Bynum Run Watershed Total Maximum Daily Load Restoration Plan for Sediment

March 2016

Prepared for:
Harford County
Department of Public Works
212 South Bond Street
Bel Air, MD 21014

Prepared by:
URS Corporation
12420 Milestone Center Drive, Suite 150
Germantown, MD 20876

BYNUM RUN WATERSHED
TOTAL MAXIMUM DAILY LOAD
RESTORATION PLAN FOR SEDIMENT

March 2016

Prepared for:

Harford County
Department of Public Works
212 South Bond Street
Bel Air, MD 21014

Prepared by:

URS Corporation
12420 Milestone Center Drive, Suite 150
Germantown, MD 20876

ACRONYMS AND ABBREVIATIONS iii

EXECUTIVE SUMMARY ES-1

SECTION ONE: INTRODUCTION 1-1
1.1 Watershed Description 1-2
1.2 MDE-Designated Use of Surface Waters 1-2
1.3 Development of TMDL For Bynum Run 1-2
1.4 Sources of Sediment Impairment 1-5
1.4.1 Point Sources 1-5
1.4.2 Non-Point Sources 1-6
1.5 TMDL Allocations for Harford County 1-6
1.6 Requirements of a TMDL Restoration Plan 1-7
1.7 Goals of Bynum Run Sediment TMDL Restoration Plan 1-8
1.8 Restoration Planning in tier ii waters 1-8

SECTION TWO: BYNUM RUN WATERSHED CHARACTERIZATION 2-1
2.1 Physiography and Soils 2-1
2.2 Land Use and Impervious Cover 2-2
2.2.1 Land Use 2-2
2.2.2 Impervious Cover 2-3
2.3 Water Quality Conditions 2-7
2.4 Stormwater Management 2-7
2.4.1 Structural Stormwater Controls 2-7
2.4.2 Non-structural Stormwater Controls 2-8
2.5 Assessment of Sediment Loads 2-9
2.5.1 Defining the Harford County Urban Areas 2-9
2.5.2 Baseline Conditions Scenario 2-11
2.5.3 Current Load Conditions Scenario 2-12

SECTION THREE: RESTORATION STRATEGIES 3-1
3.1 Structural Stormwater Management Strategies 3-1
3.1.1 High Priority Proposed Projects 3-2
3.1.2 Medium Priority Projects 3-6
3.1.3 Low Priority Projects 3-10
3.2 Alternative Urban BMPs 3-12
3.3 Programmatic Strategies 3-12
3.4 Summary 3-15

SECTION FOUR: FUNDING AND TECHNICAL ASSISTANCE 4-1
4.1 Potential Funding Sources 4-1
4.2 Technical Assistance 4-1

SECTION FIVE: IMPLEMENTATION SCHEDULE 5-1

SECTION SIX: MONITORING AND EVALUATION 6-1

6.1 Evaluating Progress of Proposed Restoration Strategies 6-1
6.2 Water Quality Monitoring..... 6-1
6.3 Inspection and Maintenance 6-2

SECTION SEVEN: REFERENCES 7-1

Appendices

Appendix A Proposed Restoration Strategies for the Bynum Run Watershed
Total Maximum Daily Load Restoration Plan for Sediment

Figures

Figure 1-1: Location of Bynum Run Watershed and the Town of Bel Air..... 1-3
Figure 2-1: 2014 Land use distribution in the Bynum Run Watershed 2-2
Figure 2-2: Physiographic setting and Hydrologic Soil Group distribution in the Bynum Run Watershed 2-4
Figure 2-3: Land use distribution in the Bynum Run Watershed 2-5
Figure 2-4: Impervious cover in the Bynum Run Watershed in 2000, 2007, and 2014 2-6
Figure 2-5: Harford County MS4 Areas in Bynum Run Watershed 2-10
Figure 3-1: Locations of proposed high priority projects 3-5
Figure 3-2: Locations of proposed medium priority projects..... 3-9
Figure 3-3: Locations of proposed low priority projects 3-11

Tables

Table 1-1: EPA-Approved TMDLs in Harford County 1-1
Table 1-2: MDE-Designated Use Classes for Surface Waters 1-2
Table 1-3: Point Sources in Bynum Run Watershed 1-5
Table 1-4: TSS Discharge Permit Limits for Lafarge-Churchville Quarry..... 1-6
Table 1-5: TMDL Allocation for Stormwater Point Sources in Bynum Run 1-7
Table 2-1: Hydrologic Soil Group Distribution in the Bynum Run Watershed 2-2
Table 2-2: Existing Structural Stormwater Controls in Bynum Run Watershed..... 2-8
Table 2-3: Land Uses included in the Baseline Conditions Scenario 2-11
Table 2-4: BMPs included in the 2005 Baseline Conditions Scenario..... 2-12
Table 2-5: Stream Restoration Projects included in the Baseline Conditions Scenario 2-12
Table 2-6: EOS Sediment Loads from the Baseline Conditions Scenario..... 2-12
Table 2-7: Land Uses included in the Current Load Conditions Scenario..... 2-13
Table 2-8: BMPs Included in the Current Load Conditions Scenario..... 2-13
Table 2-9: Stream Restoration Projects included in the Current Load Conditions 2-14
Table 2-10: EOS Sediment Loads from the Current Load Conditions Scenario 2-14

Table 3-1: High Priority Structural BMP Restoration Projects 3-3
Table 3-2: High Priority Stream Restoration Projects 3-3
Table 3-3: Medium Priority Structural BMP Restoration Projects 3-7
Table 3-4: Low Priority Structural BMP Restoration Projects 3-10
Table 3-5: Low Priority Structural BMP Restoration Projects 3-15
Table 4-1: Potentially Available Funding Sources for the Implementation of Restoration Strategies 4-2
Table 5-1: Cost and Benefits of Implementation through 2019 5-2
Table 5-2: Implementation Schedule for Restoration Projects 5-3
Table A1: High Priority – Structural BMPs 1
Table A2: High Priority – Stream Restoration Projects 5
Table A3: Medium Priority – Structural BMPs 5
Table A4: Low Priority – Structural BMPs 14
Table A5: High Priority – Alternative Urban BMPS 17

12-SW	Industrial General Permit for Stormwater Discharges
BayFAST	Chesapeake Bay Facility Assessment Scenario Tool
BMP	best management practice
BSID	Biological Stress Identification
CBP	Chesapeake Bay Program
CIP	Capital Improvement Program
COMAR	Code of Maryland Regulations
County	Harford County
CWA	Clean Water Act
DPW	Harford County Department of Public Works
EOS	edge of stream
EPA	U.S. Environmental Protection Agency
ESC	Erosion and Sediment Control
ESD	environmental site design
GIS	geographic information system
HOA	Homeowners Association
HSG	Hydrologic Soil Group
lb	pound
MDE	Maryland Department of the Environment
MD SHA	Maryland State Highway Administration
MDRC	General Permit for Stormwater Discharges Associated with Construction Activity
MGD	millions of gallons per day
mg/l	milligrams per liter
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NTU	Nephelometer Turbidity Unit
Plan	Bynum Run Watershed Total Maximum Daily Load Restoration Plan for Sediment
SPSC	step pool storm conveyance system
TMDL	Total Maximum Daily Load
TSS	total suspended solids
URS	URS Corporation

EXECUTIVE SUMMARY

Harford County Department of Public Works (DPW) has developed this Bynum Run Watershed Total Maximum Daily Load (TMDL) Restoration Plan for Sediment (This plan or Bynum Run Restoration Plan). The County's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit (11-DP-3310, MD0068268) requires the development of restoration plans for EPA approved TMDL stormwater waste load allocations (SW-WLA).

Bynum Run watershed has an approved TMDL for sediment established by the Maryland Department of Environment (MDE) and approved by the U.S Environmental Protection Agency (EPA), *Total Maximum Daily Load of Sediment in the Bynum Run Watershed, Harford County, Maryland* (MDE, 2011a) (TMDL Document).

According to the TMDL Document, "Urban land was identified as the only predominant controllable source in the watershed at 76.7% of the total watershed sediment load. Thus, reductions were only applied to this source." The report also states that MDE has expanded the watershed restoration component of the MS4 permits by stating "Theoretically extending these permitting requirements to all urban stormwater sources (i.e., not solely those sources regulated via Phase I MS4 permits) would require that all impervious areas developed prior to 1985 be retrofit at this pace."

With regard to the expansion of restoration in the TMDL Document, the County submits that Part I B. of the County's MS4 permit correctly defines the MS4 Permit Area. Outside of the permit, MDE has expressed a more expansive interpretation of the regulated permit area. The Bynum Run Restoration Plan is conservatively based on MDE's interpretation. However, the County expressly reserves its rights to reduce the load reduction goals for this plan to the minimum required by law. In addition, the County expressly reserves the right to make future refinements to this plan upon new or additional information consistent with an adaptive management approach or based upon financial, operational or legal considerations that impact the implementation of this plan.

A TMDL is defined as the maximum pollutant load a waterbody can assimilate without exceeding the State's water quality standard for the waterbody's designated use class. Bynum Run and its tributaries are identified as Use Class III, or swimming, boating, fishing, protection of aquatic life and wildlife, and shellfish harvesting and propagation and growth of natural trout.

In general, a TMDL is made up of two major components:

- **Wasteload Allocations (WLA)** including point sources such as NPDES MS4 regulated urban stormwater (SW-WLA), industrial facilities that have permitted stormwater discharges, and wastewater treatment plants.
- **Load Allocations (LA)** including non-point sources such as unregulated stormwater from urban, agriculture, forest and pasture.

Based on these assumptions, the Bynum Run TMDL document establishes a 19.7% sediment load reduction from baseline conditions (2005) for all urban areas within Harford County, excluding the Town of Bel Air.

For this plan, the Chesapeake Bay Facility Assessment Scenario Tool (BayFAST) was used to model the baseline conditions (2005) and the current conditions (2015) using local level data for landuse, forest cover, stormwater management facilities and completed watershed restoration. The model was also used to determine the level of restoration necessary to address the TMDL for sediment.

Three categories of restoration strategies were considered:

- **Structural Stormwater Management Strategies:** These include ESD (environmental site design) and traditional structural BMPs (best management practices) that are designed to the current MDE stormwater management standards and remove sediment through processes such as filtration and infiltration.
- **Alternative Urban Strategies:** Alternative urban strategies do not generally require detailed design and are aimed at conservation of natural resources through adoption of techniques such as tree planting, and converting existing impervious areas to pervious areas. These strategies are approved by MDE and can provide flexibility for jurisdictions to address their NPDES MS4 and TMDL goals.
- **Programmatic Strategies:** These include recommendations to enhance the County's existing programs as well as potential new programs that could be adopted by the County and may include educating residents on pollution prevention and natural resources conservation practices.

Restoration strategies were further grouped based on property ownership, ease of permitting and cost benefit as follows:

- **High Priority**: Restoration located on County-owned properties.
- **Medium Priority**: Restoration located on HOA (homeowners association) owned properties.
- **Low Priority**: Restoration located on commercially or industrially owned properties.

Models scenarios were calculated for each grouping of priority to determine the load reductions based on implementation. Costs were also determined for the categories of restoration based on *Costs of Stormwater Management Practices in Maryland Counties* (King and Hagan, 2011).

Implementing the high priority projects and a portion of the medium priority projects would address the Bynum Run TMDL for sediment at a cost of over $41 M. A summary of the model scenarios is listed below:

Table ES-1: Bynum Run Loads based on Proposed Strategies

Priority	Load Reductions (tons / yr)	Load Reduction (%)	Costs (millions)
High	134	10.9%	$11.5
Medium 1	138	11.3%	$30.0
Medium 2	26	2.1%	$25.5
Low	49	4%	$21.7
Total	347	28.3%	
Target Load	250	20.7%	

A $10 M budget has been developed for the MS4 program based on a portion of projected revenues from the recordation tax as established within Harford County Resolution 15-005. Harford County estimates allocating 25% of the budget for the implementation of this plan, or $2.5 M annually. Through the expiration of the County's MS4 permit in 2019, approximately 20% of the sediment load is projected to be reduced or 40 tons per year.

Table ES-2:Cost and Benefits of Implementation through 2019

Design Component	2016 (Thousands)	2017 (Thousands)	2018 (Thousands)	2019 (Thousands)	2016 - 2019 (Thousands)
Planning	$400	$80	$70	$80	$630
Design	$300	$620	$630	$620	$2,170
Construction	$300	$1,300	$1,300	$1,300	$4,200
Total	**$1,000**	**$2,000**	**$2,000**	**$2,000**	**$7,000**
*** Estimated Sediment Load Reduction (tons)**	**2.9**	**12.4**	**12.4**	**12.4**	**40.0**

* Estimated Sediment Load Reduction = Construction cost / 70% * $150,000 /ton

Average cost per ton for High and Medium Priorities = $150,000; Average construction cost = 70% total cost

In 2016, Harford County anticipates completing a watershed assessment for the Upper Bynum Run watershed and initiating a monitoring program. The assessment will provide field collected survey data and potentially identify additional restoration opportunities which are more cost effective. The monitoring program will provide long term trends towards addressing the sediment TMDL.

Based on spending $2.5 M annually for the implementation of this plan, the TMDL for sediment could be addressed by 2032. This is an estimated schedule based on projections for recordation tax revenues that fluctuate annually with home sales, and the ability for Harford County to secure bonds.

These projections are not a guarantee for future funding nor does this plan bind Harford County to complete proposed projects identified within this plan on this time schedule identified in this plan. This plan is intended to be updated annually to incorporate additional information as it becomes available and as a demonstration of progress towards addressing the SW-WLAs within the Bynum Run watershed.

The County notes that although a target of 2032 is provided, the pace of implementation will be driven by the maximum extent practicable (MEP) compliance standard for MS4s. Strict compliance with water quality standards and TMDL SW-WLAs is not required for MS4s. The County expressly reserves the right to extend the 2032 estimated timeframe as needed based on MEP factors, including, but not limited to, funding and operational factors impacting BMP installation. In addition, although trading is not reflected in this version of the plan, the County reserves the right to participate in any authorized trading program at its discretion, and may revise this plan accordingly.

SECTION ONE: INTRODUCTION

The Bynum Run Watershed Total Maximum Daily Load (TMDL) Restoration Plan for Sediment (Plan) developed by the Harford County (County) Department of Public Works (DPW) will serve as a guidance document for the County to reduce sediment in the Bynum Run Watershed. This TMDL was established by Maryland Department of Environment (MDE) and approved by the U.S. Environmental Protection Agency (EPA) in September 2011.

On December 30, 2014, MDE reissued the Phase I National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit to the County. The permit has several new requirements, including stringent stormwater management criteria, implementation of strategies to reduce litter and floatables, and development of restoration plans. Part IV.E.2.b of the NPDES MS4 permit requires the County to develop restoration plans to address stormwater wasteload allocations (SW-WLAs) for the waterbodies in the County that have EPA-approved TMDLs. Attachment B of the County's NPDES MS4 permit lists eight waterbodies in the County that have TMDLs for various impairments. Table 1-1 lists the waterbodies, type of TMDL, and the impairment.

Table 1-1: EPA-Approved TMDLs in Harford County

Type of TMDL	Watershed	Impairment
Local	Bynum Run	Sediment
	Swan Creek	Nutrients
	Loch Raven Reservoir (Non-Tidal)	Bacteria
	Loch Raven Reservoir	Mercury
	Loch Raven Reservoir	Nutrients and Sediment
Chesapeake Bay	Bush River Oligohaline	Nutrients and Sediment
	Gunpowder River Oligohaline	Nutrients and Sediment
	Chesapeake Bay Mainstem 1 Tidal Fresh	Nutrients and Sediment
	Chesapeake Bay Mainstem 2 Oligohaline	Nutrients and Sediment

This Plan only addresses the Bynum Run TMDL. The Bynum Run Watershed (MDE 8-digit: 02130704), a subwatershed of Bush River Watershed (MDE 6-digit: 021307), lies entirely in Harford County and includes the Town of Bel Air, a Phase II NPDES MS4 community. The watershed also includes State-owned properties such as Bynum Run Park and Bynum Run Conservation area and State highways. Figure 1-1 shows the location of Bynum Run Watershed in Harford County, and where it overlaps the Town of Bel Air.

1.1 WATERSHED DESCRIPTION

Bynum Run Watershed is the most urban watershed in the County. The watershed is in the southeastern portion of Harford County. It begins at the intersection of Rock Spring Road and East Jarrettsville Road in Forest Hill and extends southeast to the confluence with James Run at Bush Declaration Natural Resources Management Area, north of Pulaski Highway. These streams converge and drain to Bush River. Approximately 50 percent of the Town of Bel Air, the portion of the town east of Main Street, is in the Bynum Run Watershed.

1.2 MDE-DESIGNATED USE OF SURFACE WATERS

MDE has classified all the waterbodies in the State including streams, impoundments, and tidal waters based on their designated use [Code of Maryland Regulations (COMAR) Section 26.08.02.08]. Table 1-2 identifies the use classes designated by MDE for surface waters.

Table 1-2: MDE-Designated Use Classes for Surface Waters

Class	Designated Use
I	Swimming, boating, fishing and other activities involving water contact, protection of aquatic life and wildlife (basic water use)
I-P	All basic water use and public water supply
II	All basic water uses and support estuarine and marine aquatic life and shellfish harvesting
II-P	All Use II and public water supply
III	All basic water uses and shellfish harvesting and propagation and growth of natural trout waters
III-P	All Use III and public water supply
IV	All basic water uses and recreational trout waters
IV-P	All Use IV and public water supply

Bynum Run and its tributaries are classified as Designated Use Class III waters, which support water contact recreation, and propagate growth of trout and other cold water aquatic life. There is one impoundment in the watershed, Bynum Run Community Lake located in Bynum Run Park which is also classified as Designated Use Class III.

1.3 DEVELOPMENT OF TMDL FOR BYNUM RUN

A TMDL is a calculation of the maximum amount of a pollutant a water body can receive and still meet the State water quality standards and designated uses. TMDLs are generally developed using pollutant load models or mathematical models that are calibrated using monitoring data.

