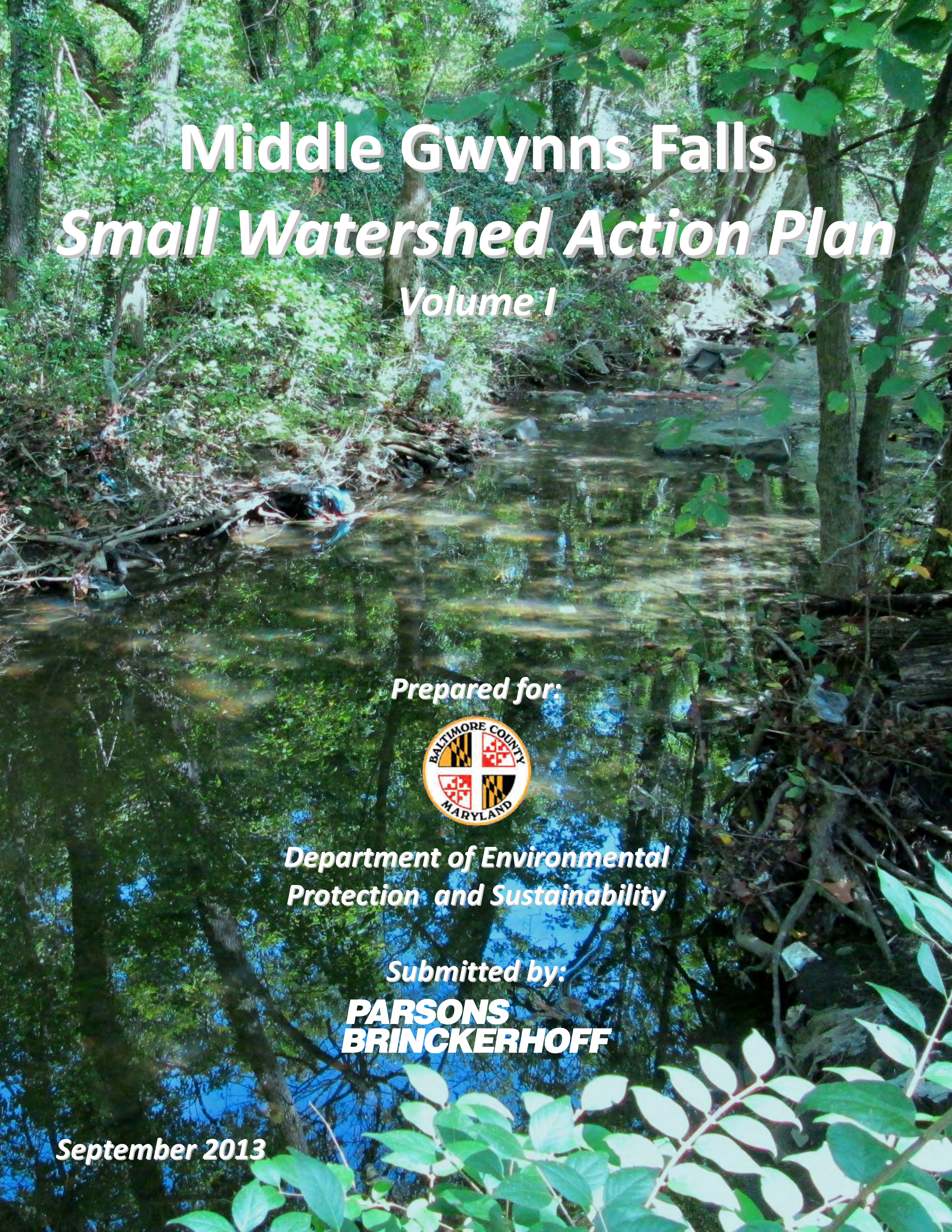

Middle Gwynns Falls
Small Watershed Action Plan
Volume I

Prepared for:

BALTIMORE COUNTY MARYLAND

Department of Environmental Protection and Sustainability

Submitted by:

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ACKNOWLEDGEMENTS

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Organization	*Representative*
Blue Water Baltimore	Darin Crew
Franklintown Community Association	Jack Lattimore
Maryland State Highway Administration	Dana Havlik, Susan Makhlouf
Reisterstown, Owings Mills, Glyndon Coordination Council	George Harman
Temple Baptist Church	Michael Green
University of Maryland – Baltimore County	Andy Miller
Waterfront Partnership	Adam Linquist
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Baltimore County Department of Environmental Protection and Sustainability (EPS)	Betty Kelley, Steve Stewart
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TECHNICAL ASSISTANCE/REPORTS

Technical Report	*Representative*
Upland Surveys (Neighborhood Source Assessments, Hotspot Assessments, and Institutional Site Assessments) and Stormwater Facility Assessment	Nathan Forand, Betty Kelley, Steve Stewart - EPS Parsons Brinckerhoff, Inc. in association with NMP Engineering Consultants, Inc.
Watershed Characterization	Parsons Brinckerhoff, Inc.

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CHAPTER 1: INTRODUCTION

1.1 Purpose

This Small Watershed Action Plan (SWAP) is a strategy for the restoration of the Middle Gwynns Falls watershed. This report presents recommendations for watershed restoration, describes management strategies for each of the 5 subwatersheds comprising Middle Gwynns Falls, and identifies priority projects for implementation. A schedule for implementation through 2025 is presented in addition to planning level cost estimates where feasible. Financial and technical partners for plan implementation are suggested for the various recommendations. This SWAP is intended to assist the Baltimore County Department of Environmental Protection and Sustainability (EPS) and other partners to keep moving forward with restoration of Middle Gwynns Falls. Figure 1-1 provides a graphic representation of the planning area covered in this SWAP.

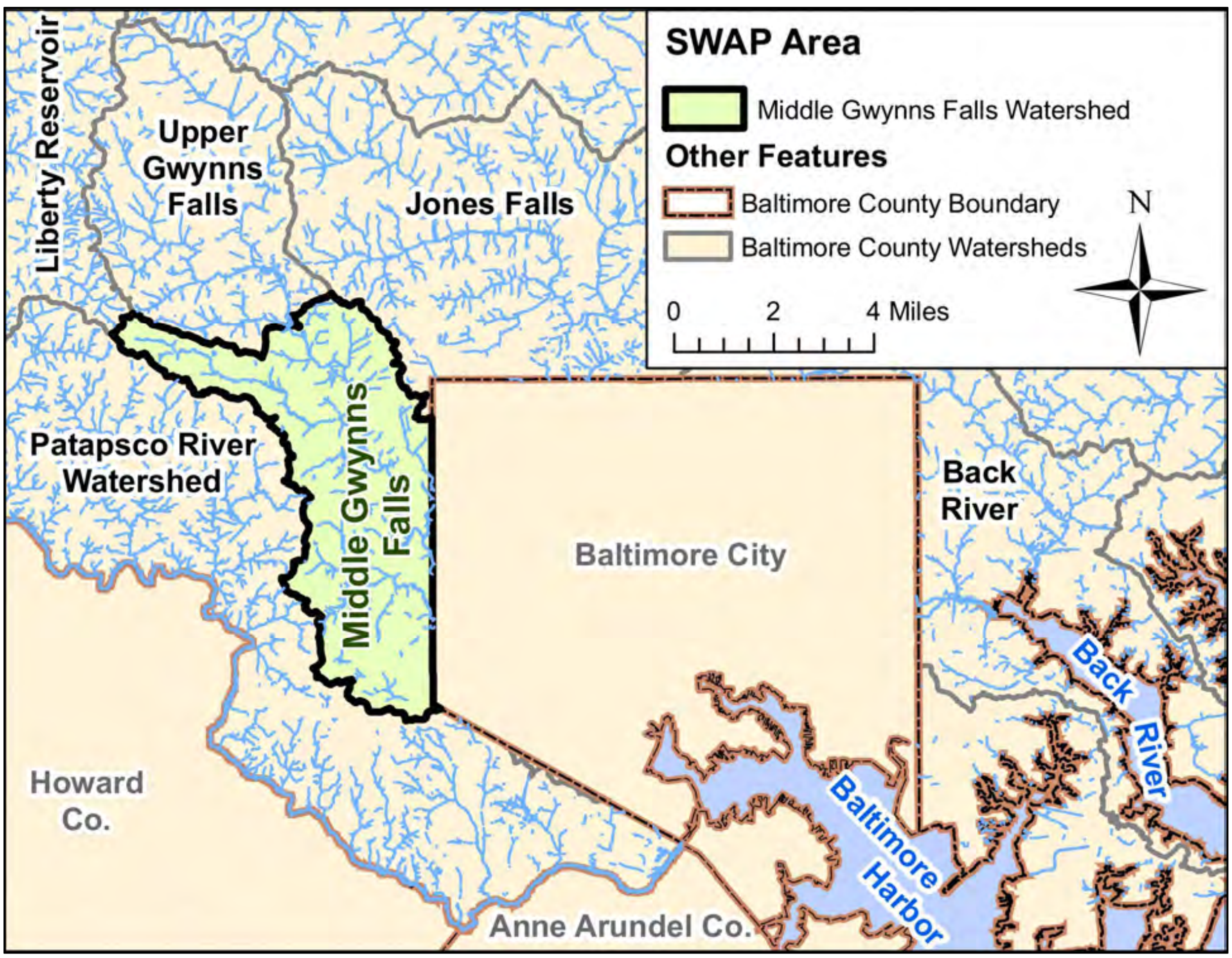

Figure 1-1: Location of Middle Gwynns Falls Watershed

1.2 Background

A SWAP identifies strategies for bringing a small watershed into compliance with water quality criteria. Strategies include a combination of government capital projects, actions in partnership with local watershed associations, citizen awareness campaigns and volunteer activities. Effective implementation of watershed restoration strategies requires the coordination of all watershed partners and the participation of many stakeholders.

Over the past year, Middle Gwynns Falls watershed partners have worked together, conducting assessments, identifying restoration opportunities, and engaging the community, in order to build a successful plan. A Steering Committee, consisting of key watershed partners, was formed to develop the Middle Gwynns Falls SWAP. This includes Baltimore County personnel and leaders from the local community. The Steering Committee met regularly throughout SWAP development. Middle Gwynns Falls Steering Committee members are listed below:

Blue Water Baltimore	……………………	Darin Crew, Elise Victoria
Franklintown Community Association	……………………	Jack Lattimore
Maryland State Highway Administration	……………………	Dana Havlik Susan Makhlouf
Reisterstown, Owings Mills, Glyndon Coordination Council	……………………	George Harman
Temple Baptist Church	……………………	Michael Green
University of Maryland – Baltimore County	……………………	Andy Miller
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Baltimore County Department of Environmental Protection and Sustainability (EPS)	……………………	Betty Kelley, Steve Stewart
Parsons Brinckerhoff	……………………	Everett Gupton, Kelley Moxley

In addition, since the participation of many stakeholders is an essential component for effective watershed restoration, two stakeholder meetings were held during SWAP development. Stakeholder meetings are intended to raise citizen awareness and solicit feedback from neighborhood residents, local community leaders, institutions, and business associations regarding watershed restoration strategies. A description of each stakeholder meeting including date, approximate number of attendees and topics covered, is provided below:

- ***Stakeholder Meeting #1*** (March 28, 2013; 14 attendees): This meeting included an introduction of the SWAP process and the Middle Gwynns Falls SWAP Steering Committee members. A description of the watershed, the County's goals, environmental requirements (see Section 1.3), and a SWAP framework were presented. The current conditions of the Middle Gwynns Falls watershed were also presented based on desktop analyses and field assessments conducted. A Vision & Goals Questionnaire was conducted during the meeting where attendees were asked to rate the importance of a list of seven (7) watershed goals. Attendees were also given an opportunity to fill out a "blue card" to report the type and location of environmental problems (e.g. dumping, erosion, illicit discharges, etc.) in the watershed. An "actions survey" was conducted to gage citizens' interest in potential restoration activities. The results of the surveys were used later to identify rates of participation for certain restoration actions that are recommended for the watershed. Finally, Darin Crew, from Blue Water Baltimore, presented an overview of the group along with an explanation of their Water Audit Program.
- ***Stakeholder Meeting #2*** (July 18, 2013; 15 attendees): An overview of the Draft SWAP developed for Middle Gwynns Falls was presented at this meeting including the SWAP process, watershed profile, key municipal and citizen-based strategies (e.g., stormwater management, reforestation, etc,), pollutant removal analysis, subwatershed prioritization, and SWAP implementation and evaluation. A representative of the Maryland State Highway Administration provided a presentation on activities its administration was taking to meet its TMDL requirements as well as to reduce the amount of salt applied during winter events in the watershed. In addition, a representative from Maryland's Red Line project gave a presentation on the impacts of its project and mitigation practices that are currently being proposed. Following the presentation, citizen action displays and sign-ups were setup for attendees to obtain more information regarding storm drain marking, proper pet waste management, downspout disconnection and rain barrels, and composting.

