects, as well as the Rock Castle Creek stream restoration project, were included in the City's Stormwater Local Assistance Fund (SLAF) grant application and were awarded funding in December 2014. The SLAF grant is a 50/50 matching grant that reimburses the City for half of the identified project costs. The total cost to implement the TMDL Action Plan projects is estimated to be approximately $1.4 million, plus an additional $2 million for the Rock Castle Creek stream restoration project ($3.4 million in total).

Each of these 5 projects (Rock Castle Creek included) were incorporated into the City's FY-2016 Capital Improvement Plan (CIP), which was approved on May 26, 2015. Therefore, consistent with Part III of the TMDL Guidance Document, the TMDL credits from these 5 projects are provided the protections of the credit guarantee, regardless of future BMP efficiency changes. As demonstrated in Section 4.3, proactive field investigation and early identification of projects for the 1st permit cycle have enabled the City to make wise and

efficient use of limited State and local resources by designing this Chesapeake Bay TMDL Action Plan in a cost effective manner.

It should be noted that the implementation of the Rock Castle Creek stream restoration project is not required to meet the City's 5% reduction requirement of this permit cycle. It is referenced in this document because the City intends to implement this project towards the City's pollutant reduction requirement for the 2nd permit cycle, as shown in Table 4-10. A description of the Rock Castle Creek stream restoration project is provided in Appendix A.

As previously stated, the POC reduction of these 4 projects are sufficient to satisfy the City's remaining pollutant reduction requirement for the 1st permit cycle (refer to Table 3-7). Table 4-8 shows the estimated TMDL credit for each of the projects and the contribution towards meeting the POC reduction requirement for the 1st permit cycle. All pollutant load reduction estimate calculations and TMDL credit estimate calculations have been performed in accordance with and reliance upon the protocols outlined in the TMDL Guidance Document, including pollutant removal efficiencies and associated credit guarantee.

Table 4-8
Action Plan Project Costs &TMDL Credit

Project	Preliminary Cost Estimate	Estimated TMDL Credit (lb/yr)			Contribution Towards Meeting 1st Permit Cycle POC Reduction Requirement (lb/yr)		
		TN	*TP*	*TSS*	*TN*	*TP*	*TSS*
Sheffield Elementary School Bioretention (1), (2), (3), (4), (7)	$100,300	17.52	2.86	1,029	6.4%	4.4%	3.5%
LAUREL School Bioretention (1), (2), (3), (7)	$115,700	23.34	3.24	625	8.5%	5.0%	2.1%
Greenwood Constructed Wetland (1), (3), (4), (5), (7)	$398,000	141.55	27.45	16,668	51.4%	42.0%	56.9%
Blackwater Creek Stream Restoration (6), (7)	$759,500	58.66	59.84	39,867	21.3%	91.5%	136.1%
Total	**$1,373,500**	**241.07**	**93.39**	**58,189**	**87.6%**	**142.9%**	**198.6%**

(1) Calculations utilized the pollutant loads from the Virginia Runoff Reduction Method (VRRM) spreadsheet
(2) Calculations utilized BMP Clearinghouse efficiencies for TP and TN and the retrofit curve efficiencies for TSS
(3) Calculations subtract POC reductions from existing facilities (i.e. TMDL credit = BMP Retrofit – Existing BMP)
(4) Calculations utilized downward modifications of pollutant removal efficiencies for existing BMPs
(5) Calculations utilized BMP efficiencies from the retrofit curves for all POCs
(6) Calculations utilized interim approved removal rates for stream restoration
(7) Calculations account for baseline reductions for unregulated areas

4.3.4 Project Schedule

Table 4-9 shows the annual benchmarks that the City plans to achieve through phased implementation of the selected TMDL Action Plan projects. It should be noted that the benchmarks shown in Table 4-9 represent the City's best estimate for project implementation as of the date of this Action Plan. The Action Plan will be implemented in an adaptive and iterative manner. The City reserves the right to modify the proposed benchmarks as conditions change. In all cases, the pollutant reduction requirements required in the MS4 Permit will be met within the applicable deadline of five years from the Permit's effective date.