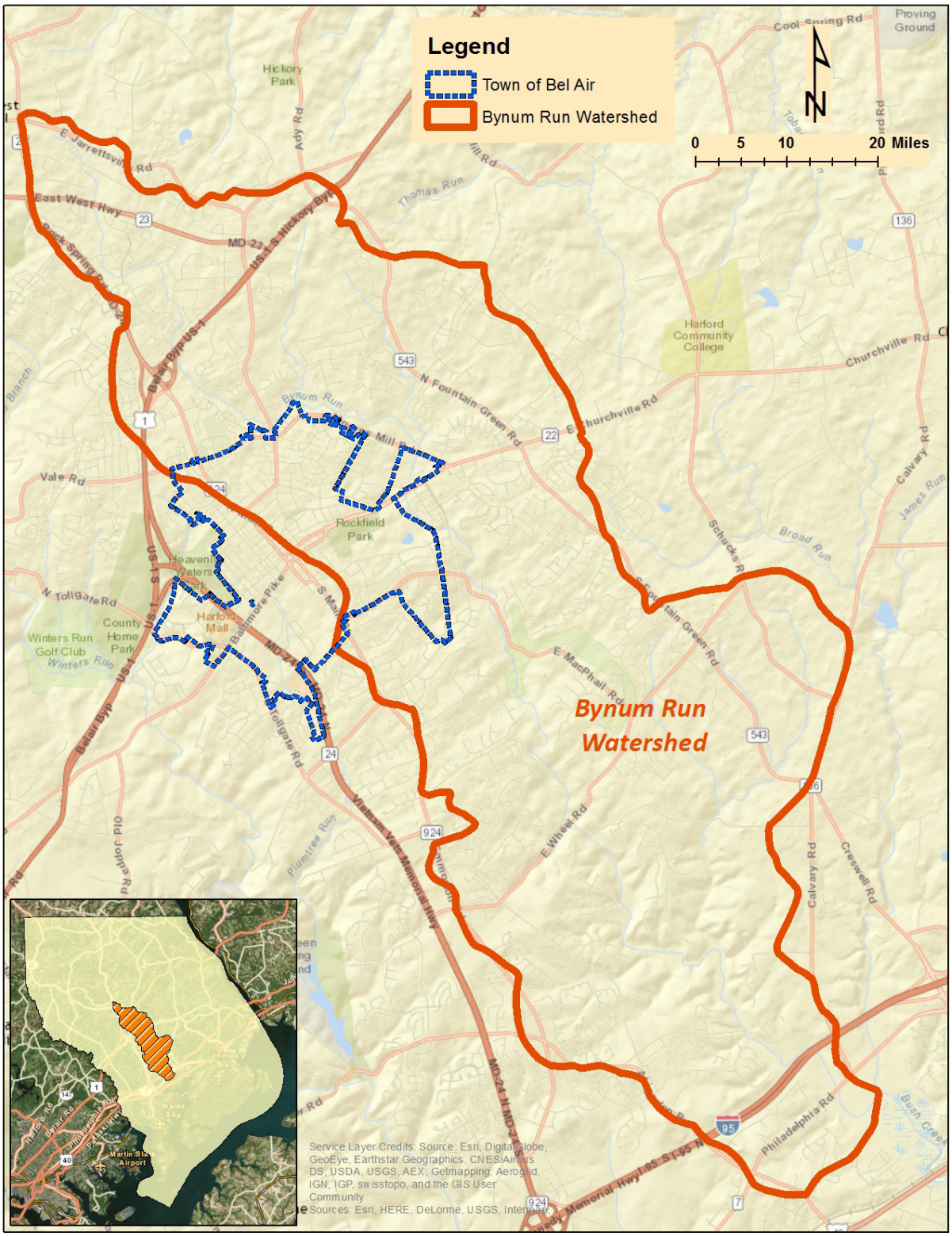


Figure 1-1: Location of Bynum Run Watershed and the Town of Bel Air

In general, a TMDL is made up of two major components:

- Wasteload allocation (WLA) includes point sources such as NPDES MS4-regulated urban stormwater (referred to as the SW-WLA) and industrial facilities that have permitted stormwater discharges and waste water treatment plants.
- Load allocation (LA) includes non-point sources such as unregulated stormwater from urban, agricultural, forested, and pasture areas.

In addition to these two components, TMDLs also include Margin of Safety (MOS), which accounts for any uncertainty in the TMDL analyses. A TMDL can be represented using the following equation:

$$\begin{aligned}&\textit{Total Maximum Daily Load}\\&\quad = \textit{Sum of Load Allocations} + \textit{Sum of Waste Load Allocations}\\&\quad + \textit{Margin of Saftey}\end{aligned}$$

$$TMDL = \sum LA + \sum WLA + MOS$$

Bynum Run Watershed was identified as impaired by sediment in the 2008 Integrated Report developed by MDE for Sections 305(b) and 303(d) of the Clean Water Act (CWA). To estimate the impact of sediment loads, MDE has used Biological Stressor Identification (BSID) methodology. Based on the results of the BSID analysis, MDE concluded that biological communities within the watershed were impacted by high flows and sediment-related stresses. To address the concerns about the sediment loads in the Bynum Run Watershed and to meet the requirements of the CWA, MDE developed a TMDL for sediment impairment for the watershed. Even though EPA approved the TMDL in 2011, MDE used 2005 data to develop it; therefore, 2005 is identified as the “baseline year” throughout this plan.

According to the TMDL Document for sediment impairment for Bynum Run Watershed (MDE, 2011a), sediment loads for the Bynum Run Watershed were estimated using the edge-of-stream (EOS) calibration target loading rates of the Chesapeake Bay Program (CBP) Phase 5.2 watershed model. Watershed-specific land use factors and erosion rates were used to calculate sediment loads from non-point sources as well as point sources such as the NPDES MS4 Phase I and II communities, which do not have limits for TSS concentrations. Sediment loads from point sources such as process water facilities that have TSS limits in their NPDES permits were calculated as a product of monthly or daily TSS concentration and corresponding flow rate.

1.4 SOURCES OF SEDIMENT IMPAIRMENT

The TMDL Document quantified sediment loads from point and non-point sources in the watershed. According to the *Total Maximum Daily Load of Sediment in the Bynum Run Watershed, Harford County, Maryland* (MDE, 2011a), "Urban land was identified as the only predominant controllable source in the watershed at 76.7 percent of the total watershed sediment load. Thus, reductions were only applied to this source." The report also states that MDE has expanded the watershed restoration component of the MS4 permits by stating "Theoretically extending these permitting requirements to all urban stormwater sources (i.e., not solely those sources regulated via Phase I MS4 permits) would require that all impervious areas developed prior to 1985 be retrofit at this pace." Part I.B of the County's MS4 permit correctly defines the MS4 Permit area. This plan is conservatively based on MDE's interpretation. However, the County expressly reserves its rights to reduce the load reduction goals for this plan to the minimum required by law.

1.4.1 Point Sources

Several permitted point sources in the watershed were identified as contributing sediment loads. These permitted sources are identified in Table 1-3.

Table 1-3: Point Sources in Bynum Run Watershed

Point Source	Permit Type	Contribution of Point Source Loads (%)
Harford County	NPDES MS4 Phase I	68
Town of Bel Air	NPDES MS4 Phase II	15
Maryland State Highway Administration (MD SHA)	NPDES MS4 Phase II	6
Lafarge-Churchville Quarry	General Discharge Permit for Discharges from Mineral Quarries, Borrow Pits, and Concrete and Asphalt Plants (Permit No. 10-MM)	1
Other Regulated Stormwater	General Permit for Stormwater Discharges Associated with Industrial Activities (12-SW) General Permit for Stormwater Discharges Associated with Construction Activity (MDRC)	10
	Total	100

Of permitted sources, Lafarge-Churchville Quarry is identified as having a process water permit that has discharge limits for TSS as average daily or monthly concentrations and flows. Table 1-4 lists the TSS discharge permit limits for Lafarge-Churchville Quarry.

Table 1-4: TSS Discharge Permit Limits for Lafarge-Churchville Quarry

Point Source	Flow (MGD)	Permit Limits for Average Quarterly TSS Concentration (mg/l)	Permit Limits for Maximum Daily TSS Concentration (mg/l)
Lafarge-Churchville Quarry	0.9	30	66

MGD = millions of gallons a day mg/l = milligrams per liter

The other seven facilities that were identified as having stormwater discharge permits do not include limits for TSS concentration. Based on a review of the current General Permit for Stormwater Discharges Associated with Industrial Activity (12-SW) permit data available on the MDE website and a spatial analysis of facilities with 12-SW permits, it was also determined that the First Student Inc.-Harford County Garage Maintenance Facility, a County-owned facility, identified in the TMDL document, is not in the Bynum Run Watershed. It is in the Deer Creek Watershed, a subwatershed of the Lower Susquehanna River Watershed, and is therefore not included.

In addition to the above-mentioned point sources, the watershed includes seven sites that are covered under the General Permit for Discharges from Swimming Pools and Spas, including Baptismal Fonts (12-SI), which are insignificant point sources of sediment loads.

1.4.2 Non-Point Sources

Non-point sources of sediment loads include crop, extractive, forest, and pasture land uses. MDE's TMDL document identified that approximately 16.4 percent of the total sediment loads in the watershed are from agricultural areas, and that forest areas contribute approximately 5.4 percent of the total sediment loads. MDE's TMDL document also identifies stream bank erosion as a significant portion of the urban sediment load but has chosen to include this within the aggregate load for urban impervious loads.

1.5 TMDL TARGETS FOR HARFORD COUNTY SW-WLA

TMDL targets were only assigned to the urban sources in the watershed. No targets were assigned to the non-point sources.

The Bynum Run TMDL for sediment requires an overall 14 percent load reduction from the baseline. This load reduction was distributed among the stormwater point sources in the watershed. Table 1-5 lists the TMDL targets for the point sources in the watershed.

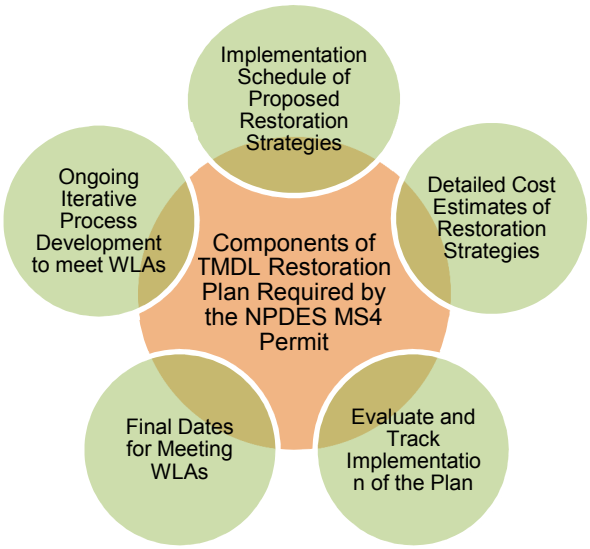
Table 1-5: TMDL WLAs for Stormwater Point Sources in Bynum Run

Facility Name	Permit Type	Sediment Load Reduction Target (%)
Harford County	NPDES MS4 Phase I	19.7
Town of Bel Air	NPDES MS4 Phase II	20.0
Maryland State Highway Administration	NPDES MS4 Phase II	19.3
Other Regulated Stormwater	12-SW, MDRC	7.4

As discussed above, not all urban stormwater sources are regulated through the County's MS4 permit. Unregulated urban stormwater should have a separate target load (non-point) for the TMDL. The analysis within this Plan is based on MDE's expansive interpretation of the County's Permit Area in documents external to the County's current MS4 permit, which correctly defines the MS4 Permit Area. All rights noted above are reserved. This Plan therefore develops strategies to reduce sediment load by 19.7% of the total urban loads within the physical boundaries of Harford County.

1.6 REQUIREMENTS OF A TMDL RESTORATION PLAN

A TMDL restoration plan is a roadmap that identifies various water quality improvement strategies that a local jurisdiction can implement to reduce loadings of a particular pollutant in a specific impaired watershed. This graphic summarizes MDE's requirements for restoration plans as outlined within the County's MS4 permit. The County reserves the right to make arguments regarding the legality of the plan requirements notwithstanding their presentation in this plan. The Bynum Run TMDL focuses only on reducing sediment loads from the urban stormwater portion of the watershed.



The main objective of this TMDL Plan is to recommend a wide array of structural, non-structural, and programmatic management strategies that could be implemented at the watershed-scale level (rather than site specific).

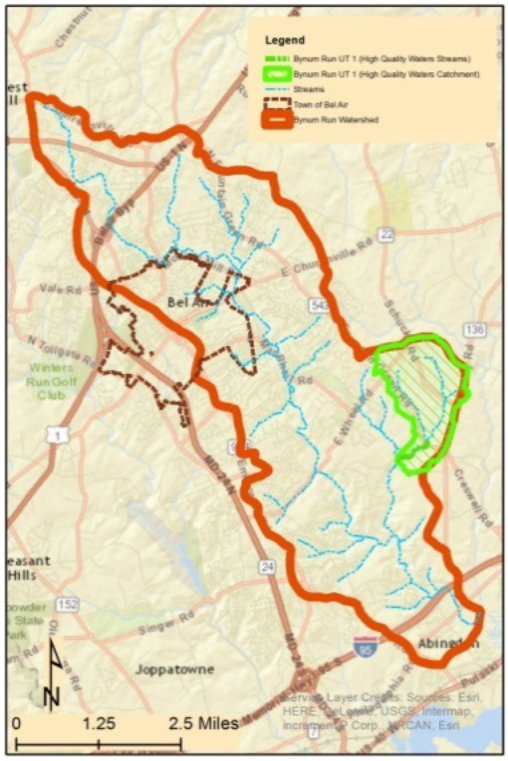
1.7 GOALS OF BYNUM RUN SEDIMENT TMDL RESTORATION PLAN

The goals for the Plan include:

- Baseline Load Conditions (2005) Scenario - Calculate sediment loads from the TMDL development baseline year based on County-level data.
- Current Load Conditions (2015) Scenario - Calculate current sediment loads based on current County-level data.
- Proposed Restoration Strategies - Propose restoration measures, implementation costs, schedules and monitoring to address the TMDL goals.
- Proposed Load Conditions Scenario – Calculate the sediment load reductions that would be achieved by implementing the proposed restoration measures.

1.8 RESTORATION PLANNING IN TIER II WATERS

MDE data indicate that Tier II waters occur in one location in the Bynum Run Watershed, at Bynum Run Unnamed Tributary 1. The tributary extends from South Green Fountain Road to Creswell Road. The catchment to Bynum Run Unnamed Tributary 1 was identified based on the MDE data. This catchment primarily includes large tracts of forested areas with minimal development. Restoration projects have not been implemented in this area, nor are they planned for the future.



SECTION TWO: BYNUM RUN WATERSHED CHARACTERIZATION

This section summarizes the general conditions of the Bynum Run Watershed and changes in the watershed conditions from the baseline year (2005) to the current year (2015). The overall characterization of the Bynum Run Watershed was conducted using County-provided geographic information system (GIS) data and previous studies conducted by the County and MDE in the Bynum Run Watershed.

2.1 PHYSIOGRAPHY AND SOILS

The Bynum Run Watershed is primarily in the Piedmont Plateau province. This region of the watershed is characterized by crystalline igneous and metamorphic rocks of possible volcanic origin. Most piedmont streams are characterized by moderate slopes up to 15- percent with gravel and sand as bedrock material, which are to some degree resistant to erosion. These areas are characterized by rolling hills littered with ridges and valleys. The bedrock geology includes metamorphic rocks such as gneiss, marble, and phyllite in the upland areas, and sedimentary rocks such as limestone, sandstone, shale, conglomerate and quartz in the lowlands.

The portion of the watershed south of Interstate 95 is located in the Atlantic Coastal Plain province, which comprises primarily gravel, sand, silt, and clay from both terrain and marine origins. Streams in coastal zones have lower slopes compared to the streams in piedmont region, from 1 percent to 11 percent, and bedrock is made of sediment layers that are easily eroded and can contribute to sediment loads.

The soils data available for Harford County on the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) website was used to evaluate the soil conditions in the Bynum Run Watershed. NRCS classifies soils into four Hydrologic Soil Groups (HSGs) (A, B, C, and D) based on factors such as runoff potential, soil texture, and infiltration rates. HSG A and B generally have sandy, loamy and silt textures and therefore they have high infiltration rates. HSG C and D have clay content and as a result have low infiltration rates and high runoff potential. Erodibility of soils increases with increase in silt and sand content. Soils with clay content are more stable and less susceptible to erosion due to the binding nature of the clay. Clay bonds with organic matter resulting in a more stable soil structure.

Table 2-1: Hydrologic Soil Group Distribution in the Bynum Run Watershed

Hydrologic Soil Group	Percent (%)
A	2
B	58
C	25
D	15
Total	**100**

The majority of the soils in the Bynum Run Watershed are HSG B (58 percent) which are susceptible to erosion and therefore may contribute to some sediment loads in the watershed. Table 2-1 shows distribution of hydrologic soil groups in the watershed, and Figure 2-2 shows the physiographic regions in the watershed.

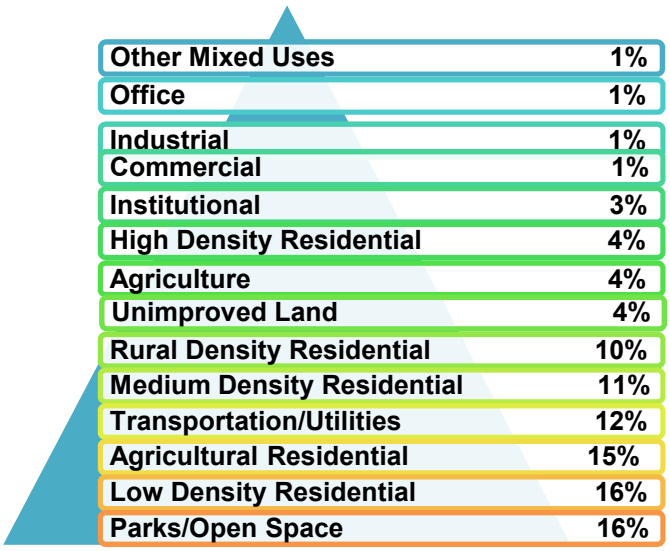
2.2 LAND USE AND IMPERVIOUS COVER

The distribution of land use and impervious cover has an impact on the amount of sediment load contributed to the streams. In general, land uses such as forest and open areas reduce the volume of runoff conveyed to the stream by promoting infiltration, thereby reducing the amount of sediment loads transported to streams. Increases in impervious cover due to development increase runoff, which may over time cause stream bank erosion and negatively impact aquatic and riparian habitat. Figure 2-1 shows in the land use distribution in Bynum Run Watershed.