1.3 Environmental Requirements

The SWAP was developed to satisfy environmental program requirements while also meeting citizen needs for a healthy environment, clean water, and an aesthetically pleasing community. The following environmental program requirements were considered during the development of this SWAP and are briefly described in the subsequent sections:

- National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit assessment and planning requirements
- 303(d) listings and Total Maximum Daily Load (TMDL) reductions for the Gwynns Falls, and the receiving tidal water segment of this watershed, the Patapsco River Mesohaline (MD_PATMH)
- TMDLs for the Chesapeake Bay for nutrient and sediment reductions to meet water quality standards

1.3.1 NPDES MS4 Permits

Many requirements of Baltimore County's NPDES permit (99-DP-3317, MD0068314) will be addressed by this plan. One of these requirements is the systematic assessment of water quality and development of restoration plans for all watersheds within the County. This assessment must include the following:

- Source identification information based on GIS data
- Determination of current water quality conditions
- Identification and ranking of water quality problems
- Results of visual watershed inspections
- Identification of structural and non-structural water quality improvement opportunities
- Specification of overall watershed restoration goals

The County's NPDES permit also requires the County to address 10% of the impervious cover during each 5-year permit term. It is anticipated that future permits will have the same requirement. To date, restoration projects have addressed 15.5% of the impervious cover county-wide, and 6.7% of the impervious cover in the entire Gwynns Falls watershed (Upper and Middle Gwynns Falls). Restoration actions and stormwater management have reduced phosphorus by 17.8% and nitrogen by 6.4%.

This SWAP meets the systematic assessment and planning requirements of the NPDES permit and provides strategies for how Baltimore County will meet the goals for addressing impervious cover.

1.3.2 303(d) Listing and Total Maximum Daily Loads (TMDLs)

According to the United States Environmental Protection Agency (USEPA), a TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet state water quality standards. TMDLs can be developed for a single pollutant or group of pollutants of concern which generally include sediment, metals, bacteria, nutrients, and pesticides.

The water quality segments in Middle Gwynns Falls that are applicable to the current SWAP area are listed for the following impairments: total suspended solids, fecal coliform, channelization, and chlorides. TMDLs have been completed for totals suspended solids (2010) and fecal coliform (2007) listings.

Note that in 2010, a Water Quality Assessments (WQA) was submitted for the Gwynns Falls in response to impairment listings for phosphorus. The WQA justified the classification of phosphorus under category 2 of the Integrated Report listings meaning the Gwynns Falls was meeting water quality standards for phosphorus.

1.3.3 TMDLs for Chesapeake Bay Nutrient and Sediment Impairment

The Chesapeake Bay Program (CBP) has developed the Phase 5 Watershed Model. This model, in conjunction with the Estuary Model, is used to determine the sources and reductions of nitrogen, phosphorus, and sediment needed to meet Chesapeake Bay tidal water quality standards. The Phase 5 model was used to develop a Chesapeake Bay-wide TMDL and to assign nutrient and sediment load reductions to individual states and ultimately local jurisdictions based on the segment loads. In Maryland, nutrient load reductions were assigned on a County-by-County basis for achievement by a

2025 timeframe. 2017 was established as an intermediary milestone with specific targeted load reductions to be achieved. Specific sediment reductions for sediment have not been assigned, but it is assumed that meeting nutrient load reductions will address needed sediment load reductions. Table 1-1 lists the nutrient load reduction requirements for Baltimore County, and in turn the Middle Gwynns Falls study area, under the Chesapeake Bay TMDL.

Table 1-1: Baltimore County Pollutant Load Reductions

TMDL Pollutant	% Pollutant Load Reduction Requirements for Baltimore County	
	2017	2025
Nitrogen	20.3%	29.0%
Phosphorous	31.6%	45.1%

1.4 USEPA Watershed Planning A-I Criteria

The Clean Water Act (CWA) was amended in 1987 to establish Section 319 Nonpoint Source Management Program, after recognizing the need for federal assistance to focus state and local nonpoint source efforts. Under this section, states, tribes, and territories can receive grant money for the development and implementation of programs aimed at reducing nonpoint source (NPS) pollution. NPS pollution comes from many different sources and is a result of human activities on the land. It is caused by pollutants from human activities and atmospheric deposition that are deposited on the ground and eventually carried to receiving waters by stormwater runoff. Common NPS pollutants and sources include:

- Excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas
- Oil, grease, and toxic chemicals from urban runoff and energy production
- Sediment from improperly managed construction sites, crop and forest lands, and eroding stream banks
- Salt from irrigation practices and acid drainage from abandoned mines
- Bacteria and nutrients from livestock, pet wastes, and failing septic systems

CWA Section 319 grant funds can be requested to support various activities such as technical assistance, financial assistance, education, training, technology transfer, restoration projects, and monitoring to assess the success of specific nonpoint source implementation projects. Watershed-based plans to restore impaired water bodies and address NPS pollution using incremental Section 319 funds must meet USEPA's A through I criteria for watershed planning:

A. An identification of the causes and sources or groups of sources that will need to be controlled to achieve the load reductions estimated in the watershed plan

B. Estimates of pollutant load reductions expected through implementation of proposed NPS management measures

C. A description of the NPS management measures that will need to be implemented

D. An estimate of the amounts of technical and financial assistance to implement the plan

E. An information/education component that will be used to enhance public understanding and encourage participation

F. A schedule for implementing the NPS management measures

G. A description of interim, measurable milestones for the NPS management measures

H. A set of criteria to determine load reductions and track substantial progress towards attaining water quality standards

I. A monitoring component to evaluate effectiveness of the implementation records over time

Table 1-2 summarizes the location(s) within this document where each criterion is addressed.

Table 1-2: Where to Locate Information for USEPA's A-I Criteria

Report Section	USEPA Criteria								
	A	B	C	D	E	F	G	H	I
Chapter 1					✓				
Chapter 2									
Chapter 3	✓	✓	✓		✓	✓		✓	
Chapter 4			✓		✓				
Chapter 5				✓			✓	✓	✓
Appendix A			✓	✓	✓	✓	✓		✓
Appendix B				✓	✓				
Appendix C		✓						✓	
Appendix D									
Appendix E	✓		✓						
Appendix F									
Appendix G									
Appendix H									
Appendix I									
Appendix J									
Appendix K			✓						
Appendix L									

1.5 Partner Capabilities

In order to achieve effective watershed restoration, the capabilities of many organizations must be brought together and coordinated. Within the Baltimore region, the cooperation and coordination has been advancing in recent years as common goals in water quality improvement in local streams and tidal waters are sought.

1.5.1 Baltimore County

Baltimore County has a waterway restoration program to implement restoration projects, including stream restoration, stormwater conversions and retrofits, reforestation, and shoreline enhancement projects. In the Middle Gwynns Falls watershed, 80 acres of unmanaged, urban land has been addressed by new stormwater management (SWM) practices or retrofits of existing SWM practices to provide additional water quality improvements. Approximately $2.7 million have been spent to date on restoration activities within the entire Middle Gwynns Falls watershed. An additional $6.2 million has been allocated for restoration projects currently either in design, construction, or planning.

Baltimore County EPS has extensive stream monitoring programs. These include, ambient trend monitoring, biological community monitoring, bacteria monitoring, measuring efficiency of restoration projects and an illicit connection program that monitors storm drain outfalls, tracks pollution sources, and coordinates remediation.

Baltimore County is under a consent decree with USEPA and MDE to address Sanitary Sewer Overflows (SSOs). The consent decree has specific requirements for improvements to pumping stations, remediation of sanitary sewer lines, maintenance, and inspection. Continued implementation of the consent decree requirements will help to reduce bacterial contamination, as well as, reduce nitrogen and phosphorus in streams.

The County operates street sweeping and inlet cleaning programs throughout the county that remove sediment, nitrogen, and phosphorus before they reach waterways. These programs are tracked and estimates of the pollution removal are calculated.

1.5.2 Blue Water Baltimore

Blue Water Baltimore (BWB) is a non-profit, community-based membership organization dedicated to restoring water quality in the greater Baltimore area. Its mission statement reads as follow:

> *Blue Water Baltimore's mission is to restore the quality of Baltimore's rivers, streams and harbor to foster a healthy environment, a strong economy, and thriving communities.*

BWB works within 4 major watersheds encompassing portions of Baltimore County and all of Baltimore City including the Gwynns Falls, Jones Falls, Herring Run and the Baltimore Harbor. In September of 2010, the four watershed associations working in the watersheds along with the Baltimore Harbor WATERKEEPER legally merged to form BWB. The group runs educational programs for the community, mobilize stream monitoring volunteers, organizes trash cleanups, and plants trees on public land along with numerous other activities. The group also provides water audit services to residents, institutions, and businesses in which they assess properties and make recommendations on potential projects to benefit the watershed including downspout disconnections, tree planting, pavement reduction, and conservation landscaping.

1.5.3 Local Businesses and Civic Organizations

A variety of community businesses and civic organizations in the Middle Gwynns Falls planning area have a vested interest in improving water quality in the watershed. Each of these organizations will have an important role in achieving the goals and objectives of the SWAP.

Community representatives involved with the planning process include representatives from the Franklintown Community Association, Reisterstown, Owings Mills, Glyndon Coordination Council as well as the Temple Baptist Church.

1.5.4 Maryland State Highway Administration

Maryland's State Highway Administration (SHA) operates and maintains several major roadways in the watershed including I-695 and I-70. As a public entity possessing its own NPDES permit for stormwater discharges, SHA is also subject to the pollution reduction requirements of the Chesapeake Bay TMDL. In addition, as chlorides from road salts are a major pollutant of concern in the watershed, coordination of water quality improvements between Baltimore County and SHA is important in achieving restoration of surface waters in the area.

1.5.5 University of Maryland, Baltimore County

As a charter principle institution in the Baltimore Ecosystem Study, the research conducted at UMBC is vital in the continued monitoring of the conditions of the Middle Gwynns Falls watershed.

1.6 Middle Gwynns Falls Watershed Overview

The total study area of the Middle Gwynns Falls SWAP is comprised of 5 subwatersheds and approximately 14,881 acres (23.25 square miles) as shown in Table 1-3.

Table 1-3: Middle Gwynns Falls Subwatershed Areas

Subwatershed	Area (Acres)	Area (Sq Miles)
Gwynns Falls	6,165	9.63
Powder Mill Run	958	1.50
Dead Run	4,177	6.53
Maiden Choice Run	928	1.45
Scotts Level	2,653	4.15
Total	***14,881***	***23.25***

As shown in Figure 1-2, the Middle Gwynns Falls watershed was subdivided for planning and management purposes into 5 subwatersheds. The smaller drainage areas are intended to focus restoration, preservation and monitoring efforts. The *Middle Gwynns Falls Watershed Characterization Report* includes detailed analyses and descriptions of the current watershed conditions and potential water quality issues. This is included as Appendix E of this report. A summary of the key watershed characteristics for Middle Gwynns Falls based on the characterization report is provided in the Table 1-4.