Table 4-9
POC Reduction Annual Benchmarks

Permit Year	Projects	Anticipated Cumulative POC Reduction (lb/yr)			Cumulative POC Reduction (% of 1st Permit Cycle POC Reduction Requirement)		
		TN	*TP*	*TSS*	*TN*	*TP*	*TSS*
1	-	0.00	0.00	0	0%	0%	0%
2	Documentation of Existing Projects	342.06	64.29	26675	124.2%	98.3%	91.1%
3	-	342.06	64.29	26675	124.2%	98.3%	91.1%
4	Sheffield Elementary School Bioretention & LAUREL School Bioretention	382.92	70.39	28,329	139.1%	107.7%	96.7%
5	Blackwater Creek Stream Restoration & Greenwood Pond Retrofit	583.13	157.68	84,864	211.8%	241.2%	289.7%

4.4 Alternative Strategies

The City reserves the ability to modify its TMDL Action plan to implement alternative strategies (other than the projects shown in this document) including, but not limited to, the following:

- Alternate POC reduction methods
- Development projects
  - Redevelopment
  - Stricter development requirements
  - Oversized BMPs
- Forest buffers

- Land use conversions
- Pollutant trading
- Public private partnerships
- Street sweeping

4.5 Future Considerations

Documentation of existing projects and the 4 TMDL Action Plan projects achieve a cumulative pollutant reduction that is greater than the City's POC reduction obligation for the 1st permit cycle. Consistent with Part III of the TMDL Guidance Document, all TMDL credits in excess of the 1st permit cycle POC reduction obligation from the projects identified in this Action Plan shall be credited towards the City's POC reduction obligation for the 2nd permit cycle and are provided the protections of the credit guarantee, regardless of future changes in BMP efficiencies. An accounting of this additional credit, as well as the credit from the Rock Castle Creek stream restoration project is provided in Table 4-10. As demonstrated in this section, the City has developed a cost effective and forward thinking plan for compliance with the Chesapeake Bay TMDL.

Table 4-10
TMDL Credit Contribution Towards 2nd Permit Cycle

Item	TMDL Credit (lb/yr)			POC (% of Total Reduction Requirement)		
	TN	*TP*	*TSS*	*TN*	*TP*	*TSS*
Documentation of Existing Projects	342.06	64.29	26,675	6.2%	4.9%	4.6%
TMDL Action Plan Projects	241.07	93.39	58,189	4.4%	7.1%	9.9%
Rock Castle Creek Stream Restoration	180.13	172.09	114,184	3.3%	13.2%	19.5%
TMDL Credit Subtotal	**763.26**	**329.77**	**199,048**	**13.9%**	**25.2%**	**34.0%**
1st Permit Cycle Reduction Requirement	**275.44**	**65.41**	**29,301**	**5.0%**	**5.0%**	**5.0%**
2nd Permit Cycle Contribution	***487.82***	***264.36***	***169,747***	***8.9%***	***20.2%***	***29.0%***

The use of any particular project for compliance with the POC reduction requirements applicable for this permit cycle or future permit cycles is subject to adaptive management. In the case of any adjustments in project inclusion, the project and additional analysis and computations that are performed will be documented in future annual reports. In all circumstances, however, the overall reductions by the City will meet or exceed the Permit's requirements for this permit cycle.

APPENDIX A

Introduction

A description of existing conditions and retrofit/restoration plans for each of the projects the City plans to implement during the 1st permit cycle is provided in the following subsections.

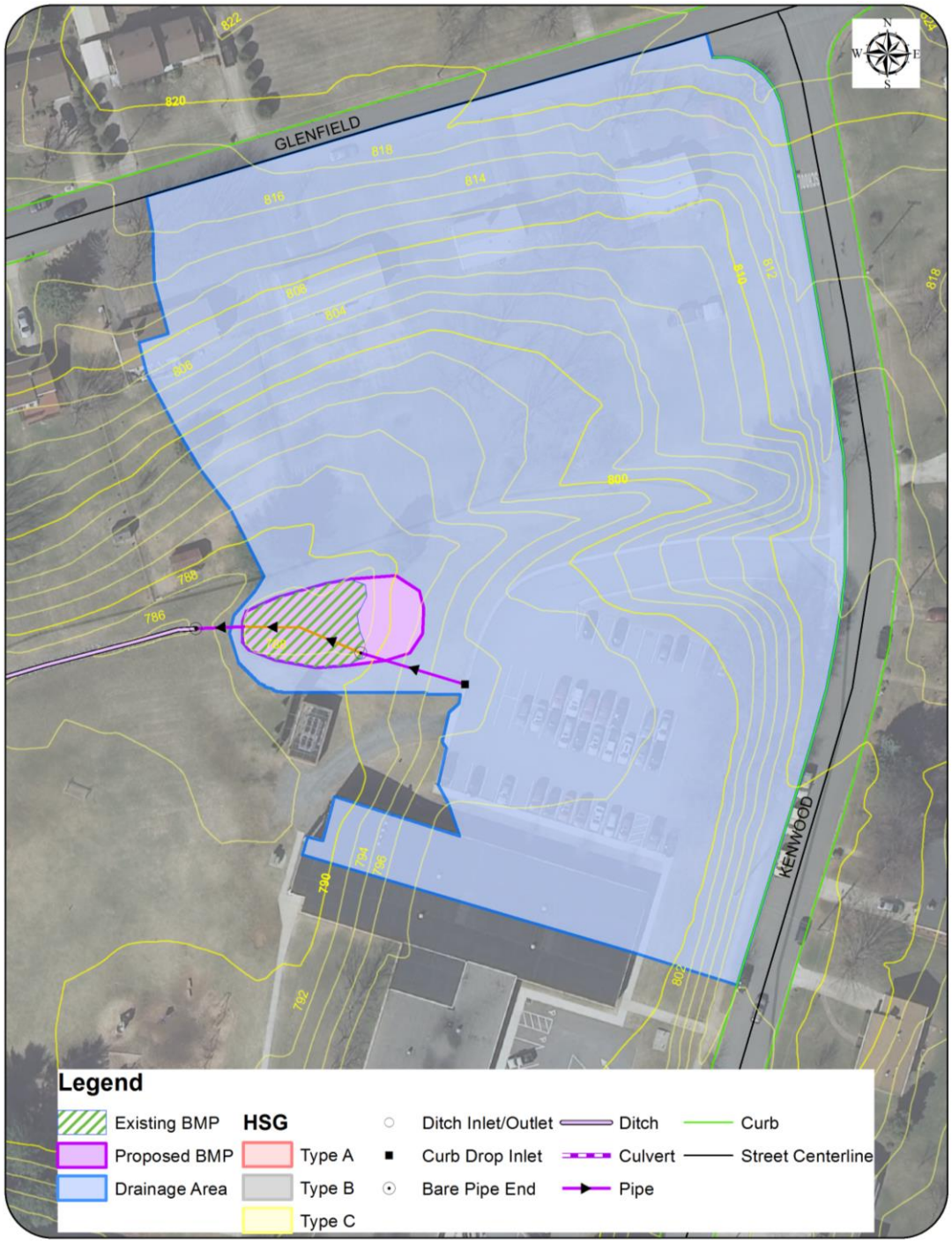
Sheffield Elementary School BMP Retrofit