2.2.1 Land Use

Harford County has developed a robust GIS dataset reflecting the current land use conditions (2015) in Bynum Run Watershed. Residential low, medium and high density areas, including agricultural residential and rural residential areas, occupy approximately 56 percent of the watershed. Industrial areas in the watershed are concentrated along Industry Lane and East Jarrettsville Road north of U.S.

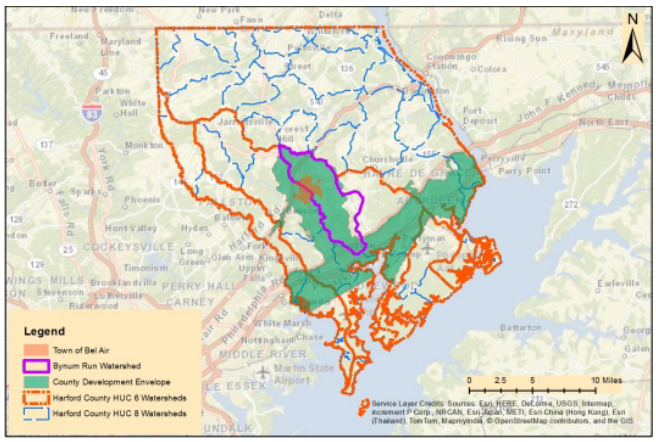
Figure 2-1: 2014 Land use distribution in the Bynum Run Watershed



Route 1. Institutions in the watershed include County public schools, learning centers, churches and libraries. The Harford County Detention Center, on Rock Spring Road is also located in the watershed. Commercial areas are distributed throughout the watershed, with the majority located along U.S. Route 1, Churchville Road, and Rock Spring Road/North Main Street. Parks and recreational areas in the watershed include Bynum Run Park and Rockfield Park on East Churchville Road, Blake's Venture Park on Melrose Lane, Cedar Lane Sports Complex on Cedar Lane, Friends Park on East Jarrettsville Road, Maryland Golf and Country Club on East MacPhail Road, and Bush Declaration Natural Resources Management Area along Pulaski Highway. Figure 2-3 shows the land use distribution in the Bynum Run Watershed.

2.2.2 Impervious Cover

According to census data, four of the five fastest-growing areas in the County are in the Bynum Run Watershed and include Belcamp, Forest Hill, Bel Air, and Abingdon. Approximately 22 percent of the Bynum Run Watershed is currently impervious. As discussed below, nearly 86 percent of development occurred prior to 2002 when MDE adopted more stringent stormwater management regulations to protect water quality.



Bynum Run Watershed is located in the Priority Funding Area (PFA) or development envelope of the County (shown in the inset as the shaded green area). In 1997 Maryland adopted the Priority Funding Act to direct funding within designated growth areas or PFAs for programs such as public water and sewer and highways. Establishing designated growth areas fulfills the State's growth policy to concentrate development where public services such as water and sewer and public safety can more efficiently be provided to the community while directing growth away from rural areas.

The development trend in the watershed is likely to continue, resulting in additional impervious areas. The County has developed the *2012 Master Plan and Land Use Element Plan* (Harford County, 2012a), which aims to protect the natural and water resources and conserve forested and open areas.

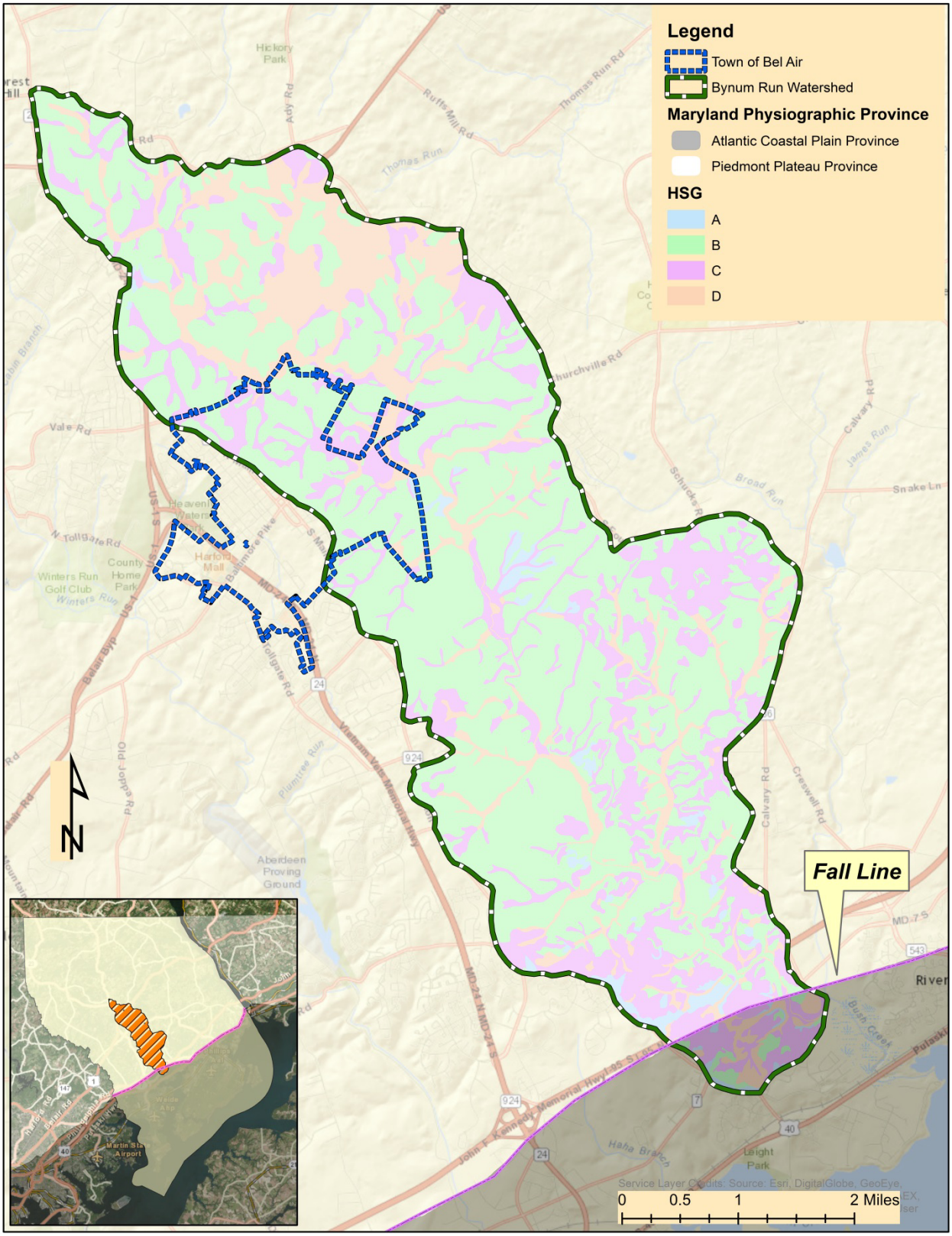


Figure 2-2: Physiographic setting and Hydrologic Soil Group distribution in the Bynum Run Watershed

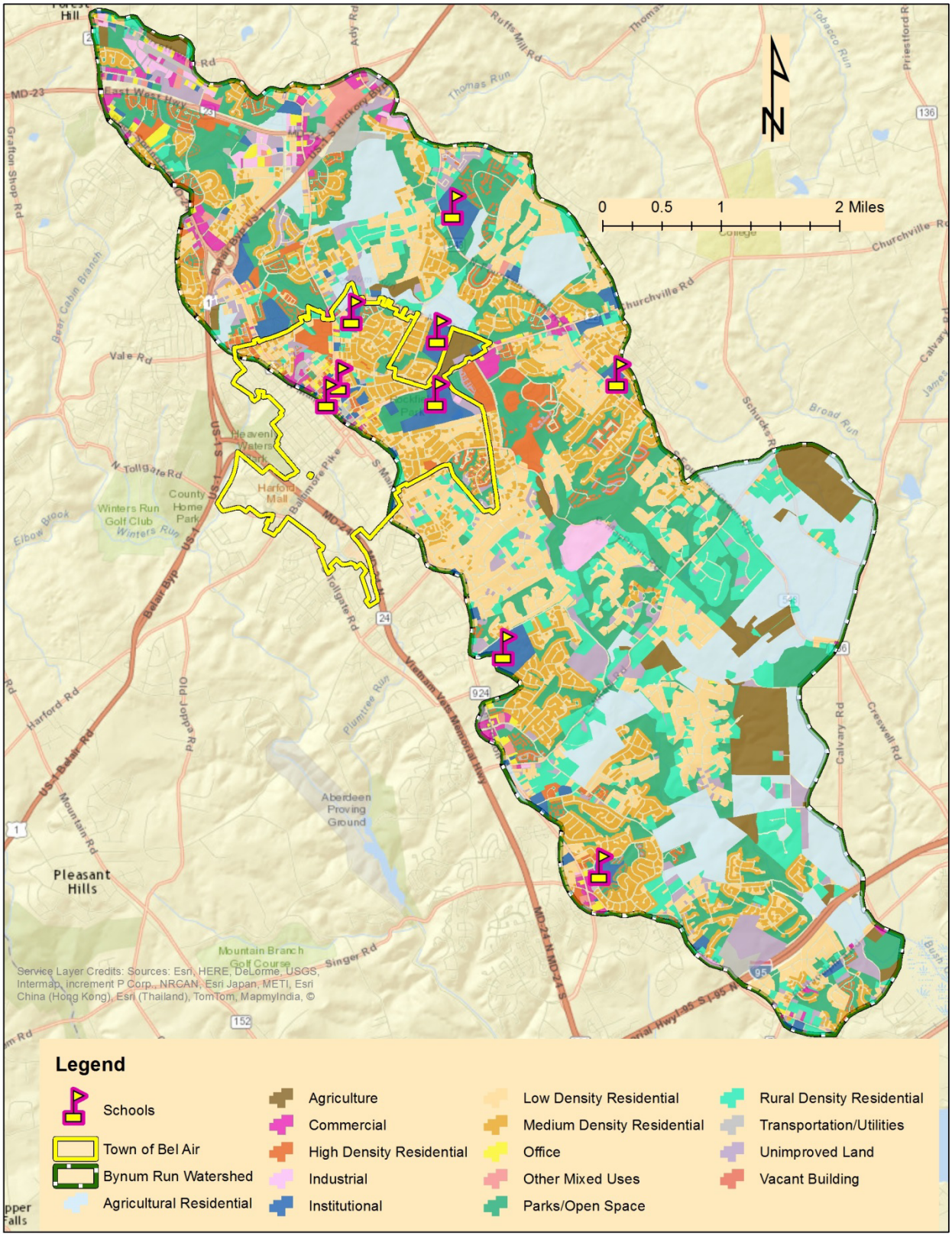


Figure 2-3: Land use distribution in the Bynum Run Watershed

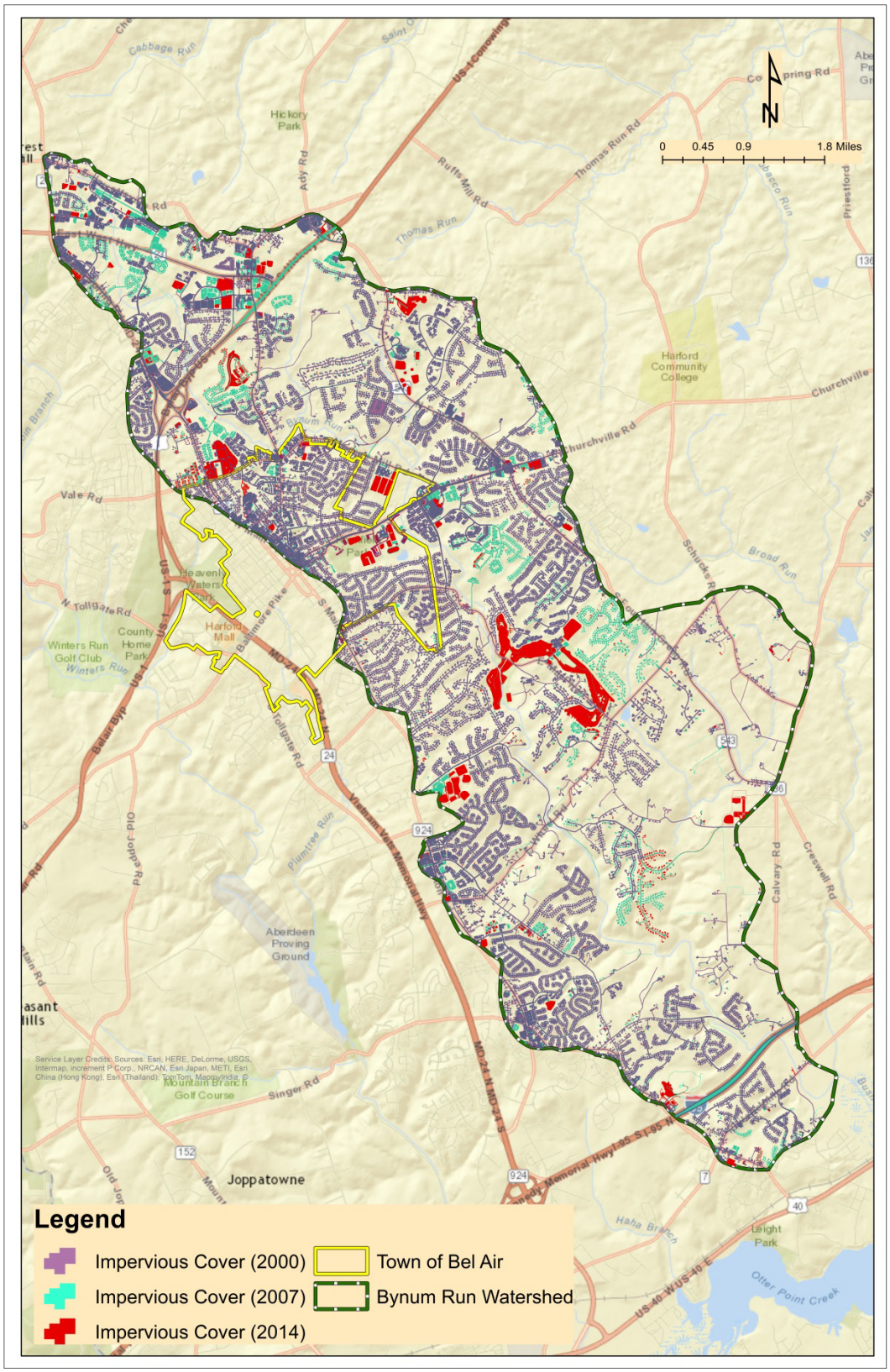


Figure 2-4: Impervious cover in the Bynum Run Watershed in 2000, 2007, and 2014

2.3 WATER QUALITY CONDITIONS

Previous studies conducted in the Bynum Run Watershed that evaluated the sediment conditions in the streams in the watershed were reviewed to analyze the health of the streams in the watershed over the years. The *Findings and Recommendations Report: Engineering Study for Bynum Run Watershed* (Harford County, 1999) and the *Watershed Report for Biological Impairment of the Bynum Run Watershed in Harford County Maryland, Biological Stress Identification Analysis Results (BSID) and Interpretations* (MDE, 2012) were conducted with a gap of 13 years and provide a good comparison of the change in stream water quality.

2.4 STORMWATER MANAGEMENT

Most areas developed prior to 1985 have no stormwater management associated with them because they were constructed before the State's stormwater management regulations were adopted.

Between 1985 and 2002, stormwater management in many jurisdictions in Maryland including Harford County, regulated only stormwater quantity. The stormwater management practices were designed to collect stormwater runoff from their drainage areas and release it at a controlled rate, providing limited water quality management.

In 2002, MDE required all jurisdictions to begin regulating stormwater quality management and increase stormwater quantity management. Stormwater management practices that provide quality treatment are designed to collect and treat rainfall through a combination of organic and inorganic filtering media such as sand, soil, gravel, and plants. Stormwater management practices that provide increased quantity management are designed to reduce stream bank erosion.

2.4.1 Structural Stormwater Controls

Approximately 86 percent of the parcels in Bynum Run Watershed were constructed prior to 2002 and as a result they do not have adequate controls for stormwater quality or quantity management to reduce stream bank erosion. The County's 2015 GIS data show that 337 stormwater management practices or BMPs (Table 2-2) have been constructed in Harford County portion of the Bynum Run Watershed. Approximately 5,813 acres of the Harford County portion of the Bynum Run Watershed is managed by these BMPs. The County continues to compile and refine historic BMP data that will be incorporated into future updates to this plan

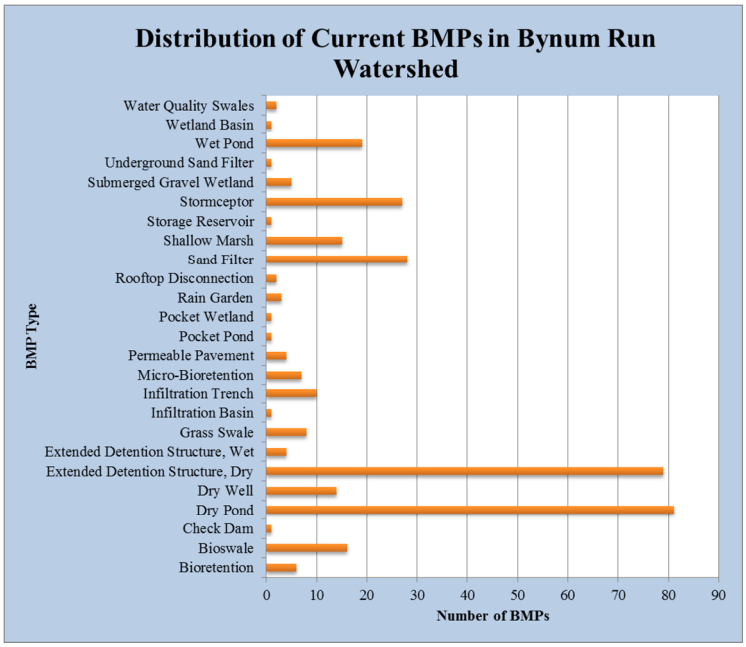


Table 2-2: Distribution of BMPs in Bynum Run from County GIS Data that meet MDE design standards (implemented 2002 to 2015)

Stormwater Management Era	Number of BMPs	Area Managed (acres)
1985-2001	175	4,852
2002-2009	109	876
2010-2015	47	85
Unknown	6	Unknown
Total	**337**	**5,813**

2.4.2 Non-structural Stormwater Controls

In 2002 MDE also approved the use of non-structural stormwater controls. These controls include disconnection of rooftop runoff, disconnection of non-roof top runoff, and sheetflow to conservation areas. Harford County has not inventoried non-structural stormwater controls. Therefore, non-structural stormwater controls are not included in this plan. The inclusion of this information into the plan will provide additional load reductions. The County will compile this historic data and incorporate the date into future updates to this plan.