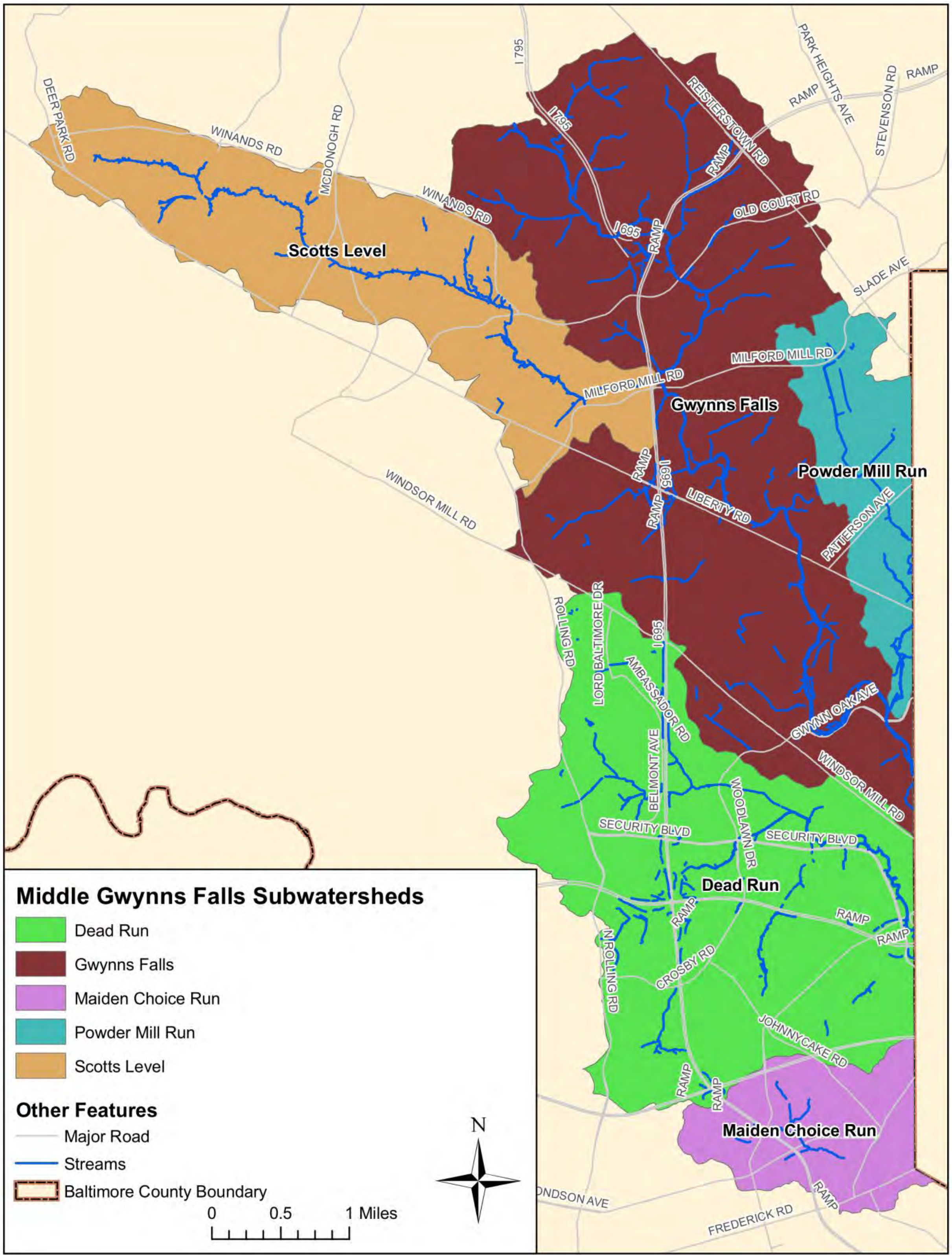

Figure 1-2: Middle Gwynns Falls SWAP Planning Area and Subwatersheds

Table 1-4: Middle Gwynns Falls Key Watershed Characteristics

Drainage Area	14881.3	acres	
	23.25	sq. mi.	
Stream Length	77.9	miles	
Population	106,839	(2010 Census)	
Land Use/Land Cover	Very Low Density Residential:		0.6%
	Low Density Residential:		2.6%
	Medium Density Residential:		42.5%
	High Density Residential:		15.2%
	Commercial:		8.3%
	Industrial:		3.5%
	Institutional:		6.4%
	Open Urban:		5.2%
	Forest:		12.5%
	Agriculture:		0.2%
	Transportation		2.9%
Impervious Cover	28.9%	of watershed	
Soils	A Soils (low runoff potential):		5.4%
	B Soils:		22.7%
	C Soils:		41.2%
	D Soils (high runoff potential):		30.6%
	Water:		0.1%

1.7 Report Organization

This report is organized into the following five major chapters:

Chapter 1 explains the purpose of this report including underlying environmental requirements and key watershed characteristics.

Chapter 2 presents the watershed vision, goals and objectives for restoring the Middle Gwynns Falls watershed.

Chapter 3 describes the types of watershed restoration practices recommended for the Middle Gwynns Falls and estimated pollutant load reductions.

Chapter 4 discusses prioritization of the 5 subwatersheds in the Middle Gwynns Falls watershed and summarizes subwatershed-specific restoration strategies.

Chapter 5 presents the implementation plan restoration evaluation criteria and monitoring framework.

This volume (Volume I) also includes the following appendices with additional, detailed information used to develop and support this SWAP:

- Appendix A: Middle Gwynns Falls Action Strategies
- Appendix B: Cost Analysis and Potential Funding Sources
- Appendix C: Chesapeake Bay Program Pollutant Load Reduction Efficiencies and Maryland *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated.*
- Appendix D: Middle Gwynns Falls SWAP Uplands Assessment Map

A second volume (Volume II) includes the following appendices with supporting documentation related to the current conditions of the Middle Gwynns Falls watershed:

- Appendix E: Middle Gwynns Falls Watershed Characterization Report
- Appendix F: Chesapeake Bay TMDL Executive Summary
- Appendix G: Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Gwynns Falls Basin in Baltimore City and Baltimore County, Maryland
- Appendix H: Total Maximum Daily Load of Sediment in the Gwynns Falls Watershed, Baltimore City and Baltimore County, Maryland
- Appendix I: Water Quality Analysis of Eutrophication for the Gwynns Falls Watershed in Baltimore County and Baltimore City, Maryland
- Appendix J: Watershed Report for Biological Impairment of the Gwynns Falls Watershed in Baltimore City and Baltimore County, Maryland Biological Stressor Identification Analysis Results and Interpretation
- Appendix K: Water Quality Management Plan Proposed Projects
- Appendix L: Abbreviations

CHAPTER 2: VISION, GOALS AND OBJECTIVES

2.1 Vision Statement

The Middle Gwynns Falls Steering Committee adopted the following vision statement that served as a guide in the development of the SWAP:

> *We envision that through responsible environmental stewardship, our neighborhoods, schools and businesses within the Middle Gwynns Falls watershed will be part of a healthy, stable, sustainable and vibrant environment that supports diverse aquatic and terrestrial life; maintains physical, chemical and hydrologic standards; and flows free of trash throughout the watershed on its way to the Baltimore Harbor and Chesapeake Bay.*

2.2 Middle Gwynns Falls SWAP Goals & Objectives

A total of seven (7) goals were identified for restoring the Middle Gwynns Falls watershed based on the vision statement and input from both Steering Committee and Stakeholder meetings. The goals were developed through discussions with the Middle Gwynns Falls SWAP Steering Committee and refined based on feedback from watershed residents at the Stakeholder meetings. Stakeholders were given the opportunity to rank the importance of goals, raise additional issues important to the community, and indicate restoration activities of interest to achieve watershed goals. Stakeholder participation is important to ensure the implementation and success of the plan.

The following sections present a discussion of each of the seven (7) goals for restoring the Middle Gwynns Falls watershed. For each goal, a series of objectives was developed to ensure that the plan will meet each goal. Action strategies describe the method that will be used to achieve the objective and ultimately, the water quality goal. An example of an action strategy for phosphorus reduction could be "implement stormwater retrofits to treat runoff" in a given watershed. The action strategies developed to achieve these objectives and goals are summarized in Appendix A and discussed further in Chapter 3.

When possible, action strategies are expressed as quantifiable measures (e.g., linear feet of forested buffer planted). However, the numerical values assigned to these actions are intended to serve as a guide rather than an absolute measure in achieving watershed goals and objectives. Many actions address multiple watershed goals and objectives. Appendix A, Table A-2 lists the action strategies proposed for Middle Gwynns Falls and their applicable goals and objectives.

The general types of restoration strategies proposed for the Middle Gwynns Falls watershed are discussed further in Chapter 3. The Steering Committee has determined that an adaptive management approach will be emphasized as SWAP implementation progresses. This approach includes evaluating the success of SWAP implementation over time (see Chapter 5) and modifying action strategies based on community acceptance and availability of funding.

Goal 1: Restore and maintain clean water to applicable water quality standards

As part of the bay-wide Chesapeake Bay TMDL requirements, Baltimore County is required to reduce the nutrient and sediment loadings into Middle Gwynns Falls by the year 2025, with intermediate milestones established for 2017. Percentage reductions will be measured against the baseline year of 2009. In addition, other contaminants such as chlorides are of particular concern to residents in the planning area. The objectives below are designed to meet the nitrogen, phosphorous, and sediment TMDL reduction requirements in the watershed while also decreasing the release of other toxins. As of the date for this report, sediment targets have not been determined for Baltimore County.

Objectives:

1. Reduce annual average Total Nitrogen loads (urban stormwater) by 20.3% in 2017 and 29.0% in 2025 compared to loading estimated for the baseline period.
2. Reduce annual average Total Phosphorous loads (urban stormwater) by 31.6% in 2017 and 45.1% in 2025 compared to loading estimated for the baseline period.
3. Reduce annual average Total Chloride loads (urban stormwater).
4. Reduce presence of bacteria in waterways (urban stormwater).
5. Reduce annual average Total Sediment loads in waterways (urban stormwater) by 20% from the baseline period.

Goal 2: Restore and improve stream hydrology

In the last century, the transformation of the Middle Gwynns Falls watershed from predevelopment conditions to the current developed state has led to a dramatic increase in stream flows and consequently, detrimental consequences to streams themselves. By enacting measures that mimic the predevelopment hydrology of the watershed, erosive flows, channelization, and the resultant sediment transport within the watershed can be greatly mitigated.

Objectives:

1. Convert existing stormwater management facilities in existing developed areas to incorporate maximum water quality treatment potential.
2. Decrease stormwater runoff by implementing stormwater control practices throughout the watershed by incorporating new technologies to the maximum extent practicable.
3. Promote redevelopment and revitalization of existing properties.
4. Increase the percentage of impervious area that is treated.
5. Remove unused excess impervious areas.
6. Encourage public and private landowners to replace highly maintained lawns and landscaped areas with low maintenance native plants (i.e. bayscaping).

Goal 3: Reduce trash and dumping

Trash and debris is generated throughout the watershed and readily moves through storm drains and tributaries and is carried by wind into surface waters. Trash and other bulk materials are also thrown directly into the streams. Besides the glaring visual detriment to natural beauty, trash contributes toxins and presents hazards to water fowl, other wildlife, and people. By educating citizens of the consequences of littering and dumping on the health of their watershed, community, and families, the stage will be set to change behaviors, and will lead to a healthier Middle Gwynns Falls.

Objectives:

1. Reduce trash in upland areas.
2. Reduce dumping of trash and other materials.
3. Increase and support community clean-ups.
4. Increase recycling of bottles, cans, plastic bags and paper.
5. Support recycling in commercial establishments

Goal 4: Use education to promote the basic understanding of watershed science and responsible stewardship and restoration of our neighborhoods, schools and business communities

Successful watershed restoration and preservation can only occur when current and future generations develop a commitment to the resolution of environmental issues. By educating citizens, and especially youth, on the importance of the environment and the positive role it plays in the community, restoration cannot only be achieved but maintained in the future.

Objectives:

1. Coordinate with neighborhoods, businesses, and community organizations to host tree planting, rain barrel and rain garden workshops, and other events.
2. Coordinate with schools to promote environmental awareness in the students by informing them of activities going on at the school and encouraging them to participate.
3. Notify business of ways to reduce trash and other forms of pollution generated from their property.

Goal 5: Improve the biological health of local streams

Physical damage to streams has resulted over time from development, poor land management practices, introduction of invasive species, and other human interactions. The objectives for this goal relate to the improvement of degraded surface waters that result in poor conditions for habitat.

Objectives:

1. Encourage riparian buffer preservation and plantings to help stabilize stream banks and reduce pollutant-laden sediment from entering the stream channels.

2. Raise the Benthic Index of Biological Integrity (IBI) scores on the streams from “Poor” to “Fair” as set by the MD DNR Maryland Biological Stream Survey (MBSS).
3. Develop and sustain healthy populations of aquatic and terrestrial wildlife by improving the physical habitat of streams.

Goal 6: Improve tree and forest coverage in the watershed

Healthy, vibrant forests create a significant ecological impact on a watershed through influences on air quality, water quality, and wildlife habitat. From absorbing pollutants in the air to pollutants in rainfall and runoff, trees are a vital part of decreasing nutrient loads in watersheds. In addition, planting trees in neighborhoods can increase property values and reduce energy use. The objectives below promote tree health in the watershed including neighborhoods, businesses, and institutions.

Objectives:

1. Conduct tree planting on private and public properties.
2. Remove invasive vegetation within forested areas
3. Increase canopy coverage inside the Urban Rural Demarcation Line to achieve and maintain 40% tree coverage by 2025.

Goal 7: Address environmental problems that disproportionately affect low-income and minority communities

Specific communities in the Middle Gwynns Falls planning area have been identified as being vulnerable to a disproportionate and burdensome amount of environmental justice risks related to water quality. By focusing on these areas, the following objectives are intended to address environmental inequality by increasing and enhancing environmental amenities and decreasing environmental hazards.

Objectives:

1. Look for retrofit and restoration opportunities that improve water quality and enhance the quality of life in these communities.
2. Involve low-income and minority communities in the planning of specific retrofit and restoration projects.
3. Target low-income and minority communities for special outreach efforts to educate citizens on environmental issues.

CHAPTER 3: RESTORATION STRATEGIES

3.1 Introduction

This chapter presents an overview of the key restoration strategies and associated pollutant load reductions proposed for restoring the Middle Gwynns Falls watershed. A complete list of actions proposed for the watersheds including goals and objectives targeted, timelines, performance measures, cost estimates, and responsible parties is included in Appendix A. Although only key, quantifiable restoration strategies are the focus of this chapter, it is important to remember that a combination and variety of restoration practices, from capital stream restoration projects to public education and outreach, are needed to engage citizens and meet watershed-based goals and objectives.