The BMP retrofit project at Sheffield Elementary School was selected primarily due to the existing facility's retrofit potential, the cost effectiveness of the project, and the opportunity for educational activities. The existing BMP is a shallow dry detention pond with a horizontal pipe outlet set at the invert of the facility. As a result, the facility provides a small amount of water quality storage in its existing condition. A photo of the existing BMP is provided in Figure A-1.

Figure A - 1
Sheffield Elementary School – Existing Stormwater Facility

The retrofit concept for this BMP is to expand the practice area and convert the existing dry detention pond into a level 2 bioretention basin. This will increase the surface area of the practice by approximately 50% and will increase the treatment volume by roughly 4 times the existing volume. This conversion from a dry detention pond to a level 2 bioretention basin will significantly increase the pollutant removal achieved by the practice. The addition of an overflow structure and an underdrain will allow for treated stormwater from the BMP to discharge to the existing riprap ditch downstream. This facility is potentially useful for providing an opportunity for students to have a meaningful watershed experience at their school and promoting environmental literacy in an educational setting. The planned footprint of the BMP retrofit is shown in Figure A-2.

Figure A - 2
Sheffield Elementary School – Proposed BMP Retrofit



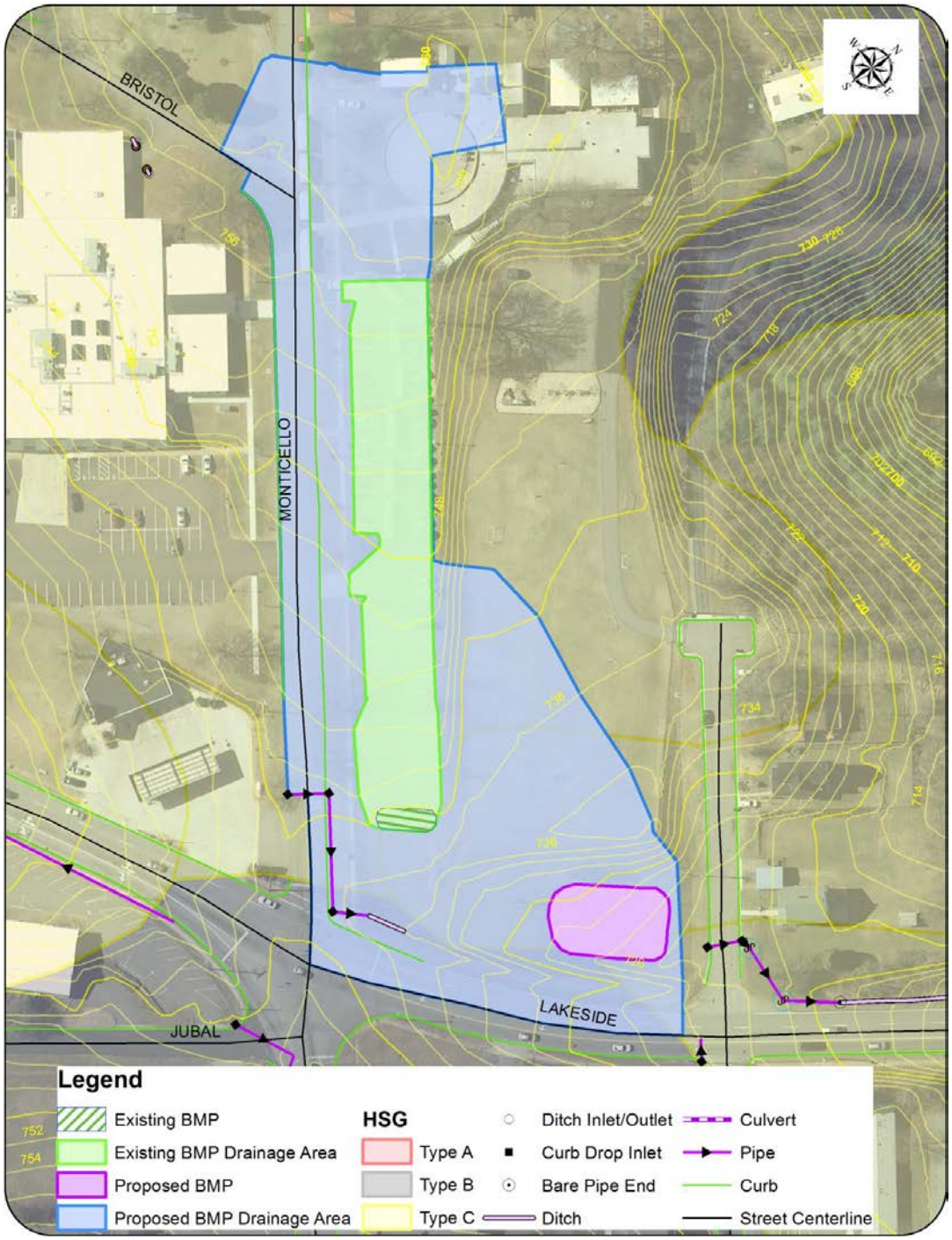
LAUREL School BMP Retrofit

The BMP retrofit project at the LAUREL Regional Program School was selected primarily due to the existing facility's retrofit potential, the cost effectiveness of the project, and the opportunity for educational activities. The existing BMP is a grass covered bioretention basin that serves the school parking lot. The existing location of the bioretention basin is susceptible to concentrated salt/slag loads from deicing the parking lot during winter months. The addition of pre-treatment could help prevent sediment and salts from reaching the facility. Additionally, there is limited vegetation within the basin, which could be added for enhanced water quality benefits. Photos of the existing BMP are provided in Figure A-3.

Figure A - 3
LAUREL School – Existing Stormwater Facility