2.5 ASSESSMENT OF SEDIMENT LOADS

As part of this Plan, sediment loads were quantified for the TMDL baseline year and the current conditions using County provided detailed data. The data used in the development of the Bynum Run TMDL by MDE were collected from the Maryland Department of Planning (MDP), which is a statewide broad scale view of land use conditions and therefore does not precisely capture detailed land use conditions. The sediment loads for this plan were calculated using an EPA-approved web-based tool called the "The Chesapeake Bay Facility Assessment Scenario Tool" (BayFAST). This tool was selected because its results are comparable to the CBP's Watershed Model, which MDE used to develop the sediment TMDL for Bynum Run. This tool is also recommended by MDE (MDE, 2014c) for NPDES MS4 permittees for estimating nutrient and sediment loads for developing the restoration plans.

2.5.1 Defining the Harford County Urban Areas

To estimate the sediment loads, the Harford County urban areas in the watershed were defined using the statewide NPDES-Regulated Stormwater Area GIS data from MDE's TMDL data center, and County GIS data. Town of Bel Air, Maryland SHA, State-owned properties and industrial properties with 12-SW permit coverage were excluded from this Plan.

The County portion of Bynum Run Watershed includes large portions of agricultural land that do not drain to the storm sewer system. These areas were identified from the County's agricultural land use GIS data and were excluded from the Harford County portion of the Bynum Run Watershed. County-owned properties within the Town of Bel Air were included in Harford County's jurisdiction such that restoration strategies could be implemented on those properties to address the TMDL. The County has included the properties in order to perform implementation on them, but the County does not concede they are properly part of the MS4 regulated Permit Area and it reserves the right to participate in any trading developed by the State.

Based on this analysis, approximately 8,033 acres were defined to be urban areas in the Harford County portion of the Bynum Run Watershed (Figure 2-5). The baseline and current load assessment scenarios were developed to estimate the sediment loads from these portions of the watershed. Similarly, the restoration strategies were also focused in these areas.

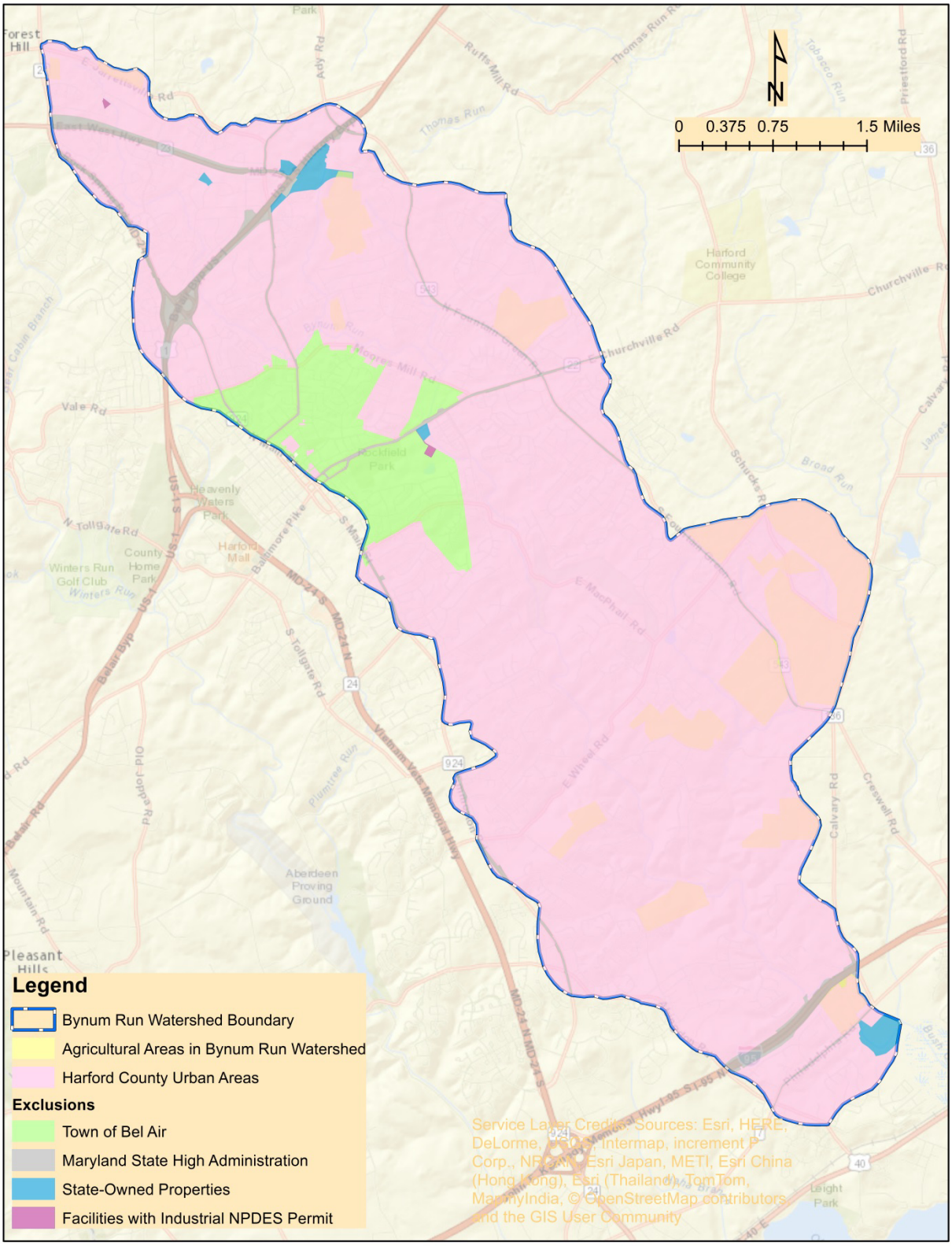


Figure 2-5: Harford County MS4 Areas in Bynum Run Watershed

2.5.2 Baseline Conditions (2005) Scenario

The baseline conditions scenario was developed to estimate the sediment loads for the baseline year and redefine the TMDL goals using BayFAST and County GIS data. The baseline year or the year which MDE estimated the sediment loads for the watershed and developed the TMDL is 2005 for Bynum Run. Harford County's impervious cover layer and vegetation layer developed in 2007 were selected by the County to develop the baseline conditions scenario. Harford County does not have data for 2005 and 2007 is the closest year that is available.

The geographic area of the Bynum Run Watershed was selected in BayFAST and the land use data populated in the baseline conditions scenario was modified using the data developed from the GIS analysis of the County impervious cover and vegetation data. Table 2-3 identifies the types and extents of the land uses that were included in the BayFAST scenario to estimate the baseline sediment loads.

Table 2-3: Land Uses included in the Baseline Conditions Scenario

Land Use	Area (acres)
Urban Pervious	5,817
Urban Impervious	2,216
Forest	3,435
Water	90
Total	**11,558**

The BMPs constructed through the year 2005 were included in the baseline conditions scenario to estimate their effectiveness in reducing the sediment loads. A detailed as-built plan review was conducted to identify the drainage area and impervious area managed by these BMPs to be included in BayFAST. BMPs that were constructed under the 1985 MDE stormwater management standards were not included in the baseline conditions scenario as they were assumed to provide no water quality treatment. The BMPs were categorized according to the BayFAST input criteria. A restoration project implemented in 2003 that included restoring approximately 810 feet of eroded stream was also included in the baseline conditions scenario.

Table 2-4 and Table 2-5 summarize the BMPs included in the baseline conditions scenario along with their drainage area, impervious area, and associated sediment removal efficiencies in BayFAST.

Table 2-4: BMPs included in the Baseline Conditions (2005) Scenario

BMP Type	Number of facilities	Drainage Area (acres)	Impervious Area (acres)	Sediment Removal Efficiency (%)
Bioretention/Rain Gardens – C/D Soils, underdrain	1	6.3	1.2	55
Dry Detention Ponds and Hydrodynamic Structures	6	21.1	13.5	10
Dry Extended Detention Ponds	4	56.6	34.8	60
Urban Filtering Practices	2	8.9	2.5	80
Urban Infiltration Practices with Sand, Vegetation – A/B Soils, no underdrain	4	47.7	23.3	95
Wet Ponds and Wetlands	1	10.6	2.4	60
Total	**18**	**151.2**	**77.7**	**N/A**

Table 2-5: Stream Restoration Projects included in the Baseline Conditions (2005) Scenario

Project Type	Length of Stream Restoration (ft)	Sediment Removal Efficiency (lbs/ft)
Urban Stream Restoration	810	44.88

The results of the baseline conditions (2005) scenario are listed in Table 2-6. According to the Bynum Run TMDL document, urban loads for Harford County must reduce the stormwater loads by 19.7 percent from the baseline year. Therefore, the redefined TMDL target based on detailed GIS data is 972 tons/year.

Table 2-6: Sediment Loads from the Baseline Conditions (2005) Scenario

Land Use	Sediment Loads (lbs/year)	Sediment Loads (tons/year)
Urban	2,227,051	1,114
Water	—	—
Forest	193,940	97
Total	**2,420,991**	**1,210**

2.5.3 Current Conditions (2015) Scenario

A current load conditions scenario in BayFAST was developed to reflect the 2015 conditions within the Harford County portion of the Bynum Run Watershed. This scenario is needed to estimate the sediment loads that are conveyed because of the increase in impervious area since 2005. This scenario includes BMPs and restoration projects that have been implemented since

2005 and redefines the reductions needed to address the TMDL defined in the baseline conditions scenario. The data used to develop the current load conditions scenario included the 2014 GIS layers developed by the County to capture the current impervious cover and the 2013 vegetation layer (Table 2-7).

Table 2-7: Land Uses included in the Current (2015) Conditions Scenario

Land Use	Area (acres)
Urban Pervious	5,429
Urban Impervious	2,604
Forest	3,435
Water	90
Total	**11,558**

BMPs that were constructed through June 2015 were included in this scenario. In a manner similar to the baseline conditions scenario, only BMPs designed to the current MDE Stormwater Management Standards were included in the current load conditions scenario. Information on the drainage area and impervious area managed by the BMPs was obtained from as-built plans. Table 2-8 and Table 2-9 show the BMPs and stream restoration projects along with the drainage areas and impervious area and the associated sediment removal efficiency as calculated by BayFAST.

Table 2-8: BMPs Included in the Current Conditions (2015) Scenario

BMP Type	Number of Facilities	Drainage Area (acres)	Impervious Area (acres)	Sediment Removal Efficiency (%)
Bioretention/rain gardens – A/B soils, underdrain	5	8.9	2.8	80
Bioretention/rain gardens – C/D soils, underdrain	10	16.0	6.8	55
Bioswale	17	13.3	4.5	80
Dry Detention Ponds and Hydrodynamic Structures	24	292.7	145.0	10
Dry Extended Detention Ponds	24	178.1	74.9	60
Permeable Pavement w/o Sand, Veg. – A/B soils, no underdrain	2	0.1	0.1	85
Permeable Pavement w/o Sand, Vegetation – A/B soils, underdrain	2	0.3	0.3	70
Urban Filter Strip Runoff Reduction	2	0.2	0.2	56

BMP Type	Number of Facilities	Drainage Area (acres)	Impervious Area (acres)	Sediment Removal Efficiency (%)
Urban Filtering Practices	29	78.1	43.7	80
Urban Infiltration Practices w/ Sand, Vegetation – A/B soils, no underdrain	17	52.8	26.3	95
Vegetated Open Channels – A/B soils, no underdrain	6	16.6	4.1	70
Vegetated Open Channels – C/D soils, no underdrain	1	4.5	2.9	50
Wet Ponds and Wetlands	17	299.4	137.2	60
Total	**156**	**961.0**	**448.9**	**N/A**

Table 2-9: Stream Restoration Projects included in the Current (2015) Conditions

Project Type	Length of Stream Restoration (ft)	Sediment Removal Efficiency (lbs/ft)
Urban Stream Restoration	2,614	44.88

As in the calculation of the baseline conditions (2015) scenario, loads from different land uses were used to estimate the new target from the current load conditions scenario to address the TMDL target. The impervious cover has increased by approximately 18 percent since 2005, which resulted in the slightly higher sediment load contributions from land uses compared to the baseline conditions (2005) scenario.

Table 2-10: Sediment Loads from the Current Conditions (2015) Scenario

Land Use	Sediment Loads (lbs/year)	Sediment Loads (tons/year)
Urban	2,250,397	1,125
Water	—	—
Forest	193,951	97
Total	**2,444,348**	**1,222**

Table 2-10 shows the sediment loads for land uses for the current load conditions (2015) scenario. A reduction of 20.7 percent from the current load will address the TMDL for Bynum Run.

SECTION THREE: RESTORATION STRATEGIES

This section discusses the proposed restoration strategies to address the sediment TMDL load reduction and to improve the water quality in the streams in Bynum Run Watershed. These strategies were evaluated using existing County GIS data, reports such as the Bynum Run Engineering Study (Harford County, 1999), Harford County, Maryland *Phase II Watershed Implementation Plan (Phase II WIP) for the Chesapeake Bay TMDL* (Harford County, 2012b), the County's Capital Improvement Program (CIP), the *Accounting Document for Stormwater Wasteload Allocations and Impervious Area Credits* (MDE, 2014b) and other relevant data and resources. This section also includes the planning-level implementation costs for the proposed restoration projects along with the potential load reductions that are estimated using BayFAST. The proposed strategies can be broadly categorized as follows:

- **Structural Stormwater Management Strategies:** These include retrofits or new BMPs that are designed to the current MDE stormwater management standards to collect and treat stormwater runoff and remove sediment through processes such as filtration and infiltration. The proposed BMPs include ESD and traditional structural practices.

- **Alternative Urban Strategies:** Alternative urban strategies in general do not require detailed design like the structural BMPs and are aimed at conservation of natural resources through adoption of techniques such as tree planting, and converting existing impervious areas to pervious areas. These strategies are approved by MDE and can provide flexibility for jurisdictions to address their NPDES MS4 and TMDL goals.

- **Programmatic Strategies:** These include recommendations to enhance the County's existing programs as well as potential new programs that could be adopted by the County and may include educating residents on pollution prevention and natural resources conservation practices.

3.1 STRUCTURAL STORMWATER MANAGEMENT STRATEGIES

New and retrofit BMP opportunities in the watershed were identified using the existing County GIS data such as parcels information, existing BMPs, and storm drain network.

The County CIP projects in the Bynum Run Watershed that are currently in the design phase are included as a part of this strategy. Implementation of new filtration, infiltration practices, retrofits of pre-2002 stormwater management facilities to current MDE standards, and storm drain outfall retrofits are examples of proposed structural BMPs. Urban stream restoration and step pool storm conveyance systems (SPSCs), which are classified as Alternative Urban BMPs by MDE, were included as a part of structural BMP restoration strategies in this restoration plan, as

they include detailed design development for implementation. The identified structural BMPs were categorized into High Priority, Medium Priority, and Low Priority Projects.

3.1.1 High Priority Proposed Projects

High priority proposed projects include all the restoration options identified on the County-owned properties. These were given high priority because of the relative ease of their implementation; the County does not need to develop any agreements to implement these projects and the projects would be easily accessible for maintenance. Approximately 75 County-owned properties in the watershed, including in the Town of Bel Air, were evaluated for potential restoration projects. Thirty-eight projects were identified at schools, fire stations, and offices. The two County stream restoration CIP projects in the Bynum Run Watershed (Sunnyview Drive Stream Restoration – Farnandis Branch and Bynum Run at St. Andrews Way) were also included in the high priority projects because they are currently in design phase.

Table 3-1 provides a summary of the structural BMPs proposed including the project type, anticipated drainage, and impervious areas. Planning-level cost calculations for the high priority projects are based on C*osts of Stormwater Management Practices in Maryland Counties* (King and Hagan, 2011). A contingency of 35 percent was added to these costs to account for increases in design, erosion and sediment control, permitting, and construction costs since the publication of the document. Figure 3-1 shows the locations of the proposed high priority structural BMPs. Implementation costs for the two proposed stream restoration projects were obtained from the County CIP. Appendix A includes the details of the proposed high priority projects.

Table 3-1: High Priority Structural BMP Restoration Projects

Proposed Structural BMP	Drainage Area (acres)	Impervious Area (acres)	Planning-Level Implementation Costs	Sediment Removal Efficiency (%)
Bioretention/Rain Gardens – A/B soils, underdrain	61.1	24.6	$6,110,000	80
Bioretention/Rain Gardens – C/D soils, underdrain	3.3	2.4	$600,000	55
Bioswale	6.7	4.7	$270,000	80
Stormwater Management Retrofit to Upgrade to Current MDE Standards	25.0	5.6	$490,000	65
Permeable Pavement without Sand, Vegetation – A/B Soils	2.7	2.5	$800,000	70
Permeable Pavement wo/Sand, Vegetation – C/D Soils	0.8	0.7	$240,000	55
Urban Filtering Practices	19.6	7.9	$530,000	80
Urban Infiltration Practices with Sand and Vegetation – A/B Soils, no underdrain	0.9	0.5	$50,000	95
Total	**134.26**	**48.89**	**$9,090,000**	**NA**

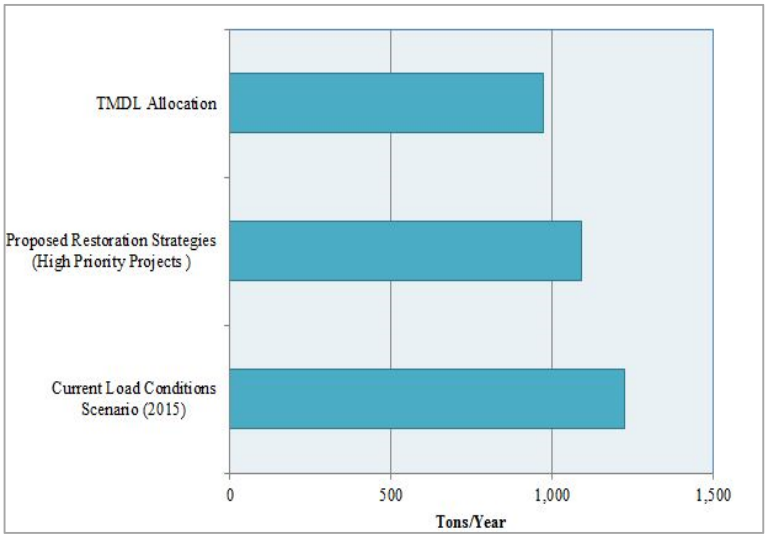
NA – Not Applicable

Table 3-2: High Priority Stream Restoration Projects

Proposed Stream Restoration Project	Length of Stream Restoration (ft)	Planning-Level Implementation Costs	Impervious Area Credits (acres)	Sediment Removal Efficiency (lbs/ft)
Sunnyview Drive Stream Restoration – Farnandis Branch	3,000	$1,000,000	30	44.88
Bynum Run at St. Andrews Way Stream Restoration	3,000	$1,500,000	30	44.88
Total	**6,000**	**$2,500,000**	**60**	**NA**

NA – Not Applicable

The current load conditions (2015) scenario input data, and all the identified high priority projects were input in BayFAST to estimate the potential sediment load reductions. As the SPSCs are not included in BayFAST, they were input as bioretention BMPs following the MDE guidance. A load reduction of 10.9 percent (134 tons/year) was estimated from the implementation of all the high priority restoration projects. Approximately 109 acres of impervious area credits would be achieved by the County by implementing high priority projects.