The restoration of the Middle Gwynns Falls watershed will occur as a partnership between the local government, watershed groups, businesses, and citizens. The actions of each partner are critical to the success of the overall watershed restoration strategy. Local governments are able to implement large capital projects such as stream restoration, large-scale stormwater retrofits, changes in municipal operations, and large-scale public awareness. Watershed groups and citizens are able to implement locally-based programs such as tree plantings, storm drain marking, and downspout disconnection. Therefore, key restoration strategies are divided into two broad categories: municipal strategies (Section 3.2) and citizen-based strategies (Section 3.3). It is important that restoration occurs at all levels to ensure that a wide range and variety of projects is implemented. This will encourage citizen participation and awareness which is also critical to the success of restoration efforts.

The watershed pollutant loading analysis performed to estimate current nutrient loads generated by the various non-point and septic sources within the Middle Gwynns Falls watershed is discussed in Section 3.4.1. Section 3.4.2 discusses the pollutant removal calculations for proposed BMPs (i.e., key restoration strategies discussed in Sections 3.2 and 3.3) to ensure that the Chesapeake Bay TMDL requirements are met in Middle Gwynns Falls.

3.2 Municipal Strategies

Baltimore County works to restore local streams and improve water quality through capital improvement projects and municipal management activities (e.g., development review, street sweeping, illicit connection programs, etc.) This plays an important role in the SWAP implementation process. Key municipal strategies proposed for restoring Middle Gwynns Falls are discussed in the following sections.

3.2.1 Stormwater Management

Increased importance of water quality and water resource protection has led to the development of the Maryland Stormwater Design Manual which provided BMP design standards and environmental incentives (MDE, 2000). Since that time there has been a general shift toward adopting low-impact practices that mimic natural hydrologic processes and achieve pre-development conditions. The Maryland Stormwater Act of 2007 takes those principles one step further and requires that environmental site design (ESD) be implemented to the maximum extent practicable via nonstructural BMPs and/or other better site design techniques. The intent of ESD best management practices (BMPs) is to distribute flow throughout a development site and reduce stormwater runoff leaving that site. This will also reduce pollutant loads and prevent stream channel erosion.

3.2.1.1 Existing Stormwater Management

A total of 317 existing SWM facilities are located within the Middle Gwynns Falls watershed including dry and wet ponds, underground detention, wetlands, infiltration practices, filtration practices, extended detention, proprietary BMPs, and grassed swales. Existing SWM facilities treat a total drainage area of approximately 3,087 acres of urban land or 24% of the total urban land use in the watershed.

3.2.1.2 Stormwater Management Conversions

Detention ponds are typically designed to address water quantity only (flood control) and therefore, provide almost no pollutant removal. Therefore, they are good candidates for conversion to a type of facility that provides water quality benefits in addition to quantity control. Fifteen (15) existing detention ponds within the Middle Gwynns Falls watershed were investigated for potential conversion to stormwater quality management facilities. For example, dry extended detention ponds are designed to capture and retain stormwater runoff to allow sediment and pollutants to settle out while also providing flood control. Out of the 15 detention ponds assessed, 10 were considered to have potential for conversion for water quality.

3.2.1.3 Stormwater Retrofits

Stormwater retrofits involve implementing BMPs in existing developed areas where SWM practices do not exist to help improve water quality. Stormwater retrofits improve water quality by capturing and treating runoff before it reaches receiving water bodies. Based on initial field and desktop evaluations, several sites with sufficient open space for stormwater retrofits to treat runoff from impervious parking lots or alleys were identified. These sites were located in two (2) of the three (3) upland components surveyed: neighborhoods and institutions.

3.2.1.4 Impervious Cover Removal

Impervious surfaces including roads, parking lots, roofs and other paved surfaces prevent precipitation from naturally seeping into the ground. As a result, impervious surface runoff can result in erosion, flooding, habitat destruction, and increased pollutant loads to receiving water bodies. Subwatersheds with higher amounts of impervious cover are more likely to have degraded stream systems and contribute significantly to water quality problems in a watershed. Removing impervious cover and converting to pervious or forested land promotes infiltration of runoff and reduces pollutant loads. Unused or unmaintained impervious surfaces with the potential for removal were identified at several institutions, mostly on school properties. The areas of these impervious surfaces were used to estimate potential pollutant load reductions as a result of impervious cover removal activities.

3.2.1.5 Stormwater Education and Outreach

While not included in pollutant reduction calculations, education and outreach tools could be used to inform residents of the water quality impacts associated with large impervious parking lots, driveways or patios and options available for conversion to or incorporating more permeable surfaces.

3.2.2 Stream Restoration

Stream restoration practices are used to enhance the aquatic function, appearance, and stability of urban stream corridors. Stream restoration practices range from routine, simple stream repairs such as vegetative bank stabilization and localized grade control to comprehensive repairs such as full channel redesign and realignment. Stream assessments were not conducted for this project but a number of stream restoration projects were recommended in the *2004 Gwynns Falls Water Quality Management Plan*. In total, 17 separate projects totaling over 19,000 linear feet of stream restoration were recommended for the planning area that have not been completed to date. In addition to the projects identified in the 2004 study, restoration of additional stream reaches will be needed to meet TMDL requirements. All streams within the study area were analyzed based on the ratio of unstable to stable length of the reach. Streams with ratios of 50% or greater unstable to stable lengths were recommended as high. These reaches should be investigated first to determine if opportunities are present for stream restoration. Stabilizing stream channels improves water quality by preventing eroded soils and the pollutants contained in them from entering streams.

3.2.3 Community Reforestation Program

The Community Reforestation Program (CRP) was established by the Department of Environmental Protection and Sustainability to provide a dedicated workforce for planting, monitoring, and maintaining forest mitigation projects. The Program is funded primarily through fees-in-lieu of mitigation for forests removed as a result of public and private land development, as required by the implementation of the County's Forest Conservation Act and Chesapeake Bay Critical Area Regulations. In a change from previous reports, the plantings conducted with mitigation monies will not be given nutrient reduction credits due to the fact that these tree plantings are offsetting deforestation. The CRP is the only full-time County-wide reforestation mitigation program among Maryland's counties.

The CRP includes a four-person reforestation crew that carries out year-round reforestation operations. The crew is based at a 1-acre site in eastern Baltimore County that is provided by the Department of Recreation and Parks. This home base houses a growing out nursery for 10 thousand tree seedlings; equipment and machinery needed for planting, monitoring, and maintaining the reforestation projects; and office space for the reforestation team.

Occasionally, the CRP will undertake special grant-funded projects to improve water quality and groundwater recharge, as well as wildlife habitat. Unlike the plantings conducted with fee-in-lieu monies, grant funded projects will be given nutrient reduction credit. The most recent example is the expansion of forest buffers and the reforestation of fields on private rural properties.

To date, the CRP has reforested over 182 acres in 76 projects in urban and rural areas of Baltimore County. Despite weather fluctuations, ever-present deer and vole predation, and other natural and human stressors, the Program has maintained a strategy of flexibility in matching species selection, planting techniques, tree protection equipment, and maintenance efforts to site characteristics. As a result the Program has experienced a steady increase in tree survival to the present 85+% in recent projects. Publicly-owned lands requiring minimal site preparation should be targeted for initial reforestation efforts.

3.2.4 Street Sweeping

Street sweeping removes trash, sediment and organic matter such as leaves and twigs from the curb and gutter system, preventing them from entering storm drains and nearby streams. This helps reduce sedimentation and pollutants, such as nutrients, oil and metals, in the stream. Excessive organic matter clogs streams and storm drains resulting in costly maintenance. In addition, decay of a disproportionate amount of organic matter in the stream takes away oxygen needed for supporting aquatic life.

Neighborhoods with significant trash and/or organic matter build-up along curbs were recommended for street sweeping during neighborhood source assessments (NSAs). These areas will be referred to Baltimore County Department of Public Works (DPW) staff to determine whether street sweeping is conducted there and at what frequency. Adding a targeted neighborhood to the sweeping route or increasing frequency of sweeping would address build-up of excessive curb and gutter material.

3.2.5 Illicit Connection Detection/Disconnection

An Illicit Discharge Detection and Elimination program has been developed by Baltimore County to find and remediate discharges into streams that are harmful to aquatic life and water quality or that are causing erosion/sedimentation problems. The County will continue their Illicit Discharge Detection and Elimination program seeking to improve techniques and methodologies for more effective reductions of these discharges. Pollutant reductions associated with this program are not included in pollutant removal analyses due to the uncertainty in the contribution of illicit connections to overall pollutant loading rates. However, this program will provide a margin of safety in the overall nutrient reduction strategy.

3.2.6 Sanitary Sewer Consent Decree

In September 2005, USEPA and MDE issued a consent decree to Baltimore County with deadlines to reduce and eliminate sanitary sewer overflows (SSOs). Implementation of work (capital projects, equipment, operations and maintenance improvements) in compliance with the consent decree will result in a reduction of nutrients and bacteria entering streams in Middle Gwynns Falls surface waters. A summary of the SSOs in Middle Gwynns Falls can be found in the *Watershed Characterization Report.*

3.3 Citizen-Based Strategies

The participation of citizens in watershed restoration is an essential part of the SWAP process. When large numbers of individuals become involved in citizen-based water quality improvement initiatives, changes can be made to the aesthetic and chemical aspects of waterways within watersheds that would not be possible otherwise. Citizen participation is critical to the implementation and long-term maintenance of restoration activities. Key citizen-based strategies proposed for Middle Gwynns Falls are discussed in the following sections.

3.3.1 Reforestation

Trees improve water quality by capturing and removing pollutants in runoff including excess nutrients through their roots before the pollutants enter groundwater and streams. Tree leaves and stems also intercept precipitation, reducing the energy of raindrops and preventing any erosion from their impact on the ground. In addition to water quality improvement, trees provide air quality, aesthetic and economic benefits. For example, trees strategically planted around a house can form windbreaks to reduce heating costs in the winter and can provide shade reducing cooling costs in the summer. Incentive programs, such as Tree-Mendous Maryland and State Highway Administration's (SHA) Partnership Program, can help increase the success of planting efforts. Several areas throughout the watershed are targeted for reforestation opportunities and are described below.

Riparian Buffer

Stream and shoreline riparian buffers are critical to maintaining healthy streams and rivers. Forested buffer areas along streams and shorelines improve water quality and prevent flooding by filtering pollutants, reducing surface runoff, stabilizing stream banks, trapping sediment, and providing habitat for various types of terrestrial and aquatic life. Buffer encroachment as a result of development was noted during uplands and stream surveys conducted throughout the watershed. Areas on privately-owned land (e.g., residential properties) can be targeted for buffer awareness initiatives to encourage landowners to plant trees and/or create a no-mow area adjacent to streams and shorelines. Approximately 11,000 linear feet of buffer reforestation projects within the 100-foot stream buffer area were identified in the *2004 Gwynns Falls Water Quality Management Report* as good candidates for tree planting and are targeted for initial buffer reforestation efforts.

Upland Pervious Areas

Converting open areas in the upland portion of the watershed to forested areas through tree plantings can also reduce nutrient inputs to nearby streams and reduce erosion. Large open areas should be investigated for tree planting potential.

Street and Shade Tree Plantings

Several opportunities for neighborhood street tree plantings were identified during NSAs. Opportunities for open space, shade tree plantings were also identified at several institutional sites and in some multi-family neighborhoods. Street trees and open space shade trees provide aesthetic value and air and water quality benefits. They provide shade and absorb nutrients through their root systems while also providing habitat for wildlife. Canvassing residents and/or contacting homeowner associations can be effective techniques for implementing a street tree planting program within a neighborhood. Tree planting incentive programs mentioned previously can also help increase the success of planting efforts.

3.3.2 Downspout Disconnection

Disconnected downspouts that direct rooftop runoff to pervious surfaces can help reduce runoff and pollutants introduced to local streams. This can be achieved through downspout redirection (from impervious to pervious areas), rain barrels and/or rain gardens. A combination of outreach/awareness techniques and financial incentives can be used to implement a downspout disconnection program in neighborhoods identified as potential candidates during NSAs. Pilot disconnection programs have been conducted in Upper Back River by Blue Water Baltimore (BWB) and Center for Watershed Protection (CWP). Results from these programs can be used to determine successful techniques and strategies for Middle Gwynns Falls.

3.3.3 Urban Nutrient Management

Raising awareness among citizens about some of the common activities around their homes and how those activities can negatively affect water quality is a vital, citizen-based strategy. Yards and lawns typically represent a significant portion of the pervious cover in an urban subwatershed and act as a major source of polluted runoff. Maintenance behaviors tend to be similar within individual neighborhoods and certain activities can impact subwatershed quality such as fertilization, pesticide use, watering, landscaping, and trash/yard waste disposal. Urban nutrient management efforts related to lawn maintenance and bayscaping can help reduce polluted runoff to nearby streams.