The retrofit concept for this BMP is to enhance, expand and relocate the practice to an area where it can treat a larger portion of the site and have adequate pretreatment to prevent clogging of the filter media with salt/slag from deicing the parking lot during winter months. The proposed retrofit will increase the surface area of the practice by roughly 5 times and will increase the treatment volume by nearly 7 times. The relocation, expansion, and enhancement of this practice will significantly increase the pollutant removal achieved. The addition of an overflow structure and an underdrain will allow for treated stormwater from the BMP to discharge to the existing catch basin on Rockbridge Avenue. This facility is potentially useful for providing an opportunity for students to have a meaningful watershed experience at their school and promoting environmental literacy in an educational setting. A map of the proposed retrofit plan is shown in Figure A-4.

Figure A - 4
LAUREL School – Proposed BMP Retrofit



Greenwood Pond BMP Retrofit

The BMP retrofit project for Greenwood Pond was selected primarily due to existing facility's retrofit potential and the cost effectiveness of the project. The existing BMP is an in-stream detention pond with a dam and spillway for flood control. The facility was installed in 1998 as part of a combined sewer system separation project. The facility has a low flow channel that allows dry weather flows (and small wet weather flows) to pass through the facility without ponding. Wet weather flows that exceed the capacity of the low-flow channel pond in the facility until the water level reaches the overflow structure, located just below the crest of the dam spillway.

The facility was designed solely for stormwater quantity control and provides very little water quality treatment. The facility is located along a stream with high erosion rates and subsequently large sediment loads, but is not equipped with any pretreatment cells (such as a forebay) to prevent these sediment loads from entering the facility. Photos of the existing facility are provided in Figure A-5.

Figure A - 5
Greenwood Pond – Existing Stormwater Facility

The retrofit concept for this BMP is to convert the existing detention pond into a constructed wetland, which will increase its pollutant removal efficiency. The proposed retrofit will use the same footprint as the existing BMP, but will enhance water quality by installing a fore bay to prevent excess sediment from entering the practice, installing a deep pool for outlet protection, as well a re-grading the stream channel an modifying the outlet structure to prevent short-circuiting. Grading from the retrofit will also tie in with the Blackwater Creek stream restoration project (refer to the next section), which will be performed in conjunction with this project.