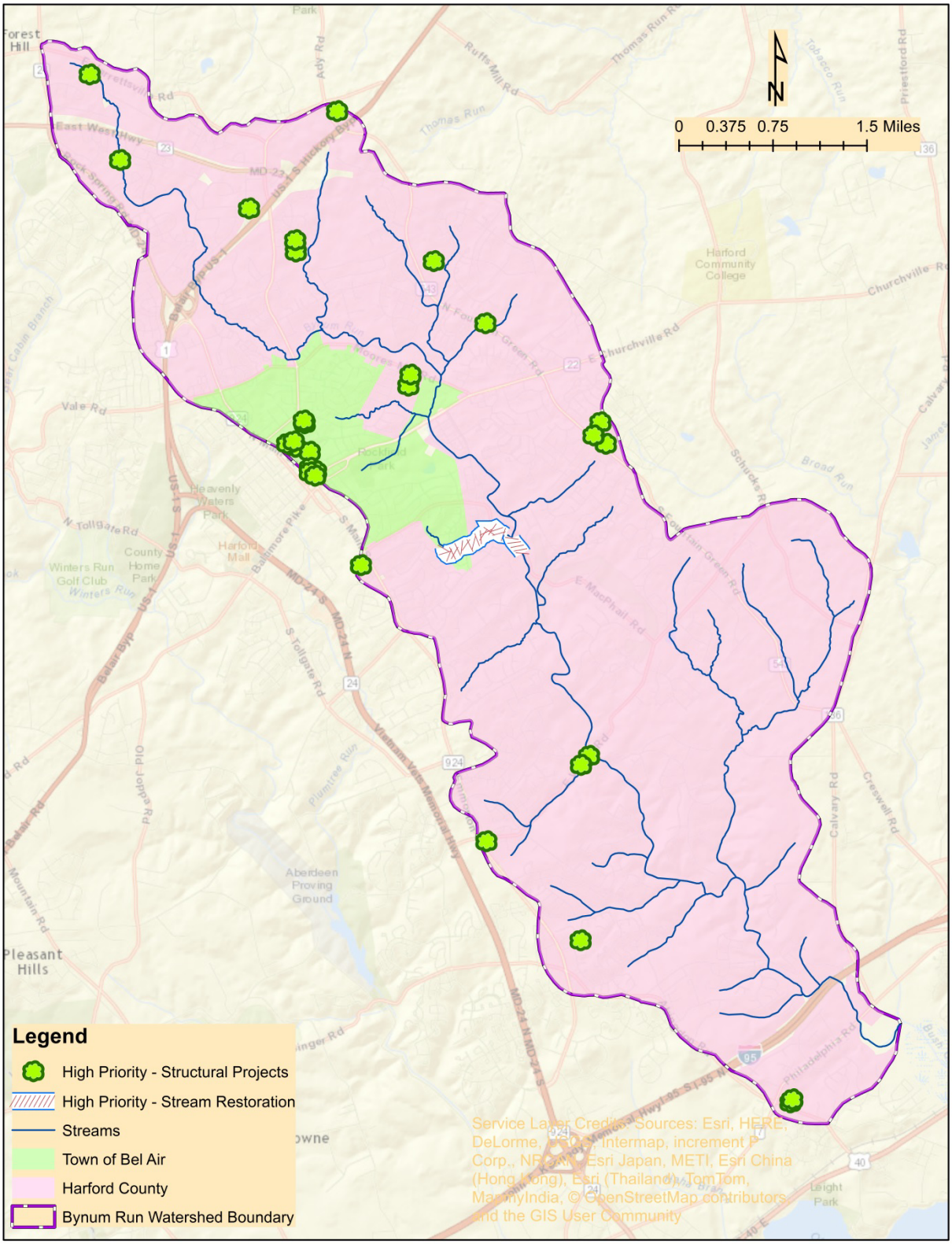


Figure 3-1: Locations of proposed high priority projects

3.1.2 Medium Priority Projects

Medium priority proposed projects include stormwater retrofits and new storm drain outfall retrofit projects on HOA-owned properties. The County has established a solid relationship with the various HOAs in Harford County by implementing various stormwater management projects and through public education and outreach. It is generally feasible to implement new and retrofit projects on HOA-owned areas through agreements, so the proposed restoration strategies on HOA-owned properties were given a medium priority.

Approximately 96 pre-2002 BMPs are located on HOA-owned properties and have the potential to be upgraded to the current MDE standards. Ideal retrofit options for dry ponds and extended detention dry ponds with drainage areas of less than 10 acres include converting them to a filtering system such as bioretention or sand filter to enhance the pollutant uptake. This option was proposed for approximately 15 dry ponds and extended detention dry ponds.

For the remaining 81 pre-2002 BMPs with drainage areas greater than 10 acres, upgrading the facility by modifying the outflow structure, increasing the flow path, and adding forebays and micropools was recommended. These include dry ponds, extended detention dry ponds; extended detention wet ponds, shallow marshes and wet ponds. The County's BMP GIS database was used to estimate the contributing drainage area for these BMPs. The impervious area captured is currently not populated in the BMP database; however, it was assumed that 22.5 percent of the drainage area was impervious based on the County's GIS data.

Additionally, storm drain outfalls that convey flow directly to the streams were evaluated for retrofit potential. Approximately 59 outfalls were identified where a BMP such as SPSC can be implemented to capture and treat the stormwater runoff before it discharges into the streams. Typically SPSCs are best suited to be implemented downstream of the outfall if the grade is less than 10 percent. Forty-nine of the 59 potential outfall retrofits are located on HOA-owned open areas.

A feasibility assessment was conducted using the County's water and sewer GIS layers to identify potential utility impacts. Forty-seven outfalls that did not have major utility impacts were categorized as medium priority, and two outfalls where potential water and sewer impacts were observed were given a low priority. Drainage areas and impervious area captured by the outfalls were delineated using the County's contour, storm drain, and 2014 impervious cover data. Implementation of SPSCs, and filtration practices such as bioretention and sand filters were proposed as outfall retrofits. Table 3-3 summarizes the proposed medium priority structural BMPs including the project type, anticipated drainage, and impervious areas to be treated.

Planning-level cost calculations for the medium priority projects are based on the *Cost of Stormwater Management Practices in Maryland Counties* (King and Hagan, 2011). A contingency of 35 percent was added to these costs to account for increases in design, erosion and sediment control, permitting, and construction costs since the publication of the document. Figure 3-2 shows the locations of the proposed medium priority structural BMPs. Appendix A includes details of the medium priority projects.

Table 3-3: Medium Priority Structural BMP Restoration Projects

Proposed Structural BMP	Drainage Area (acres)	Impervious Area (Acres)	Planning Level Implementation Costs	Sediment Removal Efficiency (%)
Bioretention/Rain Gardens – A/B soils, underdrain	105.2	42.4	$10,520,000	80
Bioretention/Rain Gardens – C/D soils, underdrain	118.1	47.1	$11,690,000	55
Stormwater Management Retrofit to Upgrade to Current MDE Standards	1,539.5	346.8	$29,970,000	65
Urban Filtering Practices	172.5	49.8	$3,300,000	80
Total	**1,935.3**	**486.1**	**$55,480,000**	**NA**

NA – Not Applicable

From the set the medium priority projects, retrofitting 81 pre-2002 BMPs with drainage areas greater than 10 acres will generate impervious area restoration credits of approximately 347 acres and help the County in addressing the NPDES MS4 permit's impervious area restoration requirements for the Bynum Run Watershed, as well as TMDL goals for the watershed.

A proposed scenario was developed in BayFAST using the current load conditions scenario input data, the identified high priority projects and the subset of medium priority projects that included upgrades of 81 pre-2002 BMPs to current MDE Stormwater Management standards. In addition to the 10.9% (134 ton/year) load reduction from the high priority projects, an additional load reduction of 11.3 percent (138 tons/year) was estimated from the implementation of the 81 pre-2002 BMPs, for a total reduction of 20.7%.

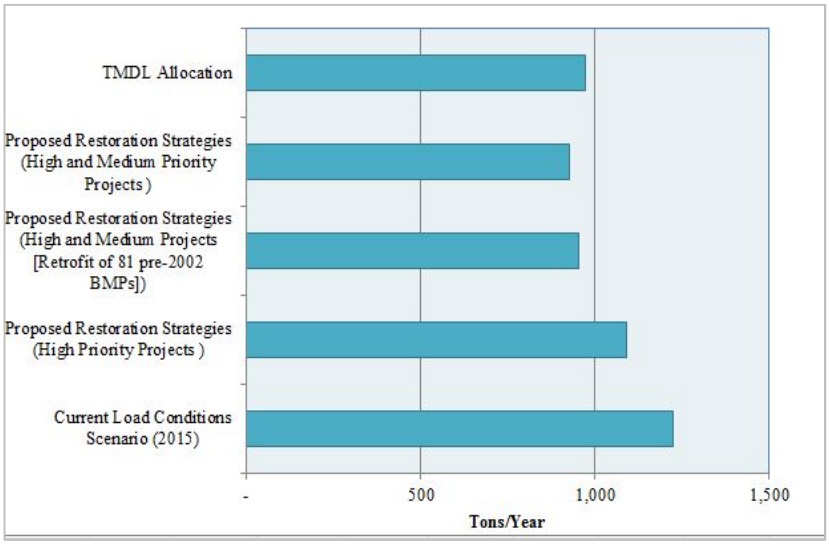
Reduction from Proposed High Priority Restoration Strategies =10.9%

Reduction from Subset of Proposed Medium Priority Restoration Strategies= 11.3%
(Retrofit of 81 Pre 2002-BMPs)

Total Reduction = 10.9%+11.3% = 22.2%

Total Reduction from 2015 Current Load Conditions Scenario = 20.7%

Even though implementation of a subset of the medium priority projects is sufficient to address the TMDL goals, another BayFAST scenario was developed to quantify the benefits from all the high and medium priority projects. The SPSCs are not included in BayFAST, so they were input as bioretention BMPs in compliance with the MDE guidance (MDE, 2014b). A sediment load reduction of 24.3 percent was estimated from the implementation of all the high and medium priority rest oration projects.



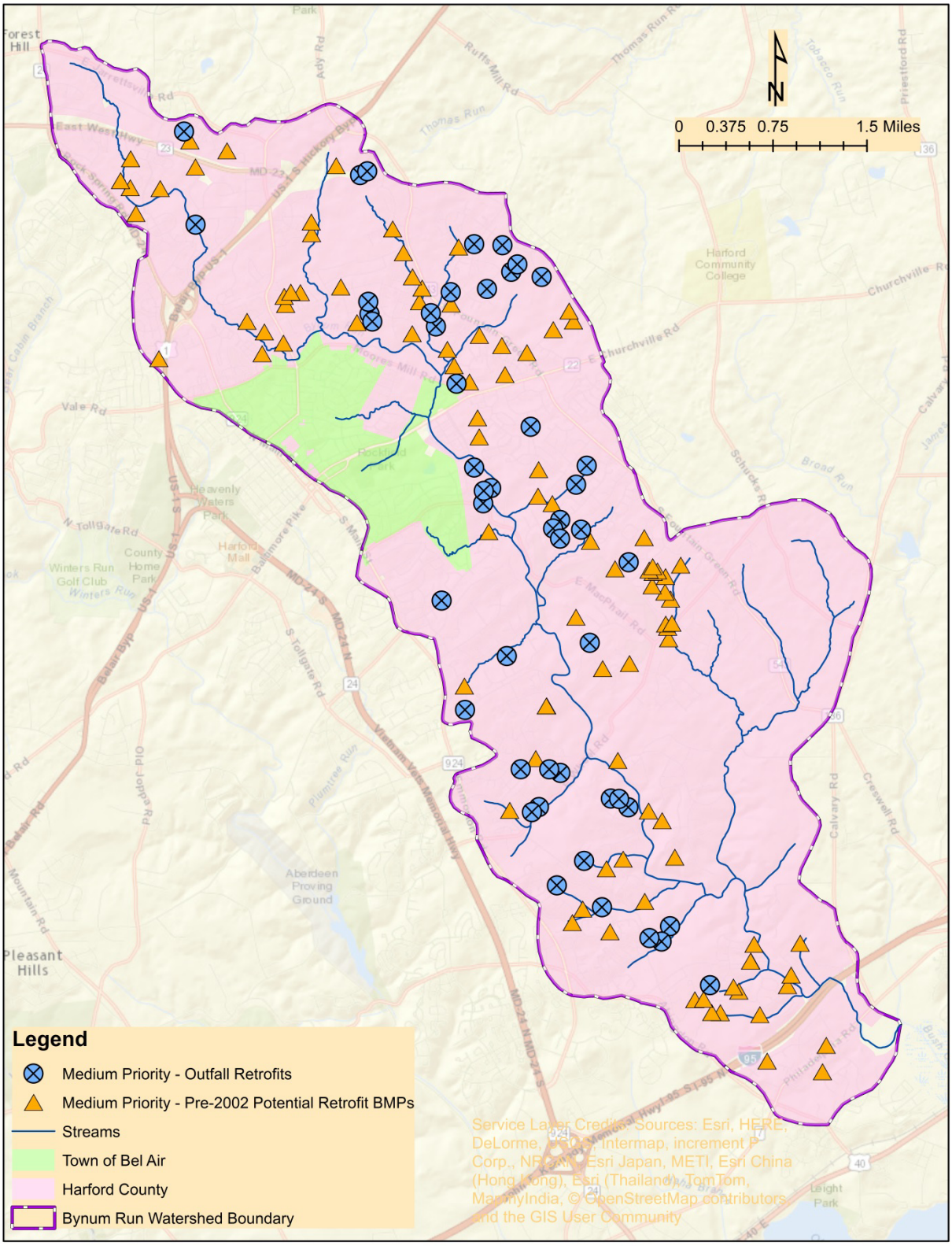


Figure 3-2: Locations of proposed medium priority projects

3.1.3 Low Priority Projects

The proposed projects on privately owned properties such as commercial and industrial areas were given low priority. These projects include retrofit of pre-2002 BMPs including dry ponds, extended detention dry ponds, shallow marshes and wet ponds, and of outfall retrofits on privately owned areas. Outfall retrofits on HOA-owned properties that have potential utility conflicts were also categorized as low priority. Projects in County-owned right-of-way were also categorized as low priority, as the County would not be implementing these projects immediately, but will consider implementation as part of road improvement projects in the watershed. Even though the sediment TMDL goals can be addressed by the implementation of high and medium priority projects, these low priority projects would provide additional options to the County if any of the proposed high and medium priority projects are deemed not feasible.

Approximately 22 pre-2002 BMP retrofits, 6 outfall retrofits, and 20 right-of-way restoration projects, as shown on Figure 3-3, were considered low priority projects. Table 3-4 summarizes the proposed low priority structural BMPs including the project type, anticipated drainage and impervious area to be treated.

Table 3-4: Low Priority Structural BMP Restoration Projects

Proposed Structural BMP	Drainage Area (acres)	Impervious Area (Acres)	Planning-Level Implementation Costs	Sediment Removal Efficiency (%)
Bioretention/Rain Gardens – A/B soils, underdrain	105.0	35.2	$8,740,000	80
Bioretention/Rain Gardens – C/D soils, underdrain	70.5	26.4	$6,560,000	55
Stormwater Management Retrofit to Upgrade to Current MDE Standards	145.9	32.9	$2,840,000	65
Urban Filtering Practices	140.2	53.3	$3,530,000	80
Total	**461.6**	**147.8**	**$21,670,000**	**NA**

NA – Not Applicable

Planning-level cost calculations for the low priority projects are based on the *Cost of Stormwater Management Practices in Maryland Counties* (King and Hagan, 2011). A contingency of 35 percent was added to these costs to account for increases in design, erosion and control, permitting, and construction costs since the publication of the document.

A scenario was developed in BayFAST using the target load assessment land uses to compute the sediment load reductions that could be achieved by implementing these identified low priority projects. Implementing these projects would reduce sediment loads by approximately 49 tons/year.