Lawn Maintenance Education

A well-maintained lawn can be beneficial to the watershed. However, lawn maintenance activities often involve over-fertilization, poor pest-management, and over-watering resulting in polluted stormwater runoff to local streams. Lawns with a dense, uniform grass cover or signs designating poisonous lawn care indicate high lawn maintenance activities. With the passage of the Maryland's Fertilizer Use Act in 2011, the amount of phosphorus and nitrogen contained in fertilizers sold in Maryland is regulated, limiting the amount of nutrients that can be applied to lawns. Neighborhoods identified as having high lawn maintenance practices should still be targeted for awareness programs emphasizing responsible fertilizing techniques such as proper application amounts, proper time of year for fertilization, soil testing for nutrient requirements, and keeping fertilizers away from impervious surfaces. Lawn maintenance education can be achieved through door-to-door canvassing, informational brochures/mailings, excerpts in community newsletters, or demonstrations at community meetings. Information on organic alternatives to chemical lawn treatments should also be included in these outreach efforts. Because of the passage of the Fertilizer Use Act, specific pollution reductions for lawn maintenance education are not computed for Middle Gwynns Falls.

Bayscaping

Reducing the amount of mowed lawn and increasing landscaping features provides water quality benefits through interception and filtration of stormwater runoff. Bayscaping refers to the use of plants native to the Chesapeake Bay watershed for landscaping. Because they are native to the region, these plants require less irrigation, fertilizers, and pesticides to maintain as compared to non-native or exotic plants. This means less stormwater pollution and lawn maintenance requirements. Bayscaping is also beneficial to wildlife. Similar to lawn maintenance education, bayscaping awareness can be raised through informational brochures/mailings, excerpts in community newsletters, or demonstrations at community meetings. A combination of outreach/awareness techniques and financial incentives can be used to implement a bayscaping program in neighborhoods identified as potential candidates during NSAs.

3.4 Pollutant Loading & Removal Analyses

This section presents results of the watershed pollutant loading analysis performed to estimate current nutrient and sediment loads generated by the various non-point and septic sources within the Middle Gwynns Falls watershed. Also discussed are the pollutant removal calculations for proposed BMPs to ensure that TMDL requirements are met in the Middle Gwynns Falls.

3.4.1 Pollutant Loading Analysis

A pollutant loading analysis was performed to estimate total nitrogen, total phosphorus, and sediment loads currently generated by all non-point and septic sources present within the Middle Gwynns Falls watershed.

3.4.1.1 Land-Use Pollutant Loading

Land-use pollutant loading estimates were based on Maryland Department of Planning's (MDP) 2010 Land Use/Land Cover (LU/LC) GIS layer and pollutant loading rates developed by MDE and Baltimore County for non-urban land uses and CBP for urban land uses. The pollutant loading analysis is described in detail in Chapter 3.3 of the *Watershed Characterization Report* (Appendix E). Table 3-1 summarizes the results from the watershed pollutant loading analysis including areas, pollutant loading rates, and annual pollutant loads for each nonpoint source/land use type.

Table 3-1: Middle Gwynns Falls Land-Use Nitrogen, Phosphorus, and Total Suspended Solids Loads

WRE Land Use	Area (acres)	NITROGEN		PHOSPHORUS		SEDIMENT	
		Loading Rate (lbs/ac)	Load (lbs)	Loading Rate (lbs/ac)	Load (lbs)	Loading Rate (lbs/ac)	Load (lbs)
Impervious Urban	4,294	17.34	74,468	1.51	6,502	2056.95	8,833,323
Pervious Urban	8,619	11.55	99,547	0.30	2,559	280.43	2,416,886
Cropland	5	23.07	117	1.32	7	1422.32	7,220
Pasture	29	7.97	232	0.74	21	307.45	8,938
Forest	1,934	2.78	5,378	0.04	76	82.17	158,925
Total	***14,881***		***179,742***		***9,165***		***11,425,292***

3.4.1.2 Septic System Pollutant Loading

Dwellings, businesses, and institutions which manage wastewater from their site through the utilization of septic systems contribute nitrogen loading within a watershed through the groundwater deposition of nitrogen. Septic systems are classified by their location in the watershed as either within 1,000 feet of a stream, within the Critical Area buffer, or greater than 1,000 feet of a stream. Unique loading rates were developed for each category to determine the nitrogen loading from individual septic systems. Table 3-2 displays the estimated nitrogen pollutant loading from septic systems in Middle Gwynns Falls developed by CBP, MDE and EPS.

Table 3-2: Middle Gwynns Falls Pollutant Loads from Septic Systems

Other Pollution Sources	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Total Suspended Solids (lbs/year)
Septic Systems	2,684	0	0

3.4.2 Pollutant Removal Analysis

As discussed in Chapter 1, as part of the Chesapeake Bay TMDL, a reduction in nitrogen, phosphorus, and sediment loads from urban stormwater discharges and septic systems is necessary to meet water quality standards. The load reductions needed within Middle Gwynns Falls to achieve this are summarized in the Table 3-3. Note that percent reductions were applied to the pollutant load from urban runoff sources (i.e., impervious and pervious urban), since the nutrient TMDL relates to urban sources only.

In addition, since specific requirements for sediment reductions for Baltimore County have not been developed, it is assumed that meeting the reduction requirements for nitrogen and phosphorus will satisfy the Chesapeake Bay TMDL for sediment. See Table 1-1 for a summary of the percent load reductions required by Baltimore County to meet Chesapeake Bay TMDL requirements for nitrogen and phosphorous.

Table 3-3: Middle Gwynns Falls Nitrogen and Phosphorus Load Reductions

Source	Area (acres)	TN Load (lbs/yr)	TP Load (lbs/yr)	TSS Load (lbs/yr)
Baseline Urban Load	12,913	174,015	9,061	11,250,209
2017 Reduction Goal:		***35,309***	***2,860***	-
2025 Reduction Goal:		***50,442***	***4,086***	-

The following sections present a quantitative analysis of pollutant removal capabilities of proposed BMPs to ensure that the required reductions in nutrient loads from urban runoff in the Middle Gwynns Falls watershed are achieved. Note that many of the removal efficiencies used to estimate pollutant reductions are based on the peer-reviewed and CBP-approved nonpoint source BMP tables developed for the Phase 5.0 CBP Watershed Model. Additional pollutant reductions from the 2011 Maryland *Draft Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* were used if values were not available in the BMP tables. The BMP tables and *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* are included in Appendix C. Also note that the calculations and estimates presented in the following subsections represent maximum potential pollutant removal capabilities.

A summary of overall pollutant load reduction estimates is presented at the end of this section for three scenarios: a maximum implementation scenario, the projected implementation schedule to meet the 2017 milestone, and the projected implementation schedule to meet the 2025 milestone.

3.4.2.1 Implemented Capital Improvement Projects

Baltimore County has implemented several capital improvement projects in Middle Gwynns Falls including stream restoration, stormwater retrofits, buffer enhancements, and stormwater conversions. Because nutrient reductions based on existing stormwater treatment facilities such as ponds and wetlands are calculated in Section 3.4.2.2, they were not counted in this section. Nutrient reductions associated with stream restoration projects were taken from the Baltimore County *NPDES – Municipal Stormwater Discharge Permit 2012 Annual Report* (EPS, 2013). A summary of the pollutant load reductions from these projects is seen in Table 3-4.

Table 3-4: Completed and Current Stream Restoration Projects in Middle Gwynns Falls

Project	Facility Type	Linear Feet	Cost	Date	Removal Rate (lbs/year) TN	TP	TSS
Dead Run @ HS	SR	200	$141,000	2003	40	13.6	62,000
Dead Run @ Woodlawn Dr (Fox)	SR	450	$232,594	2004	90	30.6	139,500
Scotts Level @ McDonogh*	SR	1,125	$1,200,000	2013	225.0	76.5	348,750
Dead Run @ West View Park*	SR	4,700	$1,000,000	2014	940.0	319.6	1,457,000
Totals		***6,475***	***$2,573,594***		***1,295.0***	***440.3***	***2,007,250***

*Project currently in design/construction phase

3.4.2.2 Existing Stormwater Management (SWM)

As described in detail in Section 2.3.6 of the *Watershed Characterization Report* (Appendix E), there are 317 existing SWM facilities in Middle Gwynns Falls including dry and wet ponds, wetlands, infiltration practices, filtration practices, extended detention, proprietary BMPs, grassed swales, and other types of SWM facilities (i.e., underground detention). The pollutant removal capability of existing SWM in the watershed is not accounted for in the pollutant loading analysis. Therefore, it is included in the pollutant removal analysis.

Pollutant reductions for existing SWM are calculated based on the approximate pollutant load received from the drainage area (DA) and removal efficiencies recommended by CBP for the various types of SWM facilities. The equation used to estimate total nitrogen (TN) load reductions for a particular type of SWM facility is expressed as:

$$[13.48(lbs/ac/yr) \times DA(acres)] \times efficiency\ (\%)$$

The equation used to estimate total phosphorus (TP) load reductions for a particular type of SWM facility is expressed as:

$$[0.70(lbs/ac/yr) \times DA(acres)] \times efficiency\ (\%)$$

The equation used to estimate total suspended solids (TSS) load reductions for a particular type of SWM facility is expressed as:

$$[871(lbs/ac/yr) \times DA(acres)] \times efficiency\ (\%)$$

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in each of the above equations. The pollutant loading rates shown, 13.48 lbs TN/ac/yr, 0.70 lbs TP/ac/yr, and 871 lbs TSS/ac/yr represent the weighted average of impervious and pervious urban rates used in the pollutant loading analysis (Table 3-1) since this represents the likely sources of runoff being treated. Note that impervious and pervious urban loading rates are based on CBP's Watershed Model run from July of 2011. The percent pollutant removal efficiency depends on the type of facility and is based on the values shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. The total pollutant load reduction expected from existing SWM is a sum of the removal capacities of the individual facilities. A summary of existing SWM load reduction calculations and results are shown in Table 3-5.

Table 3-5: Existing SWM Load Reductions

SWM Facility Type	No. (#)	DA (acres)	TN Load from DA (lbs/yr)*	TN Removal Efficiency (%)	Max Potential TN Load Reduction (lbs/yr)	TP Load from DA (lbs/yr)*	TP Removal Efficiency (%)	Max Potential TP Load Reduction (lbs/yr)	TSS Load from DA (lbs/yr)*	TSS Removal Efficiency (%)	Max Potential TSS Load Reduction (lbs/yr)
Dry Pond	85	1876.1	13.48	5%	1,264	0.70	10%	131.6	871	10%	163,454
Wet Pond	5	87.4	13.48	20%	236	0.70	45%	27.6	871	60%	45,709
Underground Detention	24	101.9	13.48	5%	69	0.70	10%	7.1	871	10%	8,874
Wetland	2	30.1	13.48	20%	81	0.70	45%	9.5	871	60%	15,719
Infiltration	31	87.0	13.48	80%	938	0.70	85%	51.9	871	95%	72,024
Filtration	43	109.5	13.48	40%	590	0.70	60%	46.1	871	80%	76,348
Extended Detention	89	729.8	13.48	20%	1,967	0.70	20%	102.4	871	60%	381,487
Proprietary BMP	20	37.8	13.48	5%	25	0.70	10%	2.7	871	10%	3,297
Grassed Swale/Channel	6	11.7	13.48	10%	16	0.70	10%	0.8	871	50%	5,112
Other	12	15.8	13.48	5%	11	0.70	10%	1.1	871	10%	1,377
Totals:	***317***	***3,087.2***			***5,197***			***380.9***			***773,401***

*Based on weighted average of impervious and pervious urban loading rates

3.4.2.3 Stormwater Management Conversions

As described previously, ten (10) of the fifteen (15) existing detention ponds surveyed have the potential for conversion to an extended detention facility that has a higher capacity for nutrient removal. In addition to the fifteen (15) ponds that were assessed for the projects, two (2) additional facilities were recommended for conversion in the 2004 *Gwynns Falls Water Quality Management Plan*, and are included in the pollution reduction calculations. Pollutant reductions for SWM conversions are calculated based on the approximate pollutant load received from the drainage area (DA) and the increase in removal efficiency based on BMP efficiencies recommended by CBP for detention and extended detention facilities. The equation used to estimate TN load reductions for SWM conversions is expressed as:

$$[13.48(lbs/ac/yr) \times DA(acres)] \times 15\%$$

The equation used to estimate TP load reductions for SWM conversions is expressed as:

$$[0.70(lbs/ac/yr) \times DA(acres)] \times 10\%$$

The equation used to estimate TSS load reductions for SWM conversions is expressed as:

$$[871(lbs/ac/yr) \times DA(acres)] \times 50\%$$

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in the equations above. Similar to existing SWM, the pollutant loading rates shown represent the weighted average of impervious and pervious urban rates used in the pollutant loading analysis (Table 3-1) since this represents the likely sources of runoff being treated. The increased pollutant removal capacity is represented by the second expression in the equations above. This is the difference between percent pollutant removal efficiencies of extended detention and detention facilities, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. A summary of SWM conversion load reduction calculations and results are shown in Table 3-6.