Since this facility is located within walking distance of Perrymont Elementary School, it has the potential to provide a unique opportunity for students to have a meaningful watershed experience at their school and to promote environmental literacy in an educational setting. A map of the contributing drainage area to Greenwood Pond is shown in Figure A-6 and a map of the facility footprint is shown in Figure A-7.

Figure A - 6
Greenwood Pond – Contributing Drainage Area

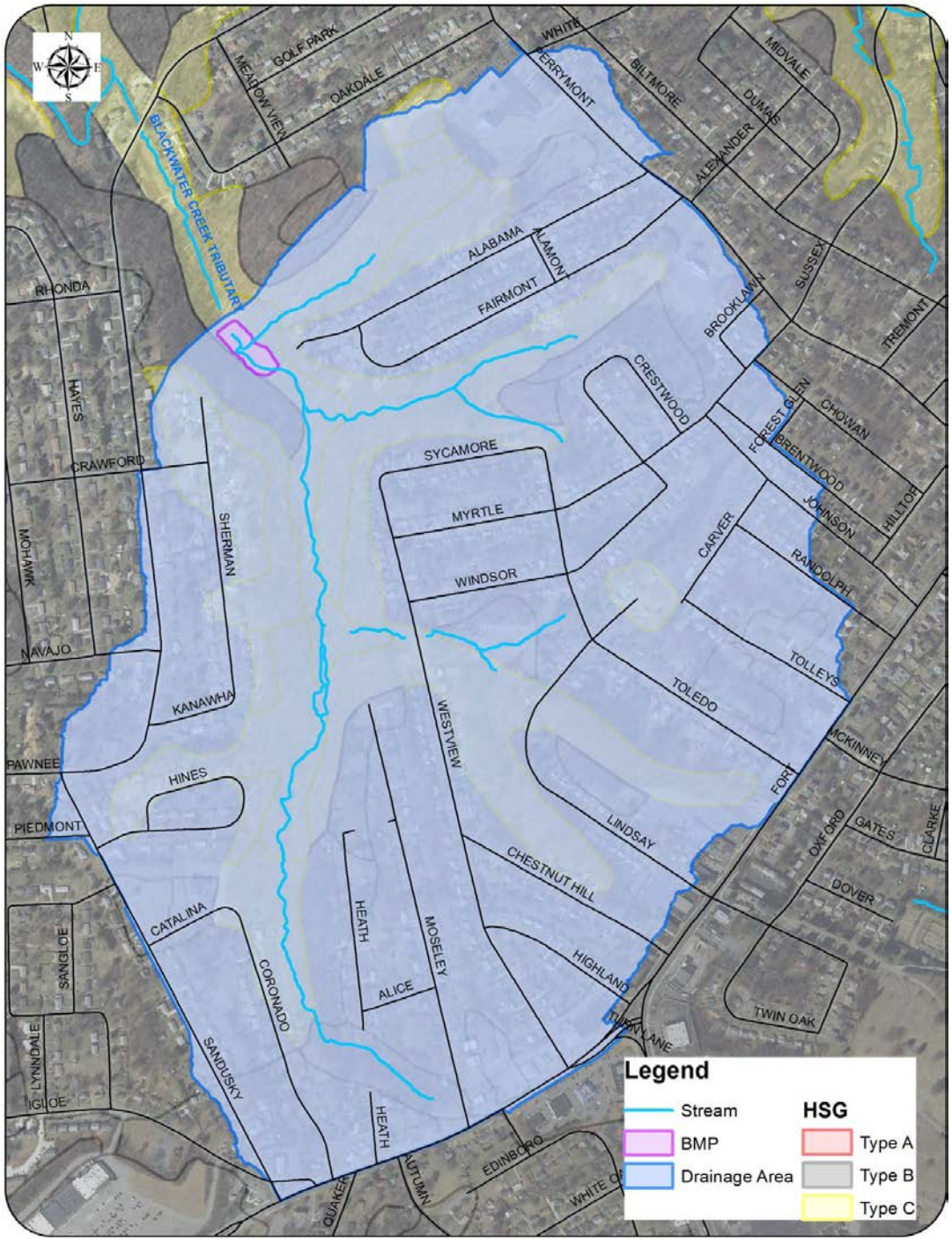
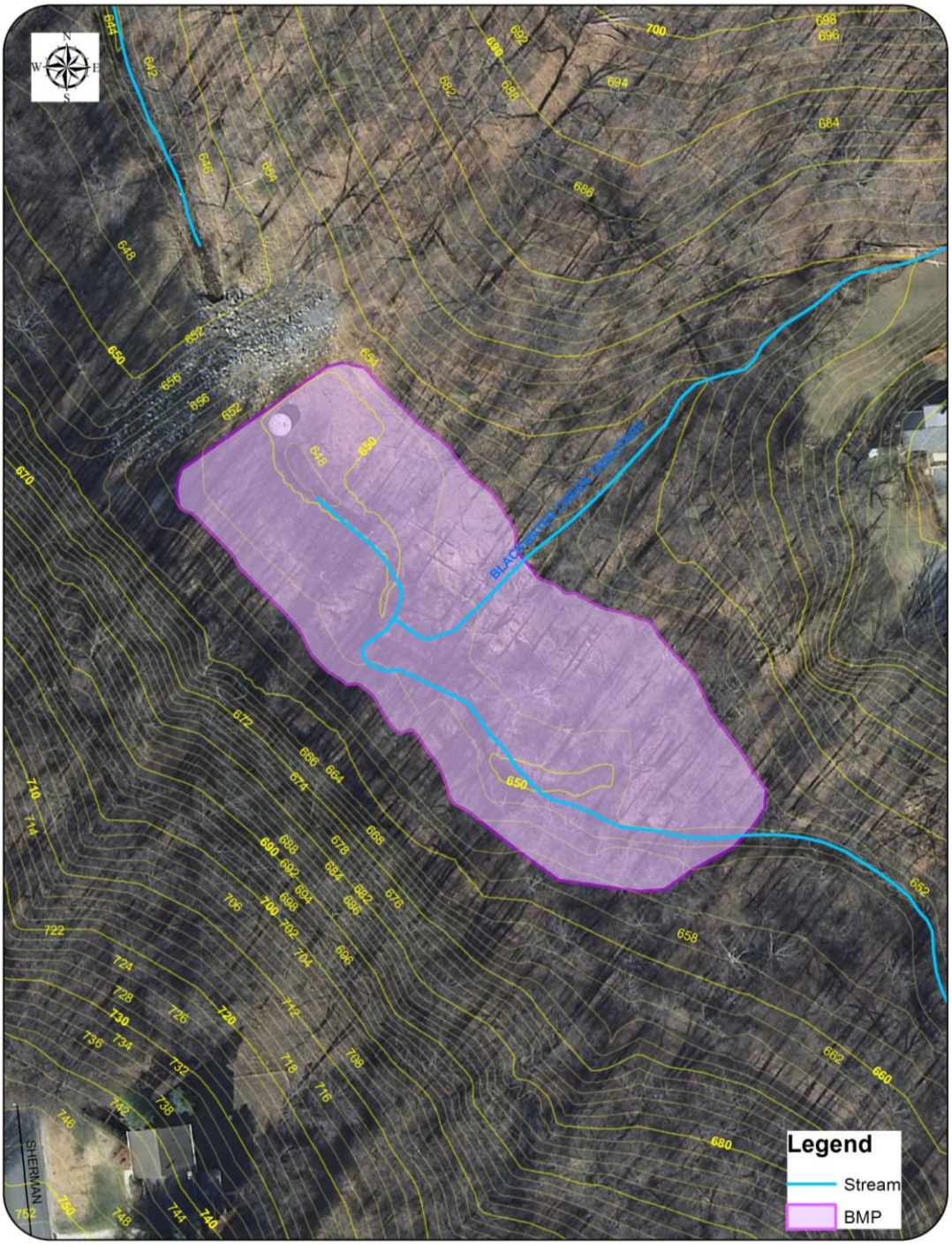