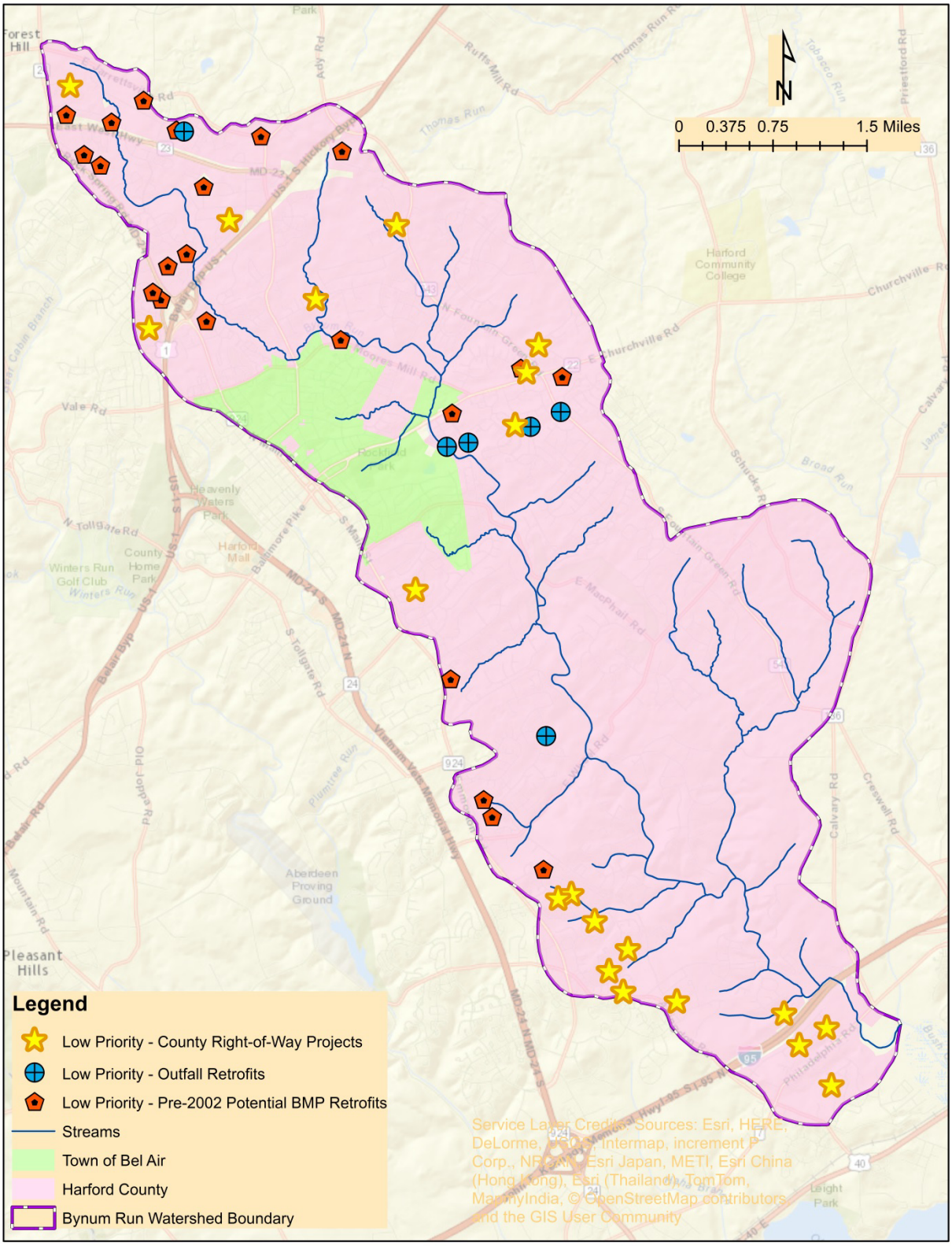


Figure 3-3: Locations of proposed low priority projects

3.2 ALTERNATIVE URBAN BMPS

In addition to the structural BMPs, MDE-approved Alternative Urban BMPs can be important options for the County to address sediment TMDL targets. The County has already adopted some of these alternative urban strategies. Expansion or modification of these strategies is proposed to receive credits from MDE as an approved Alternative Urban BMP.

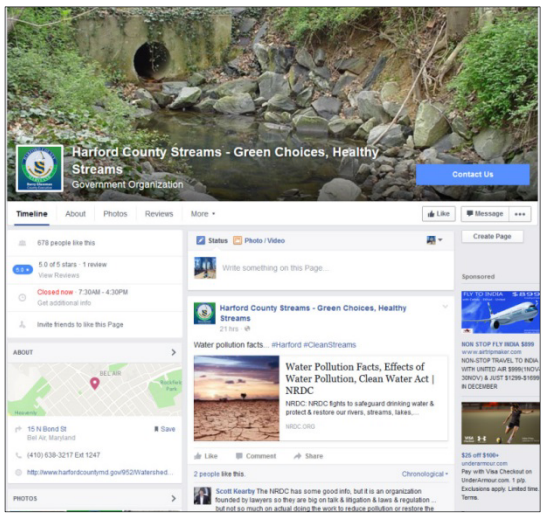
- **Urban Tree Planting:** The County is already implementing tree planting as a part of its stormwater management program on several schools and libraries. As an expansion to this program, six properties with available open area for tree planting were identified in the Bynum Run Watershed. Approximately 14 acres of open area are available for tree planting. To receive credits from MDE for tree buffers, a survival rate of at least 100 trees per acre is necessary, and 50 percent of the trees must be at least 2 inches in diameter and have a 4.5-foot-tall trunk. This alternative urban BMP was given a high priority for implementation, and it could result in reduction of sediment loads by 1,500 lbs/year. Appendix B identifies the locations of the County properties in Bynum Run Watershed with available area for tree planting. Planning-level implementation costs of $240,000 are estimated for this strategy based on *Costs of Stormwater Management Practices in Maryland Counties* (King and Hogan, 2011). A contingency of 35 percent was applied to account for increases in unit costs for trees and resources required for tree planting since the publication of this document. An impervious area credit of approximately 5 acres would be received from the implementation of the proposed tree planting projects.

- **Catch Basin Cleaning and Street Sweeping:** The County is currently not planning on expanding these programs to address TMDLs. The potential benefits from these programs will be evaluated by the County once all the restoration options are exhausted.

3.3 PROGRAMMATIC STRATEGIES

Public participation and stakeholder engagement are essential to the successful implementation of a TMDL restoration plan. Part IV.E.3 of the County's NPDES MS4 Permit requires the County to engage the public to solicit their input for potential program developments that could help the County in addressing applicable TMDLs. Most of the land in the Bynum Run Watershed is privately owned. Developing programs to promote education and outreach to these private property owners, including homeowners and businesses, on pollution prevention and good housekeeping would encourage their participation as environmental stewards.

The County currently uses Harford County's website http://www.harfordcountymd.gov and Facebook page at Harford County Streams – Green Choices, Healthy Streams to promote various education and outreach programs. The County participates in outreach events such as Earth Day and the Wade-In. The County also conducts programs at County schools annually to educate students on effective stormwater management.



In addition to the existing County programs, below are some potential programmatic strategies the County can consider to inform residents on the impacts of sediment pollution.

- **Education and Outreach Program for Erosion and Sediment Control (ESC):** Currently, the County requires implementation of ESC practices for all new development that disturb more than 5,000 square feet of area using the MDE approved ESC practices. A County inspector inspects all the sites and requires installation and maintenance of proper ESC practices. The County's ESC webpage currently has the list of sediment control practices that can be used. As Bynum Run Watershed is one of the fastest growing areas in the County, new development is anticipated to continue to increase. An education and outreach program for builders, contractors, and construction workers on the site could be developed on strategies for proper use of sediment control practices to reduce sediment pollution. The EPA-developed poster, available at http://water.epa.gov/polwaste/npdes/stormwater/upload/posterside1.pdf, can be used as one of the readily available outreach materials for the construction industry. In addition, the County can increase awareness of the readily available resources such as the County ESC webpage.

- **Education and Outreach Program for Home Owners:** The County posts several related messages on their Facebook page such as the importance of tree planting, pollution from stormwater runoff, and ongoing stormwater restoration projects throughout the County,

which increase awareness among residents about stormwater pollution. Incentive programs could be developed at the County level to promote installation of rain barrels, rain gardens, and other techniques to capture stormwater in residential areas. The EPA-developed material available at http://water.epa.gov/polwaste/npdes/stormwater/upload/solution_to_pollution.pdf could be used as potential outreach material for educating the home owners on pollution prevention. Additional resources are also available on one of Maryland's Phase I NPDES MS4 community's, Montgomery County's RainScapes website at http://www.montgomerycountymd.gov/DEP/water/rainscapes.html#resources.

- **Expansion of County's Current Urban Nutrient Management:** The County has adopted a nutrient management program at schools. This program promotes no-mow or low-mow areas throughout the property and reduction of stormwater runoff through infiltration, along with restriction on the use of any fertilizers. This program can be expanded to County properties so that concentrated runoff from impervious areas can be captured by the filter strips, thereby reducing the sediment loads.

- **Expansion of Stormwater Management Facility Maintenance Workshop Program:** The County's DPW currently conducts an annual workshop for the HOAs, businesses, and contractors on the maintenance of stormwater management facilities. Expansion of this program by conducting it bi-annually and adding more participants can increase awareness of the importance of maintaining stormwater management facilities.

3.4 SUMMARY

The TMDL goal of a 20.7 percent reduction in sediment load from the current load conditions is planned based upon implementing all high priority projects and a subset of medium priority projects. The County has flexibility to select restoration projects from the set of high, medium, low and alternative urban BMPs to address the TMDL. Table 3-5 provides a summary of sediment load reductions, implementation cost and impervious credits of high, medium and low priority restoration projects.

Table 3-5: Low Priority Structural BMP Restoration Projects

Priority	Sediment Load Reductions from Current Load Conditions (tons/year)	Sediment Load Reductions from Current Conditions (percentage)	Impervious Credits (acres)	Implementation Costs (millions)
High	134	10.9	109	$11.5
Medium (Retrofit of 81 pre-2002 BMPs)	138	11.3	347	$30.0
Medium (Remaining medium priority projects)	26	2.1	139	$25.5
Low	49	4.0	148	$21.7
Totals	**347**	**28.3**	**743**	**$88.7**
TMDL Goals	**250**	**20.7**	**N/A**	**N/A**

N/A – Not Applicable

SECTION FOUR: FUNDING AND TECHNICAL ASSISTANCE

4.1 POTENTIAL FUNDING SOURCES

The proposed restoration projects require funding for their successful implementation and continued maintenance. Funding is needed for the project implementation, operational expenditure, administrative costs, and for education and outreach program development. The County's CIP projects are funded through several sources such as bonds, recordation tax, and State and Federal grants. While these funds may be adequate to implement some of the proposed restoration strategies as a part of the CIP projects, additional funds will be needed to implement the other restoration strategies, and to expand educational and outreach programs. Table 4-1 identifies potential State and Federal funding, non-profit grants and loans that may be appropriate for the proposed restoration strategies.

4.2 TECHNICAL ASSISTANCE

Various documents, including *Guidance for Developing Stormwater Wasteload Allocation Implementation Plans for Nutrient and Sediment Total Maximum Daily Loads* (MDE, 2014a) and *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (MDE, 2014b), provide guidance on the development of restoration plans and restoration strategies to address applicable TMDLs. In addition, MDE has conducted webinars and workshops to train the staff of NPDES MS4 jurisdictions on different tools and technologies developed by MDE. Technical guidance is also available for educators through MD DNR's "Resources for Educators" at http://dnr2.maryland.gov/Education/Pages/programs.aspx.

Table 4-1: Potentially Available Funding Sources for the Implementation of Restoration Strategies

Funding Source	Funding Agency	Funding Type	Restoration Measure Type Supported
Federal	National Fish and Wildlife Foundation (NFWF)/EPA	Matching Funds/Grants	• Stream restoration • Water quality improvement
Federal	EPA 319 Funds	Matching Funds/Grants	• Restoration of impaired waters by implementing watershed plans
Federal	EPA Urban Waters Small Grants	Matching Funds/Grants	• Projects that address urban pollution through outreach
State	Maryland Department of Natural Resources (MD DNR) – Chesapeake Bay Implementation Grants	Grant	• Watershed assistance • Natural filters • Innovative technology • Maryland agriculture cost-share
State	MD DNR – Natural Filters	Technical Assistance/ Funding	• Forest buffers • Wetlands
State	MDE – The Maryland Stormwater Pollution Prevention Cost-Share Program	Cost-Share	• Stormwater Management Retrofits
State	State Water Quality Revolving Loan Fund	Loan	• Point source pollution prevention • Non-point source pollution prevention
State	Bay Restoration Funds	Grant	• Failing/non-conforming onsite sewage disposal system • Upgrade of wastewater treatment plants
Non-Profit	Chesapeake Bay Trust	Grants	• Environmental education • Outreach • Water quality improvement through restoration and retrofits

SECTION FIVE: IMPLEMENTATION SCHEDULE

On February 17, 2015, the Harford County Council approved Resolution 005-15 which dedicates a portion of the recordation tax toward watershed protection and restoration improvement projects. The projected $2M per year will be used to pay for debt services for future bonds and / or loans. Harford County's projected annual budget for the implementation of the MS4 permit including capital improvement projects, watershed assessments and plans, water quality monitoring, etc. is $10 M. Harford County projects $2.5 M per year will be available for restoration projects in Bynum Run.

As discussed in previous sections, the completion of all of the High Priority projects and a subset of the Medium Priority projects are estimated to produce load reductions consistent with the sediment TMDL for Bynum Run at a cost of $41 M or $150,000 per ton. Allocating $2.5 M per year, it will take an estimated 16 ½ years or until 2032 to address the TMDL for sediment.

In 2016, Harford County anticipates completing a watershed assessment for the Upper Bynum Run, from the headwaters downstream to the crossing at Maryland Route 22, or 20% of the watershed. An existing USGS flow gage is located here and will assist in long term monitoring discussed in the next section. The watershed assessment will provide field collected survey data of the stream conditions and identify additional restoration opportunities such as stream restoration that could provide lower costs per unit of sediment removal. Harford County will use the results of the watershed assessment to focus watershed restoration in the Upper Bynum Run over the next four years through the expiration of the County's MS4 permit on December 29, 2019.

The following table lists projected expenditures and sediment load reductions through 2019 which accounts for 40 tons or 20% of the load reduction.

Having prioritized the restoration strategies developed to address the sediment TMDL, the County will begin implementing high priority projects. Urban tree planting on school and County-owned property that is part of the restoration strategy will also be given high priority and combined with the existing tree planting program for other County-owned properties.

The County will also evaluate the medium priority projects. These projects will likely take longer to implement, as they are located on HOA properties, and agreements may need to be developed to initiate them. During the implementation process, if any of the high and medium priority projects are considered not feasible, then alternative options can be selected from the low priority projects.

Table 5-1: Cost and Benefits of Implementation through 2019

Design Component	2016 (Thousands)	2017 (Thousands)	2018 (Thousands)	2019 (Thousands)	2016 – 2019 (Thousands)
Planning	$400	$80	$70	$80	$630
Design	$300	$620	$630	$620	$2,170
Construction	$300	$1,300	$1,300	$1,300	$4,200
Total	**$1,000**	**$2,000**	**$2,000**	**$2,000**	**$7,000**
*** Estimated Sediment Load Reduction (tons)**	**2.9**	**12.4**	**12.4**	**12.4**	**40.0**

* Estimated Sediment Load Reduction = Construction cost / 70% * $150,000 /ton
Average cost per ton for High and Medium Priorities = $150,000
Average construction cost = 70% total cost

An estimated, general implementation schedule is provided in Table 5-2. Documented load reduction efficiencies established by MDE at the time designs are initiated will be locked in unless efficiencies are increased.

As noted above, the County reserves the right, because the availability of resources is dependent on several factors, and because new technologies continuously emerge, to re-evaluate the implementation plan annually and update the plan based upon the feasibility of the proposed BMPs and the implementation schedule. As noted above, compliance with the County's MS4 permit is based upon an MEP level-of-effort as determined by the County.

Table 5-2: Implementation Schedule for Restoration Projects

Restoration Project	2016 (Thousands)	2017 (Thousands)	2018 (Thousands)	2019 (Thousands)
Planning Projects Total	**$400**	**$80**	**$70**	**$80**
Complete a watershed assessment for Upper Bynum Run	$300			
Develop and initiate a monitoring plan	$50	$50	$50	$50
Develop and initiate an outreach program for Upper Bynum Run	$10			
Review and update historical BMP database	$20			
Update BayFAST model		$10		$10
Coordinate with Harford County Schools to prioritize projects on school property	X		X	
Prioritize projects on county owned property	X		X	
Investigate incentives to encourage property owners to allow the County to complete retrofits on private property	X			
Contact HOAs in Upper Bynum Run		X	X	
Contract business owners in Upper Bynum Run			X	X
Conduct targeted hotspot investigates in Upper Bynum Run	$20	$20	$20	$20
Design Projects Total	**$300**	**$620**	**$630**	**$620**
Initiate designs on County owned property in Upper Bynum Run	$300	$500	$500	$500
Initiate designs on HOA owned property in Upper Bynum Run	$0	$120	$130	$120
Construction Projects Total	**$300**	**$1,300**	**$1,300**	**$1,300**
Complete construction for projects in Upper Bynum Run	$300	$1,300	$1,300	$1,300
Sunnyview Drive Stream Restoration	$0	$0	$0	$0
Bynum Run at St. Andrews Way Stream Restorations	$0	$0	$0	$0

SECTION SIX: MONITORING AND EVALUATION

6.1 EVALUATING PROGRESS OF PROPOSED RESTORATION STRATEGIES

Documentation regarding the County's progress on restoration is to be submitted in the County's annual reports due on December 30 each year and will include net changes in pollutant load reductions, and costs for completed projects. Pollutant load reductions will be calculated for each individual project constructed. Progress towards addressing the TMDL stormwater WLA will be calculated as a reduction in the current sediment load target of 1,222 tons per year. Updated BayFAST modeling is anticipated in 2017 to incorporate a completed historical review of BMPs and refinements to the 2014 impervious cover GIS layer. This will be an updated current load scenario for 2015. Harford County anticipates updating the planimetric GIS data in 2019. An updated BayFAST current load scenario will be completed with this data.

6.2 WATER QUALITY MONITORING

One method to determine the effectiveness of restoration strategies is to conduct a combination of physical, chemical, and biological monitoring. Improvements to biological communities are not instantaneous. Reducing sediment loads does not guarantee the return of a healthy biological community because it may be impacted by yet to be determined stressors. In addition, monitoring is costly. This plan, and the underlying County review, focuses on sediment load reduction and recognizes the impact flow has on sediment loading. The flow itself within the stream can also be a biological stressor. Therefore, load reductions should be credited towards for both TMDLs and impervious area restoration for managing the channel protection volume.

Harford County has collaborated with U.S. Geological Survey (USGS) to operate a flow gage on Bynum Run (USGS 01581500) since 1999. The gage is located on the main stem of Bynum Run at MD Route 22. Approximately 20% of the drainage area flows through the gage. Adding a turbidity probe at this location may be a cost effective method to measure sediment, but would only capture a portion of the watershed. To monitor turbidity effectively, a second USGS flow gage and turbidity probe could be installed lower in the watershed. The annual cost for a second flow gage and turbidity probe is estimated as $40,000.

Since this TMDL was established based on the BSID, the County intends to conduct biological monitoring using similar methods. Harford County anticipates initiating biological monitoring in the Bynum Run Watershed in spring 2017 using standard MBSS protocols. The monitoring

methods will be established and presented to MD DNR for approval prior to monitoring. Harford County's goal is to collect scientifically defensible data.