Table 3-6: SWM Conversion Load Reductions

				REMOVAL EFFICIENCY			
Pollutant	DA for SWM Conversion (acres)	Overall Urban Loading Rate (lbs/ac/yr)	Load from DA (lbs/yr)	Detention Pond (%)	Extended Detention (%)	Increase in Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	334.78	13.48	4,512	5%	20%	15%	677
TP	334.78	0.70	235	10%	20%	10%	23
TSS	334.78	871	291,673	10%	60%	50%	145,837

3.4.2.4 Stormwater Retrofits

Proposed stormwater retrofits for the purposes of this SWAP refer to implementing BMPs to capture and treat runoff from impervious surfaces (i.e., parking lots, alleys) which are currently untreated. This includes sites indentified for retrofit potential during the uplands surveys for neighborhoods and institutions. Pollutant reductions for stormwater retrofits are calculated based on the approximate pollutant load received from the impervious drainage area (DA) and removal efficiency of infiltration type BMPs. The equation used to estimate TN load reductions for stormwater retrofits is expressed as:

$$[17.34(lbs/ac/yr) \times DA(acres)] \times 50\%$$

The equation used to estimate TP load reductions for stormwater retrofits is expressed as:

$$[1.51(lbs/ac/yr) \times DA(acres)] \times 60\%$$

The equation used to estimate TSS load reductions for stormwater retrofits is expressed as:

$$[2057(lbs/ac/yr) \times DA(acres)] \times 90\%$$

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 17.34 lbs TN/ac/yr, 1.51 lbs TP/ac/yr, and 2,057 lbs TSS/ac/yr are the impervious urban rates used in the pollutant loading analysis (Table 3-1) since this represents the source of runoff being treated. Pollutant removal efficiencies are those reported for infiltration practices, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. A summary of stormwater retrofit load reduction calculations and results for the Middle Gwynns Falls SWAP area are shown Table 3-7.

Table 3-7: Stormwater Retrofit (Bioretention Practices) Load Reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	Impervious Area for SW Retrofit (acres)	Load from DA (lbs/yr)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)

TN	17.34	29.9	519	50%	259
TP	1.51	29.9	45	60%	27
TSS	2057	29.9	61,525	90%	55,373

3.4.2.5 Impervious Cover Removal

Potential sites for impervious cover removal were identified at several institutions, neighborhoods and one hotspot. Pollutant reductions for impervious cover removal are calculated based on a land use conversion from impervious to pervious urban. The equation used to estimate TN load reductions for impervious cover removal is expressed as:

$$[17.34(lbs/ac/yr) - 11.55(lbs/ac/yr)] \times impervious\_area(acres)$$

The equation used to estimate TP load reductions for impervious cover removal is expressed as:

$$[1.51(lbs/ac/yr) - 0.30(lbs/ac/yr)] \times impervious\_area(acres)$$

The equation used to estimate TSS load reductions for impervious cover removal is expressed as:

$$[2{,}057(lbs/ac/yr) - 280(lbs/ac/yr)] \times impervious\_area(acres)$$

Impervious cover removal involves converting impervious surfaces to pervious surfaces such as turf or permeable paving. Therefore, the loading rate would be reduced by a factor equal to the difference between impervious and pervious urban loading rates used in the watershed pollutant loading analysis (Table 3-1) as shown in the first expression in brackets in the equations above. The approximate reduction in pollutant load is then the reduced loading rate multiplied by the area proposed for impervious cover removal. Because removal of impervious cover is more realistically implemented on public land, any impervious cover removal noted on private properties was not included in the calculation. A summary of impervious cover removal reduction calculations and results are shown in Table 3-8.

Table 3-8: Impervious Cover Removal Load Reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	Pervious Urban Loading Rate (lbs/ac/yr)	Reduction in Loading Rate (lbs/ac/yr)	Impervious Area Removed (acres)	Max Potential Load Reduction (lbs/yr)
TN	17.34	11.55	5.79	3.70	21.44
TP	1.51	0.30	1.22	3.70	4.51
TSS	2,057	280	1,777	3.70	6,579

3.4.2.6 Stream Buffer Reforestation

The current vegetative condition of the stream riparian buffer (100 feet on either side of stream system) was analyzed in Section 2.2.7 of the *Watershed Characterization Report*. Buffer conditions were either classified as impervious, open pervious or forested areas. Open pervious areas are the best areas to initially target for restoration. Approximately 384 acres of open pervious area were identified within the stream buffer zone. Several stream buffer enhancement projects were identified in the *Gwynns Falls Water Quality Management Plan* and are summarized in Section 4.3 and Appendix K. A separate pollution reduction calculation was not performed for these specific projects, but instead, they will be considered as part of the greater stream buffer reforestation effort in the Middle Gwynns Falls watershed.

Pollutant reductions for stream buffer reforestation are calculated based on a land use conversion from pervious urban to forest plus an additional reduction efficiency per BMP performance guidance from CBP (Appendix C). The equation used to estimate TN load reductions for the land use conversion portion of stream buffer reforestation is expressed as:

$$\text{Land Use Conversion (TN)} = [11.55\,(lbs/ac/yr) - 2.78\,(lbs/ac/yr)] \times Open\_Pervious\_Area\,(acres)$$

The equation used to estimate TP load reductions for the land use conversion portion of stream buffer reforestation is expressed as:

$$\text{Land Use Conversion (TP)} = [0.30\,(lbs/ac/yr) - 0.04\,(lbs/ac/yr)] \times Open\_Pervious\_Area\,(acres)$$

The equation used to estimate TSS load reductions for the land use conversion portion of stream buffer reforestation is expressed as:

$$\text{Land Use Conversion (TSS)} = [280\,(lbs/ac/yr) - 82\,(lbs/ac/yr)] \times Open\_Pervious\_Area\,(acres)$$

The first expression in brackets in the equations above represents the difference between pervious urban and forest loading rates used in the watershed pollutant loading analysis (Table 3-1). This reduction in loading rate is then multiplied by the available open pervious area for reforestation to determine the loads reductions from land use conversion.

An additional pollutant removal factor is added to the land use conversion to determine the total removal capacity of buffer reforestation. Per the BMP performance guidance in Appendix C, 1 acre of buffer treats approximately 1 acre of upland area for nitrogen, phosphorus and sediment with varying efficiencies for urban and mixed open buffers. The weighted loading rate for the entire watershed is used to represent this upland area and is the final number in brackets in the equations below. The TN load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

$$\text{Buffer BMP Removal (TN)} = \left[OpenPerviousArea(acres) \times \frac{1(uplandacres)}{1(bufferacre)} \times 12.08(lbs/ac/yr) \right] \times 25\%$$

The TP load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

Buffer BMP Removal (TP) = $\left[OpenPerviousArea(acres) \times \frac{1(uplandacres)}{1(bufferacre)} \times 0.62(lbs/ac/yr) \right] \times 50\%$

The TP load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

Buffer BMP Removal (TSS) =

$$\left[OpenPerviousArea(acres) \times \frac{1(uplandacres)}{1(bufferacre)} \times 768(lbs/ac/yr) \right] \times 50\%$$

The loading rates shown in the equations above represent overall watershed loading rates. This is estimated as the total watershed nutrient load divided by the total watershed area. These are used to calculate the pollutant load from the upland area that would be treated by buffer reforestation. As mentioned, the land use conversion and additional removal efficiency are added to yield a total pollutant load reduction. A summary of stream buffer reforestation reduction calculations and results are shown in Table 3-9.

Table 3-9: Stream Buffer Reforestation Load Reductions

		LU CONVERSION			BUFFER BMP REMOVAL			
Pollutant	Open Pervious Area (acres)	Pervious Urban Loading Rate (lbs/ac/yr)	Forest Loading Rate (lbs/ac/yr)	Land Use Conversion Reduction (lbs/yr)	Reduction Efficiency (%)	Overall Watershed Loading Rate (lbs/ac/yr)	Efficiency Load Reduction (lbs/yr)	Max Potential Load Reduction (lbs/yr)
TN	384	11.55	2.78	3,365	25%	12.08	3.02	3,369
TP	384	0.30	0.04	99	50%	0.62	0.31	99
TSS	384	280	82	76,083	50%	768	384	76,467

3.4.2.7 *Downspout Disconnection*

A total of 87 neighborhoods (out of 153 surveyed) have potential for downspout disconnection. A neighborhood is recommended for disconnection if at least 25 percent of the downspouts are directly and/or indirectly connected to the storm drain system and the average lot has at least 15 feet of pervious area available down gradient from the downspout. During the uplands survey, the percentage of homes with connected downspouts was noted. This percentage was used to determine the rooftop area that could be addressed by disconnection in recommended neighborhoods. This is explained in further detail in Chapter 4 of the *Watershed Characterization Report*.

Pollutant reductions for downspout disconnection are calculated based on the pollutant load received from the total rooftop DA recommended for disconnection and the removal efficiency of filtration type BMPs. The equation used to estimate TN load reductions for downspout disconnection is expressed as:

$$\left[17.34(lbs/ac/yr) \times DA(acres) \right] \times 50\%$$

The equation used to estimate TP load reductions for downspout disconnection is expressed as:

$$\left[1.51(lbs / ac / yr) \times DA(acres)\right] \times 60\%$$

The equation used to estimate TSS load reductions for downspout disconnection is expressed as:

$$\left[2{,}057\,(lbs / ac / yr) \times DA(acres)\right] \times 90\%$$

The pollutant load received from the impervious rooftop drainage area recommended for disconnection is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 17.34 lbs TN/ac/yr, 1.51 lbs TP/ac/yr, and 2,057 lbs TSS/ac/yr are the impervious urban rates used in the pollutant loading analysis. Pollutant removal efficiencies are those reported for "Disconnection of Rooftop Runoff," in the *Accounting for Stormwater Wasteload Allocations and Impervious Areas Treated* released by MDE. A summary of downspout disconnection load reduction calculations and results are shown in Table 3-10.

Table 3-10: Downspout Disconnection Load Reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	DA (Rooftop area recommended for downspout disconnect) (acres)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	17.34	206	50%	1,785
TP	1.51	206	60%	187
TSS	2,057	206	90%	381,051

3.4.2.8 Tree Plantings

Several opportunities for planting street and open space shade trees were identified in neighborhoods throughout the watershed. Similarly, tree planting opportunities were also identified at many of the institutional sites that were investigated. For both neighborhood and institutional tree planting opportunities, the number of trees was estimated based on a spacing of one tree per 30 feet for street tree planting and a planting density of 135 trees per acre for reforestation and shade tree planting. Pollutant reductions for pervious area reforestation are calculated based on a land use conversion from pervious urban to forest. An approximation of 135 trees per acre is used to calculate the area available for conversion. This density was taken from the *Baltimore County Policy and Guidelines for Community Tree Planting Projects* and assumes a survival density of 100 trees per acre after 25 years. The equation used to estimate TN load reductions for tree plantings is expressed as:

$$\left[11.55(lbs/ac/yr) - 2.78(lbs/ac/yr)\right] \times \left[\#Trees \cdot \frac{1(acre)}{135(trees)}\right]$$

The equation used to estimate TP load reductions for tree plantings is expressed as:

$$\left[0.30(lbs/ac/yr) - 0.04(lbs/ac/yr)\right] \times \left[\#Trees \cdot \frac{1(acre)}{135(trees)}\right]$$

The equation used to estimate TSS load reductions for tree plantings is expressed as:

$$\left[280(lbs/ac/yr) - 82(lbs/ac/yr)\right] \times \left[\#Trees \cdot \frac{1(acre)}{135(trees)}\right]$$

Tree plantings would involve converting open pervious area to forest. Therefore, the loading rate would be reduced by a factor equal to the difference between pervious urban and forest loading rates used in the watershed pollutant loading analysis, as shown in the first expression in brackets in the equations above. The approximate reduction in pollutant load is then the reduced loading rate multiplied by the open pervious area available for reforestation (i.e., the expression in the second brackets in the equations above). A summary of tree planting load reduction calculations and results are shown in Table 3-11 and Table 3-12.