Figure A - 7
Greenwood Pond – Facility Footprint



Blackwater Creek Stream Restoration

Reach 4F of Blackwater Creek was selected primarily due to its high estimated stream bank erosion rate, the cost effectiveness of the project, the accessibility of the stream, and the ability to implement the project in conjunction with the conversion of Greenwood pond to a constructed wetland (refer to the previous section). According to the Virginia Water Quality Assessment 305(b) / 303(d) Integrated Report (January 2014), "*Blackwater Creek is an urban stream with many non-point sources of pollution, in addition to scouring and high sediment loads during rain events*". Photos of the existing stream bank condition along this reach are depicted in Figure A-8.

Figure A - 8
Blackwater Creek Reach 4F – Existing Stream Bank Condition

Bank Type A

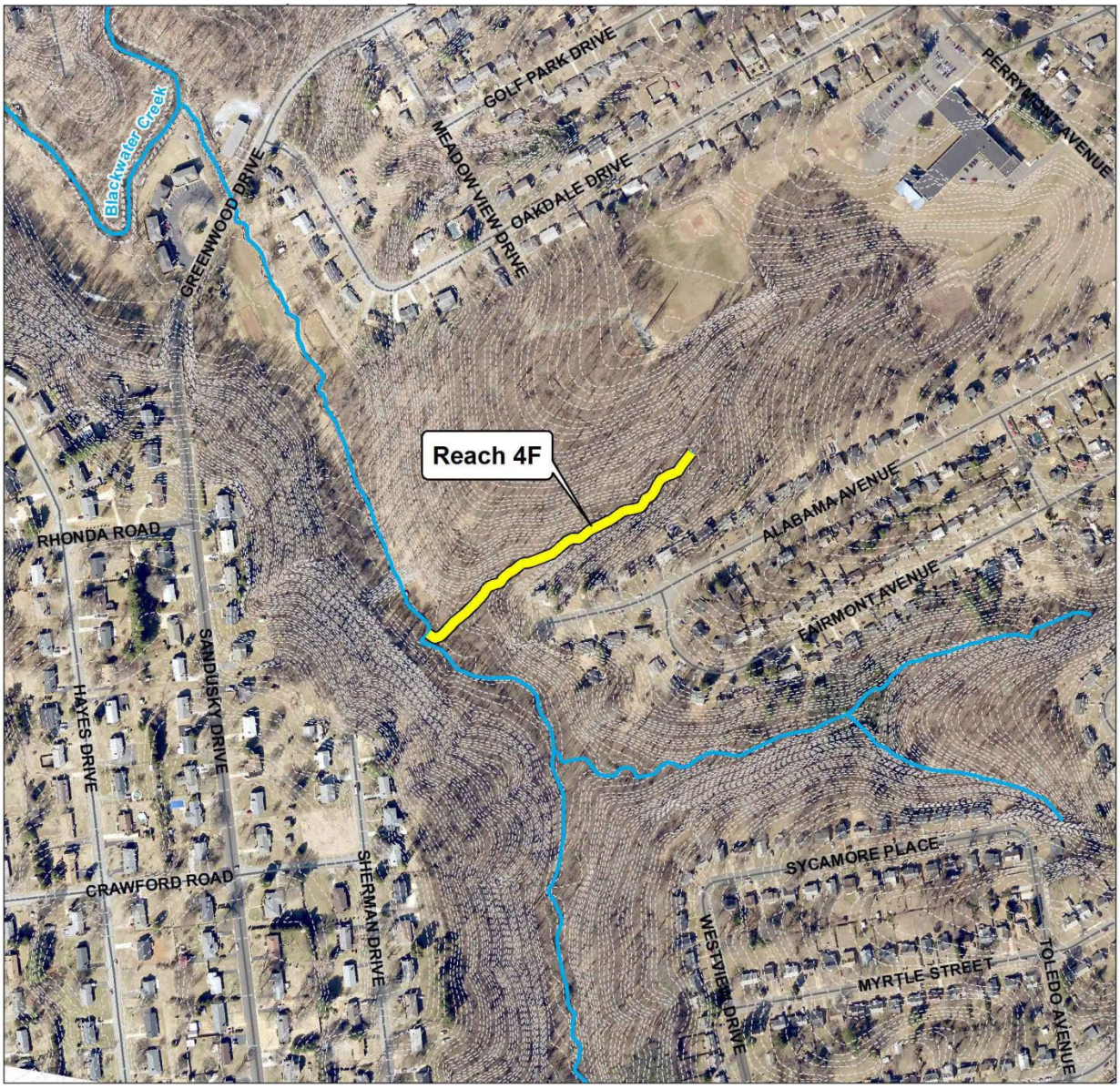
Bank Type B

Bank Type C

Bank Type D

The restoration of this stream reach will return stability to a badly degraded urban stream channel. This will not only reduce pollutant loads to downstream receiving waters, but will also greatly improve the ecological function of the channel and adjacent floodplain, as well as provide significant societal benefits in the form of an aesthetically pleasing riparian corridor in an urbanized area. A map of Reach 4F is provided in Figure A-9.

Figure A - 9
Blackwater Creek – Stream Restoration



Rock Castle Creek Stream Restoration

Reaches 5C, 5D, 5E, and 5G of Rock Castle Creek were selected to be included in the City's SLAF grant application primarily due to its high estimated stream bank erosion rate (highest of all assessed streams) and the cost effectiveness of the project. It should be noted that this project is currently not part of the City's TMDL Action Plan to reach its 1st permit cycle reduction requirements, but is part of the City's strategy for addressing its future obligations in the 2nd permit cycle. According to the Virginia Water Quality Assessment 305(b) / 303(d) Integrated Report (January 2014), the streams downstream of this project "*suffer from heavy algal growth in addition to fine sediments covering the stream bottom*". Photos of the existing stream bank condition along each of these reaches are depicted in Figure A-10, Figure A-11, Figure A-12, and Figure A-13.