This proposed monitoring program aligns with the County's current watershed monitoring strategy. Watershed based monitoring programs have been established in the Plumtree Run and Foster Branch watershed including USGS gages for flow and water quality. The purpose of this watershed based approach is to utilize this data to demonstrate water quality improvements on a watershed level. Conducting site specific monitoring as generally required through wetland permitting by MDE and / or U.S. Army Corp of Engineers is very costly, labor intensive, and does not provide useful data for restoration planning at the local level.

6.3 INSPECTION AND MAINTENANCE

Maintenance is a key component for the success of any proposed or existing BMP to maintain the design level of treatment of runoff. Inspectors are important because they provide guidance for BMP operators to ensure they are following maintenance consistent with BMP design. Chapter 3 and Chapter 5 of the Maryland Stormwater Design Manual (MDE, 2000) describe maintenance requirements for conventional stormwater BMPs and for ESD practices, respectively.

Maintenance can be broken up into three general categories: routine, structural, and emergency. Routine maintenance should be the most frequent and does not require any structural changes to an existing stormwater practice (e.g., mowing, weeding, and removing trash from an existing stormwater practice). Structural maintenance is less frequent and involves replacing or repairing structural features of an existing practice (e.g., replacing broken storm drain pipes, repairing riser structures, replacing filter media). Emergency maintenance is the least common, and is required when an existing structure has failed or is about to fail (e.g., emergency spillway failure, flooding at an existing BMP).

Typical maintenance practices for stormwater BMPs include removal of invasive vegetation, mowing grass, removing sediment from pretreatment forebays, and replacing structural features (e.g., weirs, storm drain pipes, overflow structures). Wetlands require additional maintenance, as wetland plantings may be required if vegetation cover requirements are not met. Infiltration (e.g., infiltration trenches, infiltration basins, dry wells) and filtering practices (sand filters, bioretentions, micro-bioretentions, submerged gravel wetlands, and rain gardens) require additional inspection and maintenance considerations related to the filtering media, which may need to be replaced if clogged with sediments.

Inspectors must understand the unique design considerations and maintenance needs of each type of stormwater BMP. For example, wet swales and bio-swales do not require mowing, a dry swale should have grass heights in the 4 to 6 inch range, and a surface sand filter should have grass heights of less than 12 inches. While these slight differences may seem trivial, incorrect maintenance can substantially reduce pollutant removal effectiveness. Qualified inspectors are therefore an important element in enforcing proper maintenance practices.

MDE's *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (MDE, 2014a) indicates that:

> *Regular maintenance shall occur for all BMPs once every 3 years and each jurisdiction shall implement appropriate actions and document that any deficiencies are rectified. Otherwise, the credits will be removed until proper performance is verified.*

Harford County is responsible for conducting triennial inspections for all stormwater management facilities. Most stormwater management facilities are privately owned, typically by homeowner associations, individual businesses or business parks. These owners are required to provide preventative and long-term maintenance as outlined within a maintenance agreement and / or maintenance schedules included within approved design plans. Ensuring these facilities are functioning properly is important in maintaining load reductions for Bynum Run. Harford County anticipates reviewing the status of all existing stormwater management facilities within the Bynum Run watershed. All maintenance records will be associated with plans review records, and an inspection and outreach program will be developed. Restoration that includes retrofitting existing stormwater management facilities and constructing new stormwater management facilities are included in the inventory for triennial inspections.

SECTION SEVEN: REFERENCES

CWP (Center for Watershed Protection). 2003. *Impacts of Impervious Cover on Aquatic Systems.*

EPA (U.S. Environmental Protection Agency). 1986. *Quality Criteria for Water 1986*. Available at http://yosemite.epa.gov/water/owrcCatalog.nsf/ 065ca07e299b464685256ce 50075c11a/18888fcb7d1b9dc285256b0600724b5f!OpenDocument.

EPA. 1999. *Stormwater O&M Fact Sheet: Catch Basin Cleaning.* Available at http://yosemite.epa.gov/water/owrccatalog.nsf/e673c95b11602f2385256ae1007279fe/ 8d3112de1d84d80685256d83004fda3d!OpenDocument.

Harford County. 1999. *Findings and Recommendations Report: Engineering Study for Bynum Run Watershed*.

Harford County. 2012a. *2012 Master Plan and Land Use Element Plan*. Available at http://www.harfordcountymd.gov/771/2012-Master-Plan-Land-Use-Element-Plan.

Harford County. 2012b. *Chesapeake Bay TMDL Phase II Water Implementation Plan*. Final.

Harford County, 2014. Guidance Document for Implementing Low Cost Water Quality Improvement Measures.

King, D. and P. Hagan. 2011. *Costs of Stormwater Management Practices in Maryland Counties*. Draft Final Report. Prepared for the Maryland Department of the Environment. Available at https://www.mwcog.org/uploads/committee-documents/kl1fWF1d20111107094620.pdf.

MDE (Maryland Department of the Environment). 2000. *Maryland Stormwater Design, Manual Volumes I and II*. Available at http://www.mde.state.md.us/programs/water/stormwatermanagementprogram/maryland stormwaterdesignmanual/Pages/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.aspx.

MDE. Maryland's Surface Water Quality Standards. Available at http://www.mde.state.md.us/assets/document/factsheets/surfwater.pdf

MDE. 2006. Integrated Report of Surface Water Quality in Maryland.

MDE. 2008. Integrated Report of Surface Water Quality in Maryland.

MDE. 2011a. Total Maximum Daily Load of Sediment in the Bynum Run Watershed, Harford County, Maryland. Final.

MDE. 2011b. Maryland Standards and Specifications for soil Erosion and Sediment Control

MDE. 2012. *Watershed Report for Biological Impairment of the Bynum Run Watershed in Harford County, Maryland; Biological Stress Identification Analysis and Results*.

MDE. 2014a. General Guidance for Developing a Stormwater Wasteload Allocation (SW-WLA) Implementation Plan - Final. May.

MDE. 2014b. *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated*.

MDE. 2014c. *Guidance for Developing Stormwater Wasteload Allocation Implementation Plans for Nutrient and Sediment Total Maximum Daily Loads*. Final.

MDE. . Maryland's Designated Uses of Surface Waters. Available at http://www.mde.state.md.us/programs/Water/TMDL/Water%20Quality%20Standards/Pages/programs/waterprograms/tmdl/wqstandards/wqs_designated_uses.aspx

MDE. Surface Water Quality Standards. Available at http://www.mde.state.md.us/assets/document/factsheets/surfwater.pdf

MDE. Tier II High Quality Waters Map. Available at http://www.mde.state.md.us/programs/Water/TMDL/Water%20Quality%20Standards/Pages/HighQualityWatersMap.aspx

Maryland Geological Survey (MGS). Maryland Geology. Available at http://www.mgs.md.gov/geology/

Maryland Department of Natural Resources (MD DNR), 2005. Maryland Streams Take a Closer Look. Available at http://www.dnr.state.md.us/irc/docs/00012830.pdf

APPENDIX A:
Proposed Restoration Strategies for the Bynum Run Watershed Total Maximum Daily Load Restoration Plan for Sediment

Structural Stormwater Best Management Practices (BMPs)

Table A1: High Priority – Structural BMPs

Project Name	Owner	Location	Proposed Project Type	Drainage Area (Acres)	Impervious Area (Acres)	Proposed Restoration
CP-1	Board of Education	William S. James Elementary School	Tree Box Filter	0.85	0.78	Two inlets at the northwestern parking lot can be retrofitted with tree box filters to treat the stormwater runoff from the parking lot and the driveways at the northern and western ends of the property.
CP-3	Board of Education	East of Forest Hill Annex	Bioretention	0.78	0.59	A bioretention can be implemented in the open area east of the parking lot.
CP-5	Board of Education	C. Milton Wright High School	Step Pool Storm Conveyance System (SPSC)	20.29	8.86	Majority of the property drains to the outfall on the southwestern corner. A channel runs downstream from the outfall until confluence with the stream. The area is a good place to implement SPSC at OF001309.
CP-6	Harford County	Abingdon Fire Company	Bioretention	1.34	0.80	A bioretention to treat rooftop runoff and parking lot in front of the building can be implemented. The grass area in front of the building is available for implementation.
CP-6A	Harford County	Abingdon Fire Company	Permeable Pavement	0.66	0.64	Parking lot can be converted to permeable pavement to treat stormwater runoff.
CP-7	Board of Education	Southampton Middle School	Bioretention	1.10	0.37	A bioretention can be implemented to treat stormwater runoff from parking lot south of Moores Mill Road. Open area is available to implement the bioretention.
CP-7A	Board of Education	Southampton Middle School	Bioretention	6.03	4.33	Multiple bio-filtering practices can be implemented in the open area around the building to treat rooftop runoff and parking lot runoff.
CP-9	Harford County	County Property on 45 E. Gordon Street	Micro-Bioretention	0.28	0.12	Micro-bioretention to treat a portion of the roof can be implemented in the open area available southeast of the property.
CP-10	Harford County	County Property on 503 Bynum Road	Bioretention/ Sand Filter	0.11	0.05	A filtration practice can be implemented to treat runoff from the entire building and a portion of the driveway in the open area west of the property.

Project Name	Owner	Location	Proposed Project Type	Drainage Area (Acres)	Impervious Area (Acres)	Proposed Restoration
CP-11	Harford County	Harford County Animal Control Division	Bioswale	3.61	2.01	Almost half of the property currently drains to a grass area along the road. A bioswale can be implemented in the grass area.
CP-12	Harford County	County Property on 621A Hickory Overlook Drive	Bioretention	0.28	0.13	A bioretention to treat half of driveway and the buildings can be implemented in the open area south of the property. Infiltration not possible because is the open area has C/D soils.
CP-12A	Harford County	County Property on 621A Hickory Overlook Drive	Permeable Pavement	0.16	0.08	The lower portion of the driveway drains to the wooded area on the east. Potential for permeable pavement or infiltration practice to treat runoff from the northern half of the driveway.
CP-13	Harford County	County Property on Wright Street	Micro-bioretention	0.25	0.18	County parking lot can be treated by adding a micro-bioretention at the eastern corner next to the entrance.
CP-14	Board of Education	Bel Air Elementary School	Bioretention	3.40	2.0	A flow splitter can be added to the inlet near the median to divert the flow to the open area southeast of the property where a bioretention can be implemented.
CP-14A	Board of Education	Bel Air Elementary School	Downspout Disconnection and Micro-Bioretention	0.16	0.14	Downspouts from the rooftop of eastern building can be disconnected, and a micro-bioretention can be implemented in the open area next to it.
CP-15	Board of Education	Wakefield Elementary School	Downspout Disconnection and Landscape Infiltration	0.37	0.35	Hydrologic soil group (HSG) B in the area, so runoff can be treated by downspout disconnection and landscape infiltration at the main building.
CP-16	Board of Education	County Property on S. Conowingo Road	Bioswale	3.04	2.69	A bioswale can be implemented downstream of the existing outfall. Topo looks suitable for implementation of a bioswale.
CP-17	Harford County Commissioners	County Property on Courtland & Burns Alley	Permeable Pavements	0.22	0.19	Permeable pavement is a possible option for the area because there is not much open area available for other practices.

Project Name	Owner	Location	Proposed Project Type	Drainage Area (Acres)	Impervious Area (Acres)	Proposed Restoration
CP-18	Harford County	County Property on 11 W. Courtland Street	Permeable Pavements	0.11	0.11	Permeable pavements possible option because there is not much open area available for other practices.
CP-19	Harford County	County Property on 112 S. Hickory Avenue	Permeable Pavements	0.19	0.19	Permeable pavements possible option because there is not much open area available for other practices.
CP-20	Harford County	County Property on Wheel and Old Emmorton Road	Bioretention	0.24	0.18	Bioretention can be implemented to treat portion of Old Emmorton Road, which is a County-owned road.
CP-21	Harford County	County Property off Mardic Drive	Infiltration Trenches	0.56	0.18	Possibility to treat the road parcel using infiltration practices because the soils are HSG B in the area.
CP-22	Harford County	Fountain Green Elementary School	Retrofit of Pond to Filtering Practice	3.62	1.95	Portion of parking lot drains to this unidentified pond. Potential to retrofit the stormwater pond to a filtering practice to provide water quality.
CP-25	Harford County	County Senior Citizen Center	Micro-Bioretentions	0.60	0.29	Micro-bioretention can be implemented to treat a portion of the property in the open area northeast of the property.
CP-26	Harford County Commissioners	County Public Library –Bel Air	Permeable Pavement	0.52	0.41	Potential to convert parking lot to permeable pavement to treat portion of rooftop and parking lot runoff as well.
CP-27	Harford County	County Property on 611 E. Wheel Road	Sand Filter	0.57	0.37	A filtration practice can be implemented in the County open area to treat a portion of Wheel Road, which is County owned.
CP-28	Harford County	County Property on 703 Wheel Road	Sand Filter	0.19	0.16	A filtration practice can be implemented in the County open area to treat a portion of Wheel Road, which is County owned.
CP-30	Board of Education	Fountain Green Elementary School	Micro-Bioretention	0.44	0.41	A micro-bioretention can be implemented in the open to treat portion of roof top in the open area east of the building.
CP-30A	Board of Education	Fountain Green Elementary School	Micro-Bioretention	0.45	0.38	A micro-bioretention can be implemented to treat runoff from parking lot west of the property.

Project Name	Owner	Location	Proposed Project Type	Drainage Area (Acres)	Impervious Area (Acres)	Proposed Restoration
CP-31	Harford County	County Property on 121 S. Main Street	Permeable Pavements	1.68	1.56	Permeable pavements are potential option at this property as there is not much open area available for other practices.
SWM000164	Board of Education	Fountain Green Elementary School	MS4 Permit Required Stormwater Retrofit	25.0	5.6	The existing pre-2002 wet pond is proposed to be upgraded to the current MDE standards.
OF-17	Board of Education	C. Milton Wright High School	Bioretention	1.55	1.04	A filtering practice can be implemented at the outfall to treat the runoff before it is conveyed to the stream.
OF-18	County	County Property South of Malku's Way	SPSC	4.71	2.02	The outfall can be retrofitted with an SPSC to treat runoff from May Court and Malku's Way neighborhood.
OF-19	County	County Property North of East Broadway	Sand Filter	6.61	2.16	A sand filter can be implemented at the outfall to treat runoff from East Broadway and Ardmore Way neighborhood.
OF-33	County	County Property East of Briarcliff Lane across Rolling Place	SPSC	10.00	2.25	The outfall can be retrofitted with an SPSC to treat a portion of runoff from Saratoga Drive and Briarcliff Lane neighborhood.
OF-35	County	County Property South of Glenangus Drive	Sand Filter	7.79	2.46	A sand filter can be implemented at the outfall to treat a portion of runoff from Glenangus Drive.
OF-49	County	County Property End of Brewster Drive	SPSC	5.26	1.61	The outfall can be retrofitted with a SPSC to treat a portion of runoff from Parliamentary Drive and Brewster Lane neighborhood.

Table A2: High Priority – Stream Restoration Projects

Project Name	Owner	Location	Proposed Project Type	Length of Restoration (feet)	Impervious Area (acres)	Proposed Restoration
Sunnyview Drive Stream Restoration – Farnandis Branch	Private / Home Owners Association (HOA)	Sunnyview Drive and Ring Factory Road	Stream Restoration	3,000	30	Stabilize stream to reduce sediment loads using various restoration techniques.
Bynum Run at St. Andrews Way Stream Restoration	County	Woodland Drive	Stream Restoration	3,000	30	Stabilize stream to reduce sediment loads using various restoration techniques.

Table A3: Medium Priority – Structural BMPs

Project Name	Owner	Location	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)
SWM000223	Private – Residential	Next to 1318 Hidden Stream Drive	Retrofit	25.0	5.6
SWM000089	Private – Residential	Between 3723 and 3715 Federal Lane	Retrofit	12.8	2.9
SWM000287	Private – Residential	End of Gittings Court	Sand Filter	7.6	1.7
SWM000085	Private –- Residential	Next to 3120 Birchbrook Lane	Retrofit	25.0	5.6
SWM000084	Private – Residential	Next to 321 Eastbend Court	Retrofit	25.0	5.6
SWM000359	Private – Residential	Eastbend Court	Retrofit	25.0	5.6
SWM000415	Private – Residential	Next to 805 Tiffany Terrace	Retrofit	19.7	4.4
SWM000286	Private – Residential	End of Towson Drive	Retrofit	20.3	4.6

Project Name	Owner	Location	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)
SWM000126	Private – Residential	Next to 911 Deer Court	Retrofit	25.0	5.6
SWM000118	Private – Residential	Behind 34 Mitchell Drive	Sand Filter	7.4	1.7
SWM000040	Private – Residential	Behind 305 Lindsay Court	Retrofit	25.0	5.6
SWM000039	Private – Residential	Behind 2603 Smallwood Court	Sand Filter	6.3	1.4
SWM000229	Private – Residential	Next to 368 Hunters Run Drive	Retrofit	25.0	5.6
SWM000363	Private – Residential	Next to 540 David Drive	Retrofit	25.0	5.6
SWM000006	Private – Residential	N.S. David Dr. E. of Rambler Road	Retrofit	25.0	5.6
SWM000259	Private – Residential	Behind 1504 Parkland Drive	Retrofit	25.0	5.6
SWM000295	Private – Residential	Across from 1500 Dunkeld Way	Retrofit	25.0	5.6
SWM000198	Private – Residential	Behind 1402 Royal Troon Court	Retrofit	25.0	5.6
SWM000685	Private – Residential	Next to 1307 Forest Oak Court	Retrofit	25.0	5.6
SWM000166	Private – Residential	N.S. Foxborough D. West of Bennett Place	Retrofit	25.0	5.6
SWM000199	Private – Residential	S. Macphail Road at Ring Factory Road	Retrofit	25.0	5.6
SWM000163	Private – Residential	Fountain Glen Drive	Retrofit	25.0	5.6
SWM000203(1)	Private – Residential	West of Vanguard S. of Royston Place	Retrofit	16.2	3.6