Table 3-11: Neighborhood Tree Planting Load Reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Forest Loading Rate (lbs/ac/yr)	Reduced Loading Rate (lbs/ac/yr)	Estimated # Trees for NSAs (#)	New Forested Area (acres)	Max Potential Load Reduction (lbs/yr)
TN	11.55	2.78	8.77	9,041	66.97	587
TP	0.30	0.04	0.26	9,041	66.97	17
TSS	280	82	198	9,041	66.97	13,278

Table 3-12: Institution Tree Planting Load Reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Forest Loading Rate (lbs/ac/yr)	Reduced Loading Rate (lbs/ac/yr)	Estimated # Trees for ISIs (#)	New Forested Area (acres)	Max Potential Load Reduction (lbs/yr)
TN	11.55	2.78	8.77	9,693	71.80	630
TP	0.30	0.04	0.26	9,693	71.80	18
TSS	280	82	198	9,693	71.80	14,235

3.4.2.9 Bayscaping

Bayscaping refers to educating citizens about environmentally friendly lawn care techniques by reducing the amount of mowed lawn. Neighborhoods targeted for bayscaping education were those where the typical lot was at least ¼ acre in size, was less than 10 percent landscaped, and where there was sufficient grass area available (42 out of 153 NSAs). The total area of lawn that can be addressed through bayscaping is based on NSA results which are explained in Chapter 4 of the *Watershed Characterization Report.*

Pollutant reductions for bayscaping are calculated based on the pollutant load received from the total lawn DA recommended for bayscaping and removal efficiency. Removal efficiencies were obtained from the December, 2012 study entitled *Recommendations of the Expert Panel to Define Removal Rates for Urban Nutrient Management* (Schueler & Lane, December, 2012). For bayscaping, the blended rates from the report for high and low risk lawns were used to estimate nutrient reductions. The equation used to estimate TN load reductions for bayscaping is expressed as:

$$[11.55(lbs/ac/yr) \times DA(acres)] \times 9\%$$

The equation used to estimate TP load reductions for bayscaping is expressed as:

$$[0.30(lbs/ac/yr) \times DA(acres)] \times 4.5\%$$

No reduction of TSS is calculated for implementation of bayscaping.

The pollutant load received from the lawn area recommended for bayscaping is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 11.55 lbs TN/ac/yr and 0.30 lbs TP/ac/yr are the pervious urban rates used in the pollutant loading analysis (Table 3-1) since this represents the source of runoff being addressed. Pollutant removal efficiencies are those reported for urban nutrient management, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs. A summary of bayscaping reduction calculations and results are shown in Table 3-13.

Table 3-13: Bayscaping Load Reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Estimated Area Available for Bayscaping (acres)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	11.55	392	9%	408
TP	0.30	392	4.5%	5
TSS	280	392	0%	0

3.4.2.10 Street Sweeping

Thirty-four (34) neighborhoods were recommended for street sweeping in Middle Gwynns Falls and contain approximately 76.1 miles of road. A review of the aerial mapping of the SWAP study area and specifically the neighborhoods recommended for street sweeping was conducted and an average street width of 30 feet was assumed to determine the total area of street sweeping

Pollutant reductions for street sweeping are calculated based on the pollutant load received from the total street DA recommended for sweeping and removal efficiency. Pollution reduction efficiencies were obtained from the *Accounting for Stormwater Wasteload Allocations and Impervious Areas Treated* guidance from MDE. The equation used to estimate TN load reductions for street sweeping is expressed as:

$$[17.34(lbs/ac/yr) \times DA(acres)] \times 5\%$$

The equation used to estimate TP load reductions for street sweeping is expressed as:

$$[1.51(lbs/ac/yr) \times DA(acres)] \times 6\%$$

The equation used to estimate TSS load reductions for street sweeping is expressed as:

$$[2{,}057\,(lbs\,/\,ac\,/\,yr) \times DA\,(acres)] \times 25\%$$

The pollutant load received from the roadway areas recommended for street sweeping is represented by the first term in the brackets above which is the impervious urban pollutant loading rate. Removal efficiencies are those reported for urban nutrient management, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs. A summary of street sweeping reduction calculations and results are shown in Table 3-14.

Table 3-14: Street Sweeping Load Reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	Proposed Miles of Street Sweeping (miles)	Proposed Area of Street Sweeping* (acres)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	17.34	76.1	276.8	5%	240
TP	1.51	76.1	276.8	6%	25
TSS	2,057	76.1	276.8	25%	142,348

3.4.2.11 Sanitary Sewer Overflows

A total of 281 SSO events were documented between 2000 and 2011 within the Middle Gwynns Falls planning area. An estimated 21,282,383 gallons were discharged over this 12-year period. Pollutant loads associated with these SSO events and volume were calculated based on the following assumptions (more detail can be found in Section 3.5 of the *Watershed Characterization Report*):

- ***Total Nitrogen (TN):*** A conversion factor of 5.0×10^{-4} was used to convert gallons of overflow to pounds of pollutant. This is based on a 60 mg/L TN concentration and a multiplier of 8.3×10^{-6} lb·L/mg·gal.
- ***Total Phosphorus (TP):*** A conversion factor of 8.3×10^{-5} was used to convert gallons of overflow to pounds of pollutant. This is based on a 10 mg/L TP concentration and a multiplier of 8.3×10^{-6} lb·L/mg·gal.
- ***Total Suspended Solids (TSS):*** A conversion factor 3.3×10^{-3} was used to convert gallons of overflow to pounds of pollutant. This is based on a 400 mg/L TP concentration and a multiplier of 8.3×10^{-6} lb·L/mg·gal.

Based on these conversion factors, approximately 10,599 lbs of TN, 1,766 lbs of TP, and 70,658 lbs of TSS were released over the 12-year period as a result of SSOs. This is equivalent to pollutant reduction capabilities of 883 lbs TN/yr, 147 lbs TP/yr, and 5,888 lbs TSS/yr. Note that TN, TP, and TSS concentrations shown above are values for wastewater characteristics from CWP's Watershed Treatment Model version 3.1.

3.4.2.12 Stream Restoration Projects

Several potential stream restoration sites were identified in the 2004 *Gwynns Falls Water Quality Management Plan* to address stream stability issues and improve water quality. A summary of each of the projects is included in Appendix K. In addition, a summary of the projects within each subwatershed is included in Section 4.3 of this report. The 2004 report also categorized the unstable stable stream ratios for the entire stream network located within the watershed. For the purpose of this report, pollutant removal from stream restoration projects were divided into two categories, those from the *Gwynns Falls Water Quality Management Plan* and the remaining streams classified as having a high unstable stable ratio.

In the December, 2012 document of *Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects* produced by the Chesapeake Stormwater Network and the Center for Watershed Protection, interim pollutant load reduction estimates in pounds per linear foot of stream restoration were developed (Schueler & Stack, Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects, December, 2012). These rates were derived from six stream restoration monitoring studies located in Maryland and Pennsylvania and have been approved by CBP. The interim rates use a baseline reduction factor based on the linear footage of stream restoration that is proposed. The equation used to estimate total nitrogen (TN) load reductions for stream restoration is expressed as:

$$0.02(lbs\ /\ ft) \times RL(ft)$$

The equation used to estimate TP load reductions for stream restoration is expressed as:

$$0.068(lbs\ /\ ft) \times RL(ft)$$

The equation used to estimate TSS load reductions for stream restoration is expressed as:

$$310(lbs\ /\ ft) \times RL(ft)$$

A summary of potential stream restoration reduction calculations and results from stream restoration projects found within the *Gwynns Falls Water Quality Management Plan* are shown in Table 3-15.

Table 3-15: Stream Restoration Load Reductions for Stream Reaches in the Gwynns Falls Water Quality Management Plan

Pollutant	Reduction in Loading Rate (lbs/ft)	Stream Reach Length (ft)	Max Potential Stream Load Reduction (lbs/yr)
TN	0.2	19,930	3,986
TP	0.068	19,930	1,355
TSS	310	19,930	6,178,300

The total stream length within the Middle Gwynns Falls watershed is 77.92 miles or 411,933 linear feet. Based on the *Gwynns Falls Water Quality Management Plan*, 20.61% of streams in the study area were found to have a high unstable stable stream ratio. Subtracting out the total linear feet of the specific projects recommended in the 2004 study, a total of 64,863 linear feet of streams with high unstable stable stream ratios remain for consideration. A summary of potential stream restoration reduction calculations and results from restoring the remaining stream reaches with high unstable stable stream ratios are shown in Table 3-16.

Table 3-16: Stream Restoration Load Reductions for the Remaining Stream Reaches with High Unstable-Stable Ratios

Pollutant	Reduction in Loading Rate (lbs/ft)	Stream Reach Length (ft)	Max Potential Stream Load Reduction (lbs/yr)
TN	0.2	64,863	12,973
TP	0.068	64,863	4,411
TSS	310	64,863	20,107,568

3.4.2.13 WQMP Wetland BMP Creation Projects

One potential wetland BMP creation project was identified in the 2004 *Gwynns Falls Water Quality Management Plan* to treat drainage from two (2) Baltimore County outfalls in the Scotts Level watershed.

Pollutant reductions for wetland creation are calculated based on the approximate pollutant load received from the impervious drainage area (DA) and removal efficiency of wetland BMPs per BMP performance guidance from CBP (Appendix C). The equation used to estimate TN load reductions for wetland BMP creation is expressed as:

$$[13.48(lbs/ac/yr) \times DA(acres)] \times 20\%$$

The equation used to estimate TP load reductions for wetland BMP creation is expressed as:

$$[0.70(lbs/ac/yr) \times DA(acres)] \times 45\%$$

The equation used to estimate TSS load reductions for wetland BMP creation is expressed as:

$$[871(lbs/ac/yr) \times DA(acres)] \times 60\%$$

The pollutant load received from the drainage area contributing to the BMP facility is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 13.48 lbs TN/ac/yr, 0.70 lbs TP/ac/yr, and 871 lbs TSS/ac/yr are the weighted urban rates used in the pollutant loading analysis since this represents the source of runoff being treated. A summary of wetland BMP creation load reduction calculations and results for the Middle Gwynns Falls SWAP area are shown Table 3-17.

Table 3-17: Load Reductions from Wetland BMP Creation

Pollutant	Urban Loading Rate (lbs/ac/yr)	Urban Drainage Area for Wetland BMP (acres)	Load from Drainage Area (lbs/yr)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	13.48	62.8	846	20%	169
TP	0.70	62.8	44	45%	20
TSS	871	62.8	54,689	60%	32,813

3.4.2.14 WQMP BMP Creation Projects

Several BMP creation projects were identified in the 2004 *Gwynns Falls Water Quality Management Plan* to treat drainage from existing outfalls and storm drain systems in the Middle Gwynns Falls watershed. Details on the BMP creation projects can be found by subwatershed in Section 4.3 along with Appendix K. Pollutant reductions for BMP creation are calculated based on the approximate pollutant load received from the drainage area (DA) and removal efficiency of the particular BMP constructed. To provide a conservative estimate of pollution reductions from BMP installations, the calculations assume that extended dry detention ponds will be used to treat the runoff. The equation used to estimate TN load reductions for BMP creation is expressed as:

$$[13.48(lbs/ac/yr) \times DA(acres)] \times 20\%$$

The equation used to estimate TP load reductions for BMP creation is expressed as:

$$[0.70(lbs/ac/yr) \times DA(acres)] \times 20\%$$

The equation used to estimate TSS load reductions for BMP creation is expressed as:

$$[871(lbs/ac/yr) \times DA(acres)] \times 60\%$$

The pollutant load received from the drainage area contributing to the BMP facility is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 13.48 lbs TN/ac/yr, 0.70 lbs TP/ac/yr, and 871 lbs TSS/ac/yr are the weighted urban rates used in the pollutant loading analysis since this represents the source of runoff being treated. A summary of BMP creation load reduction calculations and results for the Middle Gwynns Falls SWAP area are shown Table 3-18.

Table 3-18: Load Reductions from BMP Creation

Pollutant	Urban Loading Rate (lbs/ac/yr)	Urban Drainage Area for BMP (acres)	Load from Drainage Area (lbs/yr)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	13.48	357.4	4817	20%	963
TP	0.70	357.4	251	20%	50
TSS	871	357.4	311,407	60%	186,844

3.4.2.15 Potential Redevelopment of Urban Areas

Development of natural areas to impervious urban landscapes causes an increase in pollutant loading through changes in land use. Redeveloping urban areas into a more natural setting can provide pollutant load reductions. In the Water Resources Element (WRE) of its Master Plan 2020, Baltimore County has analyzed redevelopment scenarios and identified potential land for redevelopment in each of its watersheds (EPS, 2010).

Pollutant reductions for redevelopment are calculated based on the pollutant removal efficiencies from the current urban nutrient loading developed by Baltimore County during their analysis. The equation used to estimate TN load reductions from redevelopment is expressed as:

$$\left[13.48\,(lbs\,/\,ac\,/\,yr) \times DA\,(acres)\right] \times 59\%$$

The amount of material removed is converted to TP load removed from redevelopment is expressed as:

$$\left[0.70\,(lbs\,/\,ac\,/\,yr) \times DA\,(acres)\right] \times 55\%$$

The amount of material removed is converted to TSS load removed from redevelopment is expressed as:

$$\left[871\,(lbs\,/\,ac\,/\,yr) \times DA\,(acres)\right] \times 60\%$$

Within the WRE document, a total of 2,565 acres of developed area was identified as available for redevelopment in the entire Baltimore County portion of the Gwynns Falls watershed. As the Middle Gwynns Falls watershed only makes up a portion of the whole Gwynns Falls watershed (52%), a similar proportion of the available redevelopment area was counted for the Middle Gwynns Falls. A summary of potential urban redevelopment reduction calculations and results are shown in Table 3-19.