Figure A - 10
Rock Castle Creek Reach 5C – Existing Stream Bank Condition

Bank Type A

Bank Type B

Figure A - 11
Rock Castle Creek Reach 5D – Existing Stream Bank Condition

Bank Type A

Bank Type B

Bank Type C

Bank Type D

Bank Type E

Figure A - 12
Rock Castle Creek Reach 5E – Existing Stream Bank Condition

Bank Type A

Bank Type C

Bank Type D

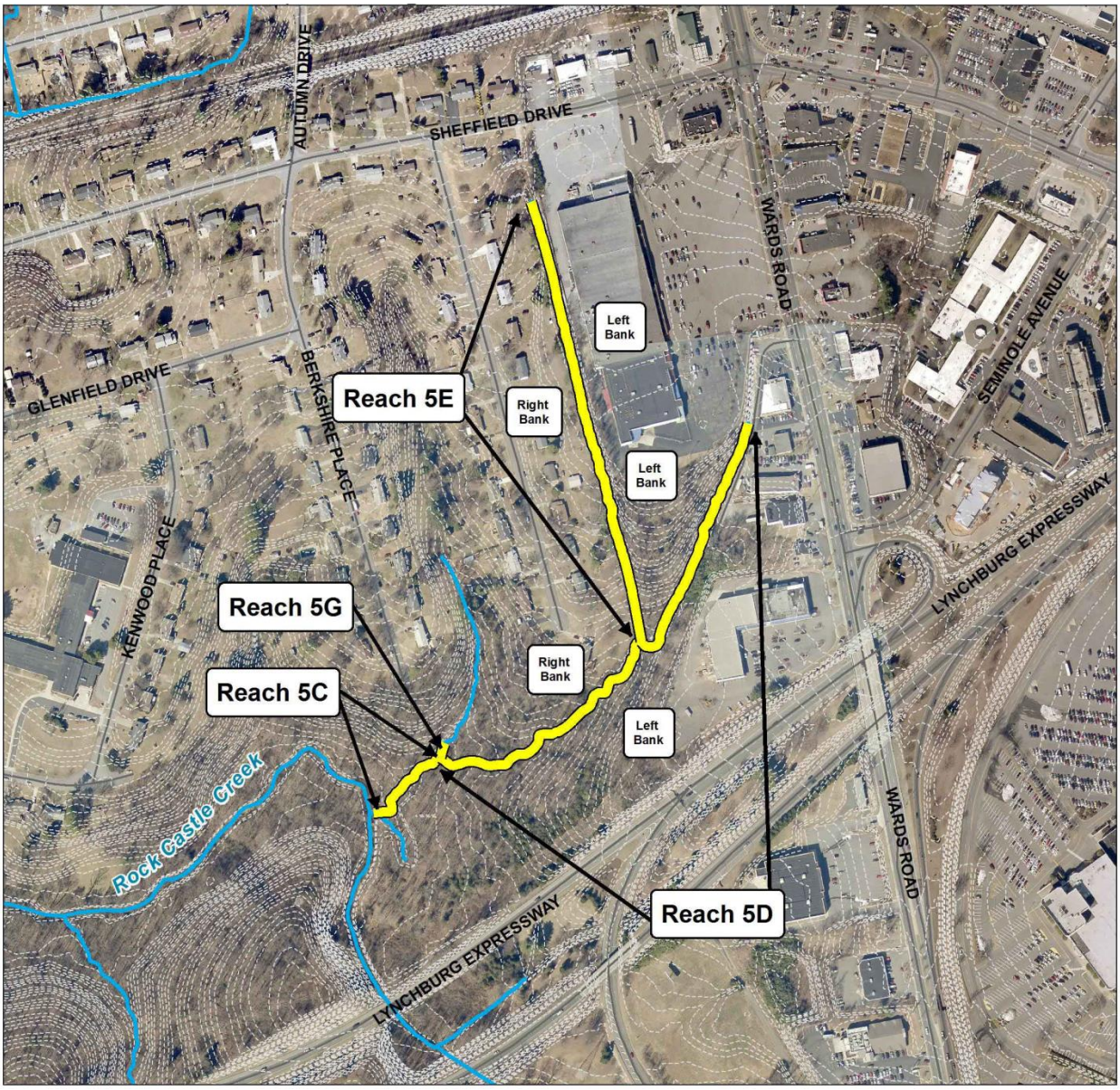
Bank Type B

Figure A - 13
Rock Castle Creek Reach 5G – Existing Stream Bank Condition

Bank Type A

The restoration of Reaches 5C, 5D, 5E, and 5G will return stability to badly degraded urban stream channels. This will not only reduce pollutant loads to downstream receiving waters, but will also greatly improve the ecological function of the channel and adjacent floodplain, as well as provide significant societal benefits in the form of an aesthetically pleasing riparian corridor in an urbanized area. A map of these stream reaches is provided in Figure A-14.

Figure A - 14
Rock Castle Creek – Stream Restoration



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