Project Name	Owner	Location	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)
SWM000338	Private – Residential	Todd Rd and Treadmore Road	Retrofit	25.0	5.6
SWM000096	Private – Residential	Across from 1302 Beckett Court	Retrofit	10.4	2.3
SWM000097(1)	Private – Residential	Behind 1204 Bancroft Court	Sand Filter	7.0	1.6
SWM000116	Private – Residential	Behind 1357 Crofton Drive	Retrofit	18.9	4.3
SWM000037(2)	Private – Residential	Across from 438 Ellis Lane	Retrofit	25.0	5.6
SWM000099	Private – Residential	Behind 1200 Gyros Court	Retrofit	16.4	3.7
SWM000260	Private – Residential	Behind 1100 Runnymede Lane	Retrofit	25.0	5.6
SWM000210	Private – Residential	Behind 1203 Hampton Ridge Lane	Retrofit	25.0	5.6
SWM000070	Private – Residential	Intersection Route 543 and Thomas Run Road	Retrofit	25.0	5.6
SWM000014	Private – Residential	Behind 1013 Shaffner Drive	Sand Filter	5.3	1.2
SWM000209	Private – Residential	N.S. Henderson Rd W. Of Md. Route. 543	Retrofit	25.0	5.6
SWM000011	Private – Residential	Behind 1315 Cheshire Lane	Retrofit	11.9	2.7
SWM000012	Private – Residential	Behind 1339 Cheshire Lane	Sand Filter	5.1	1.1
SWM000073	Private – Residential	Behind 1800 Queen Anne Square	Retrofit	25.0	5.6
SWM000382	Private – Residential	Behind 721 Hickory Limb Circle	Retrofit	24.8	5.6

Project Name	Owner	Location	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)
SWM000428	Private – Residential	East Side of Birch Brook Lane	Sand Filter	5.8	1.3
SWM000416	Private – Residential	Behind 4001 off Andrew Court	Retrofit	10.9	2.5
SWM000125	Private – Residential	Across from Bynum Overlook Drive on Hookers Mill Rd	Retrofit	13.8	3.1
SWM000332	Private – Residential	Off Hookers Mill Rd	Retrofit	25.0	5.6
SWM000347	Private – Residential	Clarkson Drive	Retrofit	11.0	2.5
SWM000333	Private – Residential	Off Oak Mill Court	Sand Filter	6.8	1.5
SWM000041	Private – Residential	Behind 2608 Rhododendron Drive	Retrofit	24.1	5.4
SWM000453	Private – Residential	Behind 925 Sidehill Drive	Retrofit	16.2	3.7
SWM000257	Private – Residential	Behind 803 Deep Wood Court	Retrofit	22.2	5.0
SWM000342	Private – Residential	Behind 511 Cedar Hill Court	Retrofit	12.7	2.9
SWM000058	Private – Residential	Behind 1704 Sable Court	Retrofit	25.0	5.6
SWM000621	Private – Residential	Behind 1200 Sparrow Mill Way	Retrofit	25.0	5.6
SWM000455	Private – Residential	Behind 1302 Streamview Court	Retrofit	12.6	2.8
SWM000469	Private – Residential	Behind 1301 Harling Court	Retrofit	17.7	4.0
SWM000281	Private – Residential	Next to 1344 Agora Place	Retrofit	11.5	2.6

Project Name	Owner	Location	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)
SWM000290(1)	Private – Residential	Northeast Corner of Amyclae Drive and Md 543	Retrofit	25.0	5.6
SWM000064	Private – Residential	Next to 1411 Banstead Court	Retrofit	24.0	5.4
SWM000322	Private – Residential	Behind 904 Felicia Court	Sand Filter	6.3	1.4
SWM000100	Private – Residential	Behind 318 Sparta Court	Sand Filter	5.3	1.2
SWM000321	Private – Residential	Behind 589 Henderson Road	Retrofit	10.3	2.3
SWM000337	Private – Residential	Next to 1712 Amyclae Drive	Sand Filter	8.0	1.8
SWM000458	Private – Residential	Next to 569 Henderson Road	Retrofit	25.0	5.6
SWM000447	Private – Residential	Across from 303 Wagner Road	Retrofit	14.7	3.3
SWM000449	Private – Residential	Next to 1806 Amyclae Drive	Retrofit	25.0	5.6
SWM000543	Private – Residential	Next to 1015 Henderson Manor Court	Retrofit	12.1	2.7
SWM000208(1)	Private – Residential	Behind 1219 Cheshire Lane	Retrofit	25.0	5.6
SWM000401	Private – Residential	Next to 616 Loring Avenue	Sand Filter	5.5	1.2
SWM000320	Private – Residential	Behind 733 Hickory Limb Circle	Retrofit	25.0	5.6
SWM000329	Private – Residential	Across from 1733 Chrisara Court on Spenceola Parkway	Retrofit	20.4	4.6
SWM000408	Private – Residential	Behind 327 Donald Circle	Retrofit	14.2	3.2

Project Name	Owner	Location	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)
SWM000476	Private – Residential	Next to 101 Wagner Way	Sand Filter	7.5	1.7
SWM000475	Private – Residential	Next to 16 Wagner Way	Retrofit	25.0	5.6
SWM000025	Private – Residential	Md. Rt. 23 and Aster La West of Melrose Lane	Bioretention	1.2	0.3
SWM000335	Private – Residential	Behind 1011 Saddleback Way	Sand Filter	9.5	2.1
SWM000409	Private – Residential	Next to 2046 Mardic Drive	Retrofit	21.3	4.8
SWM000240	Private – Residential	Behind 2195 Sewanee Drive	Retrofit	16.6	3.7
SWM000348	Private – Residential	Behind 2290 Howland Drive	Retrofit	25.0	5.6
SWM000256(1)	Private – Residential	Behind 812 Bynum Run Court	Retrofit	25.0	5.6
SWM000419	Private – Residential	Northwest Corner Wheel Rd and Willow Chase Drive	Retrofit	1.4	0.3
SWM000421	Private – Residential	West Side of Willow Chase Drive Adjacent to Lot 45	Retrofit	5.5	1.2
SWM000420	Private – Residential	Northeast Corner of Wheel Rd and Willow Chase Drive	Retrofit	2.0	0.4
SWM000422	Private – Residential	East Side of Willow Chase Drive Behind Lot 5	Retrofit	8.3	1.9
SWM000423	Private – Residential	East Side of Willow Chase Drive Behind Lot 8	Retrofit	7.1	1.6
SWM000430	Private – Residential	East Side of Springvale Court Behind Lots 13 and 14	Retrofit	4.0	0.9
SWM000429	Private – Residential	East Side Of Springvale Court Behind Lot 20 and 21	Retrofit	4.0	0.9

Project Name	Owner	Location	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)
SWM000425	Private – Residential	South Side of Springvale Court adjacent to Lot 17	Retrofit	1.1	0.2
SWM000427	Private – Residential	South Side of Springvale Court adjacent to Lot 18	Retrofit	1.6	0.4
SWM000424	Private – Residential	North Side of Springvale Court adjacent to Lot 28	Retrofit	1.9	0.4
SWM000426	Private – Residential	North Side of Springvale Court adjacent to Lot 27	Retrofit	4.4	1.0
SWM000254	Private – Residential	Across from 1320 Valley Oak Way	Retrofit	25.0	5.6
SWM000045	Private – Residential	Behind 1400 Federal Garth	Retrofit	25.0	5.6
SWM000117	Private – Residential	Across from 52 Laurentum Parkway	Retrofit	25.0	5.6
SWM000009	Private – Residential	Merrick Way Cul-De-Sac	Retrofit	25.0	5.6
SWM000230	Private – Residential	N.E. Corner Laurel Bush Road and Point to Point	Retrofit	25.0	5.6
SWM000069	Private – Residential	S.S. Wheel Rd W. of Md. Route 543	Retrofit	25.0	5.6
SWM000620	Private – Residential	Behind 1502 Stone Post Court	Retrofit	17.7	4.0
SWM000402	Private – Residential	Behind 616 Loring Avenue	Retrofit	18.2	4.1
SWM000207	Private – Residential	Next to 905 Hnderson Road	Retrofit	25.0	5.6
OF-10	HOA – Private	West of Bramble Court	Bioretention/Sand Filter	1.0	0.5
OF-11	HOA – Private	West of Othello Court	Bioretention/Sand Filter	3.2	1.5
OF-12	HOA – Private	East of Fallstaff Road	Bioretention/Sand Filter	1.0	0.4

Project Name	Owner	Location	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)
OF-13	HOA – Private	North of Shakespeare Drive	Bioretention/Sand Filter	5.4	2.3
OF-14	HOA – Private	End of Fall Staff Court	SPSC	5.0	1.9
OF-15	HOA – Private	South of Greenwood Drive	SPSC	10.7	3.1
OF-16	HOA – Private	West of Thomas Run Road	SPSC	13.1	3.8
OF-2	HOA – Private	South of Saddleback Way	SPSC	2.6	1.5
OF-20	HOA – Private	End of Beckett Court	Bioretention/Sand Filter	1.6	0.8
OF-23	HOA – Private	End of Clifton Terrace	SPSC	9.0	3.5
OF-24	HOA – Private	North end of Ellicott Drive	SPSC	2.3	1.1
OF-25	HOA – Private	East of Ellicott Drive	SPSC	2.9	0.9
OF-26	HOA – Private	North of East Mcphail Road, across Ellicott Drive	SPSC	13.8	4.6
OF-27	HOA – Private	Fountain Glen Drive across Sandy Ray Terrace	SPSC	3.6	1.9
OF-28	HOA – Private	West end of Lochern Terrace	Bioretention/Sand Filter	4.6	2.2
OF-29	HOA – Private	Fountain Glen Drive next to Loch Carron Way	SPSC	2.4	1.3
OF-3	HOA – Private	End of Oakville Court	SPSC	1.1	0.5
OF-30	HOA – Private	End of Loch Carron Way	SPSC	2.0	1.1
OF-31	HOA – Private	West end of Brierhill Estates	SPSC	3.0	1.6
OF-32	HOA – Private	West end of Stone Ridge Way	Bioretention/Sand Filter	2.4	1.2
OF-34	HOA – Private	West of Ring Factory Road across Colony Place	Bioretention/Sand Filter	12.7	3.9
OF-36	HOA – Private	East of Glenangus Drive next to Lytham Court	SPSC	5.5	2.0
OF-38	HOA – Private	Patterson Mill Road across Patterson Mill Middle School	SPSC	3.9	2.1

Project Name	Owner	Location	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)
OF-4	HOA – Private	South of Montgomery Drive	SPSC	24.1	9.2
OF-40	HOA – Private	North of Sand Park Court	Bioretention/Sand Filter	18.1	5.5
OF-41	HOA – Private	End of Fox Hunt Court	SPSC	1.1	0.5
OF-42	HOA – Private	End of Kempton Park Circle	SPSC	12.0	5.2
OF-43	HOA – Private	End of Sedgefield Court	Bioretention/Sand Filter	17.5	7.3
OF-44	HOA – Private	East of Chantaway Court	SPSC	4.2	1.9
OF-45	HOA – Private	End of Abbey Circle	SPSC	1.7	0.9
OF-46	HOA – Private	End of Sutton Place	SPSC	4.4	1.4
OF-47	HOA – Private/County	East of Abbey Circle across Parliament Drive	SPSC	4.7	1.9
OF-48	HOA – Private	End of Butterfield Drive	SPSC	1.4	0.7
OF-5	HOA – Private	End of Brighton Court	Bioretention/Sand Filter	4.5	1.4
OF-50	HOA – Private	End of Millwright Circle	Bioretention/Sand Filter	3.9	2.3
OF-51	HOA – Private	East of Parallel Path	SPSC	12.4	4.9
OF-52	HOA – Private	Northeast of Burgh-Westra Way	SPSC	2.3	1.1
OF-53	HOA – Private	End of Toddsbury Court	Bioretention/Sand Filter	1.6	0.9
OF-54	HOA – Private	At the intersection of Burgh-Westra Court and Laurel Bush Road	SPSC	3.4	1.0
OF-55	HOA – Private	End of Clarkson Drive	Bioretention/Sand Filter	2.1	1.0
OF-56	HOA – Private	South of Laurel Valley Court between Long Meadow Drive and Parallel Path	SPSC	34.7	12.9
OF-57	HOA – Private	End of Lynndale Court and Waterbury Court	Bioretention/Sand Filter	11.7	4.2
OF-59	HOA – Private	East of Brierhill Estates Drive	Bioretention/Sand Filter	3.9	2.0

Project Name	Owner	Location	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)
		next to Briergreen Court			
OF-6	HOA – Private	End of Manchester Court	Bioretention/Sand Filter	2.1	0.9
OF-7	HOA – Private	End of Midwood Court	SPSC	1.7	0.7
OF-8	HOA – Private	West of Crescent Knoll Drive	Bioretention/Sand Filter	13.7	5.5
OF-9	HOA – Private	End of Dulwich Lane	Bioretention/Sand Filter	1.3	0.7

Table A4: Low Priority – Structural BMPs

Project Name	Owner	Location	Proposed Project Type	Drainage Area (Acres)	Impervious Area (Acres)
SWM000029	Private – Commercial	128 St Mary' s Church Road	Bioretention	4.3	1.0
SWM000393	Private	2225 and 2227 Old Emmorton Road	Bioretention	4.6	1.0
SWM000123(1)	Private	Next to 2100 Laurel Bush Road	Retrofit	25.0	5.6
SWM000122	Private – Commercial	Southeast Corner Md Route 22 and Brierhill Drive	Bioretention	0.9	0.2
SWM000023	Private – Commercial	1 Red Pump Road	Bioretention	0.3	0.1
SWM000168	Private – Commercial	Behind 1503 Rock Spring Road	Bioretention	2.1	0.5
SWM000007(1)	Private – Commercial	5 Maurice Drive	Retrofit	17.7	4.0
SWM000222(1)	Private – Commercial	534 E Jarrettsville Road	Bioretention	3.2	0.7
SWM000231	Private – Commercial	1515 Emmorton Road	Bioretention	2.5	0.6
SWM000245	Private – Commercial	1645 E. Churchville Road	Sand Filter	5.2	1.2
SWM000280	Private – Commercial	1203 Agora Drive	Bioretention	1.2	0.3
SWM000232	Private – Commercial	804 Moores Mill Road	Bioretention	2.0	0.5
SWM000033	Private – Commercial	Northeast corner of Md.Route 924 and North Ave	Sand Filter	9.2	2.1

Project Name	Owner	Location	Proposed Project Type	Drainage Area (Acres)	Impervious Area (Acres)
SWM000461	Private – Commercial	207 Bynum Road	Bioretention	1.1	0.3
SWM000202(1)	Private – Commercial	Next to 1631 Robin Hill Circle	Retrofit	25.0	5.6
SWM000053	Private	1 Colgate Drive	Sand Filter	6.0	1.4
SWM000353	Private – Commercial	Behind 1303 Enterprise Court	Retrofit	25.0	5.6
SWM000379	Private – Commercial	Behind 2209 Commerce Road	Retrofit	25.0	5.6
SWM000157	Private – Commercial	Next to 23 Newport Drive	Retrofit	25.0	5.6
SWM000156	Private – Commercial	5 Newport Drive	Bioretention	1.3	0.3
SWM000227	Private	209 E Jarrettsville Road	Bioretention	1.3	0.3
SWM000588	Private – Commercial	St Francis Road	Retrofit	3.2	0.7
OF-1	HOA – Private	End of Duffy Court	Bioretention/Sand Filter	1.6	0.9
OF-39	HOA – Private/Private	North of Fox Catcher Road	SPSC	2.3	1.2
OF-58	HOA – Private	End of Umbarger Drive	Bioretention/Sand Filter	1.5	0.6
ROW-1	County	Agora Drive	Tree Box Filters	0.5	0.4
ROW-2	County	Alconbury Court, Brighwater Lane, Ruskin Court, Salford Drive and Meredith Court	Bioretention	29.8	11.0
ROW-3	County	Harrogate Way, Dumbarton Drive, Colchester Court, Hastings Court, Taunton Court, and Greenock Court	Bioretention	21.8	8.3
ROW-4	County	Academy Garth and Federal Lane	Bioretention	10.6	4.8
ROW-5	County	Andreas Drive, Andreas Court and Parthenon Court	Tree Box Filter	6.9	3.8
ROW-6	County	Frogleay Way	Bioretention	0.7	0.0
ROW-7	County	North Forest Drive, Tory Way	Tree Box Filters	17.3	7.9

Project Name	Owner	Location	Proposed Project Type	Drainage Area (Acres)	Impervious Area (Acres)
		and Issacs Way			
ROW-9	County	Hidden Stream Court and Swift Run Court	Tree Box Filter	6.4	3.0
ROW-10	County	My Lady's Drive	Tree Box Filter	4.0	1.8
ROW-11	County	Pouska Road	Tree Box Filter	5.6	2.6
ROW-12	County	Jourdan Court	Tree Box Filter	1.6	0.9
ROW-13	County	Parallel Path	Tree Box Filter	8.9	3.0
ROW-14	County	Kensington Parkway, Strathaven Lane, Craigston Lane, Sunderland Court and Maidstone Lane	Tree Box Filter	34.7	13.4
ROW-15	County	Lynnbrook Place, Fairmont Drive, and Sherwood Place	Tree Box Filter	27.6	8.9
ROW-16	County	Boxthorn Road, Bluebell Court, White Rose Court and Red Rose Court	Tree Box Filter	6.2	2.9
ROW-17	County	Longstream Court, Henderson Road, and Autumn View Court	Bioretention	10.5	4.8
ROW-18	County	Bynum Ridge Road, Montgomery Court, Carrolton Court	Bioretention	20.0	4.9
ROW-19	County	Marston Court	Bioretention	1.4	0.7
ROW-20	County	Long Meadow Drive, Edith Stone Drive, Cinnamon Tree Drive, and Whisper Wood Court	Bioretention/Tree Box Filters	16.1	6.8
ROW-21	County	Fordham Court, Princeton Lane, Saint Francis Road and Marywood Drive	Bioretention/Tree Box Filters	34.3	12.1

Alternative Urban BMPs

Table A5: High Priority – Alternative Urban BMPS

Project Name	Owner	Location	Proposed Project Type	Area (Acres)	Proposed Restoration
CP-2	Board of Education	William S. James Elementary School	Tree Planting	1.71	Open area at the northwestern part of the property along Laurentum Parkway is available for tree planting.
CP-4	Harford County	County Property on 1200 Macphail Road	Tree Planting	1.40	Bynum Run Restoration at St. Andrews is planned in the same area. As a part of the project this open area can be converted to a tree planting area.
CP-8	Harford County	County Property on 2213 Old Emmorton Road	Tree Planting	0.18	The entire property drains to a large pond behind the property. Potential for tree planting in the available open space.
CP-23	Harford County	County Property on E Route 1	Tree Planting	0.32	Stream buffer area. Tree planting recommended.
CP-24	Harford County	County Property Off Bynum Road	Tree Planting	9.31	Tree planting along with outfall retrofit.
CP-29	Harford County	County Property on 702 Wheel Road	Tree Planting	1.22	Potential for tree planting in the open area.