Table 3-19: Load Reductions from Redevelopment of Urban Land

Pollutant	Weighted Urban Loading Rate (lbs/ac/yr)	Estimated Area Available for Redevelopment (acres)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	13.48	1339	59%	10,648
TP	0.70	1339	55%	517
TSS	871	1339	60%	700,037

3.4.2.16 Fertilizer Act of 2011

On May 19, 2011, Governor Martin O'Malley signed the Fertilizer Use Act of 2011, an environmental law designed to reduce the amount of nutrients washing into the Chesapeake Bay from lawns, golf courses, parks, recreation areas and other non-agricultural sources. The law limits the amount of phosphorus contained in lawn fertilizer products sold to the public, establishes a training, certification and licensing program for people who are hired to apply fertilizer to non-agricultural landscapes, limits fertilizer amounts applied to turf, and requires the implementation of a homeowner education program about best management practices to be followed when using fertilizers (MDA 2011). The Fertilizer Act will be fully implemented in October 2013 and contains new content requirements and labeling instructions including restricting phosphorous and decreasing nitrogen amounts in fertilizer sold in Maryland.

Pollutant reductions from the Fertilizer Act of 2011 are calculated based on the December, 2012 study entitled *Recommendations of the Expert Panel to Define Removal Rates for Urban Nutrient Management* (Schueler & Lane, December, 2012). For states with fertilizer legislation, a 25% reduction in phosphorus was recommended from urban pervious land uses. For nitrogen, a 9% reduction was estimated for commercial areas and a 4.5% rate was recommended for "do-it-yourself" land uses. To reach a blended nitrogen reduction weight, a weighted average was calculated based on the amount of commercial and residential land use within the study area. The equation used to estimate TN load reductions from the Fertilizer Act of 2011 is expressed as:

$$[11.55(lbs/ac/yr)\times Urban\_Pervious\_Area(acres)]\times 4.95\%$$

The amount of material removed is converted to TP load removed from the Fertilizer Act of 2011 is expressed as:

$$[0.30(lbs/ac/yr)\times Urban\_Pervious\_Area(acres)]\times 25\%$$

It is assumed that no reduction in TSS will occur because of the new law. Calculations and results of the nutrient reductions derived from the Fertilizer Act of 2011 are summarized in Table 3-20.

Table 3-20: Load Reductions from Fertilizer Act of 2011

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Pervious Urban Area (acres)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	11.55	8619	4.95%	4,928
TP	0.30	8619	25%	640
TSS	280	8619	0%	0

3.4.2.17 MS4 Retrofits

Baltimore County, as part of its NPDES permit, is currently assessing the condition of each of the County outfalls to determine if there is retrofit potential at the outfall and restoration potential in the downstream drainage way. As part of the Phase II Watershed Implementation Plan, Baltimore County estimated that 16% of the County's outfalls will need to be retrofit in order to meet pollution reduction and impervious area treatment requirements.

Pollutant reductions for outfall retrofits are calculated based on the approximate pollutant load received from the urban area within the watershed and removal efficiency of urban BMP retrofits from the June 2011 draft document, *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (MDE, 2011). The equation used to estimate TN load reductions for outfall retrofits is expressed as:

$$[13.48(lbs/ac/yr)\times UrbanArea(acres)]\times 25\%$$

The equation used to estimate TP load reductions for stormwater retrofits is expressed as:

$$\left[0.70\,(lbs\ /\ ac\ /\ yr\,) \times UrbanArea \quad (acres\,)\right] \times 35\,\%$$

The equation used to estimate TSS load reductions for stormwater retrofits is expressed as:

$$\left[871\,(lbs\ /\ ac\ /\ yr\,) \times UrbanArea \quad (acres\,)\right] \times 60\,\%$$

The pollutant load received from the urban land use is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 13.48 lbs TN/ac/yr, 0.70 lbs TP/ac/yr, and 871 lbs TSS/ac/yr are the weighted average of impervious and pervious urban rates used in the pollutant loading analysis (Table 3-1) since this represents the source of runoff being treated. A summary of stormwater retrofit load reduction calculations and results for the Middle Gwynns Falls SWAP area are shown in Table 3-21.

Table 3-21: MS4 Outfall Retrofit Load Reductions

Pollutant	Urban Loading Rate (lbs/ac/yr)	Urban Area (acres)	Load from Retrofit Urban Area (lbs/yr)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	13.48	12,913	174,015	25%	43,504
TP	0.70	12,913	9,061	35%	3,171
TSS	871	12,913	11,250,209	65%	7,312,636

3.4.2.18 State Owned Property Restoration

Although the Middle Gwynns Falls watershed lies entirely within Baltimore County, there is approximately 1,100 acres of land in the study area owned and operated by the State of Maryland. The State of Maryland and its departments owning property within the Middle Gwynns Falls includes the State Police (17 acres), Transit Administration (74 acres), and State Highway Administration (1,009 acres). Because the State of Maryland has responsibility for the pollution reduction requirements on its own property, specific projects and restoration opportunities were not identified in these areas. Instead, a line item is created to account for the pollution reductions that must be achieved by the state government within the planning area. Table 3-22 provides the calculation estimating the pollutant loading from state-owned properties within the Middle Gwynns Falls watershed. Ultimately, it is assumed that the State of Maryland will be required to meet the same mandatory percentage nutrient reduction requirements of the Chesapeake Bay TMDL as Baltimore County which is summarized in Table 3-3.

Table 3-22: State Owned Property Pollutant Loading

Pollutant	Urban Loading Rate (lbs/ac/yr)	State Owned Drainage Area (acres)	Load from Drainage Area (lbs/yr)
TN	17.34	1100.1	19,076
TP	1.51	1100.1	1,666
TSS	2,057	1100.1	2,262,845

3.4.2.19 Overall Pollutant Load Reductions

The sum of maximum potential pollutant load reductions calculated for individual BMPs represents the overall pollutant removal capacity for a maximum implementation scenario (i.e., 100% of projects implemented). A practicable pollutant load reduction was estimated for each BMP as the maximum potential load reduction multiplied by a projected participation factor. An overall projected pollutant removal capacity is the sum of practicable pollutant load reductions for individual BMPs. Projected participation factor assumptions are described in Table 3-23. Participation rates for existing measures that have already been implemented are 100%.

Table 3-23: Projected Participation Factors

BMP	Projected Participation	Basis of Assumption
Completed Measures		
CIP - Stream Restoration	100%	Existing – stream restoration already implemented
Existing SWM	100%	Existing – BMPs already implemented
SSO Reduction/Elimination	100%	Consent Decree requirements
Proposed Measures		
SWM Conversions	100%	Complete 3 conversions
SW Retrofits (NSA, ISI)	50%	General estimate to achieve reduction goal
NSA SW Retrofit	50%	General estimate to achieve reduction goal
ISI SW Retrofit	50%	General estimate to achieve reduction goal
ISI Impervious Cover Removal	75%	General estimate to achieve reduction goal
NSA Downspout Disconnection	43%	43% willingness factor
Reforest Stream Buffer	33%	General estimate to achieve reduction goal
NSA Tree Plantings	43%	43% willingness factor
ISI Tree Plantings	65%	65% of estimated trees on public lands
NSA Bayscaping Education	7%	10% recall rate (workshop/public mtg) * 71% willingness factor
Street Sweeping	100%	General estimate to achieve reduction goal
WQMP Stream Restoration Projects	85%	General estimate to achieve reduction goal
Stream Restoration	50%	General estimate to achieve reduction goal
WQMP Wetland Creation Projects	100%	General estimate to achieve reduction goal
WQMP BMP Creation Projects	60%	General estimate to achieve reduction goal
Redevelopment of Urban Areas	67%	General estimate to achieve reduction goal
Credits for Fertilizer Act of 2011	100%	100% participation as part of Maryland law
MS4 Retrofits	33%	General estimate to achieve reduction goal
State Owned Property Restoration	100%	Based on TMDL Requirements

Table 3-24 presents a summary of estimated pollutant load reductions for three scenarios – maximum implementation and projected practicable implementation by 2017 and 2025 – including how reductions were credited, pollutant removal efficiencies, maximum potential load reductions, units available for restoration, projected participation, and projected load reductions. Currently, the project implementation plan shown in Table 3-23 does meet the 2017 and 2025 goals for nitrogen and phosphorous reduction. There are opportunities to achieve greater reductions if restoration BMPs are implemented to a greater extent than those assumed by projected participation factors. Greater reductions may also be achieved through restoration actions not included in this analysis such as public education/outreach efforts (e.g., watershed trash and recycling campaign, tours of completed projects, and education of hotspots). These types of actions are not included in the pollutant removal analysis because reduction efficiencies are not well known and difficult to estimate.

Table 3-24: Summary of Pollutant Load Reduction Estimates

BMP	How Credited	TN Efficiency	TP Efficiency	TSS Efficiency	Units Available		Projected Participation	Max Potential TN Load Reduction	Max Potential TP Load Reduction	Max Potential TSS Load Reduction	Projected 2017 TN Load Reduction	Projected 2017 TP Load Reduction	Projected 2017 TSS Load Reduction	Projected 2025 TN Load Reduction	Projected 2025 TP Load Reduction	Projected 2025 TSS Load Reduction
Completed Measures																
CIP - Stream Restoration	NPDES Permit	varies	varies	varies	7,775	ft	100%	1,295	440	2,007,250	1,295	440	2,007,250	1,295	440	2,007,250
Existing SWM	Efficiency	varies	varies	varies	3,087	acres	100%	5,197	381	773,401	5,197	381	773,401	5,197	381	773,401
SSO Reduction/Elimination	Direct Removal	N/A	N/A	N/A	223,390	gal	100%	883	147	5,888	883	147	5,888	883	147	5,888
Proposed Measures																
SWM Conversions	Efficiency	15%	10%	50%	335	acres	100%	677	23	145,837	271	9	58,335	677	23	145,837
SW Retrofits (NSA, ISI)	Efficiency	50%	60%	90%	30	acres	50%	259	27	55,373	26	3	5,537	130	14	27,686
NSA SW Retrofit	Efficiency	50%	60%	90%	17	acres	50%	151	16	32,321	15	2	3,232	76	8	16,161
ISI SW Retrofit	Efficiency	50%	60%	90%	12	acres	50%	108	11	23,052	11	1	2,305	54	6	11,526
ISI Impervious Cover Removal	LU Conversion	N/A	N/A	N/A	4	acre	75%	21	5	6,579	16	3	4,934	16	3	4,934
NSA Downspout Disconnection	Efficiency	50%	60%	90%	206	acres	43%	1,785	187	381,051	209	22	44,687	767	80	163,852
Reforest Stream Buffer	LU Conversion + Efficiency	25%	50%	50%	384	acres	33%	3,369	99	76,467	303	9	6,882	1,112	33	25,234
NSA Tree Plantings	LU Conversion	N/A	N/A	N/A	67	acres	43%	587	17	13,278	84	2	1,903	253	7	5,709
ISI Tree Plantings	LU Conversion	N/A	N/A	N/A	72	acres	65%	630	18	14,235	136	4	3,084	409	12	9,253
NSA Bayscaping Education	Efficiency	17%	22%	0%	392	acres	7%	770	26	0	18	1	0	54	2	0
Street Sweeping	Efficiency	5%	6%	25%	76	miles	100%	240	25	142,348	240	25	142,348	240	25	142,348
WQMP Stream Restoration Projects	Lbs per Ln Ft	0.20	0.068	310	19,930	ft	85%	3,986	1,355	6,178,300	3,388	1,152	5,251,555	3,388	1,152	5,251,555
Stream Restoration	Lbs per Ln Ft	0.20	0.068	310	64,863	ft	50%	12,973	4,411	20,107,568	6,486	2,205	10,053,784	6,486	2,205	10,053,784
WQMP Wetland Creation Projects	Efficiency	20%	45%	60%	63	acres	100%	169	20	32,813	169	20	32,813	169	20	32,813
WQMP BMP Creation Projects	Efficiency	20%	20%	60%	357	acres	60%	963	50	186,844	193	10	37,369	578	30	112,106
Redevelopment of Urban Areas	Efficiency	59%	55%	60%	1,339	acres	67%	10,648	517	700,037	4,057	197	266,723	7,134	346	469,025
Credits for Fertilizer Act of 2011	Efficiency	4.95%	25%	0%	8,619	acres	100%	4,928	640	0	4,928	640	0	4,928	640	0
MS4 Retrofits	Efficiency	25%	35%	65%	12,913	acres	34%	43,504	3,171	7,312,636	5,843	426	982,087	14,791	1,078	2,486,296
State Owned Property Restoration	Efficiency	25%	35%	65%	457	acres	100%	7,923	692	939,872	1,608	218	0	2,297	312	0
Additional Retrofits to be Identified	Efficiency	POLLUTION REDUCTION PROJECTS TO BE INDENTIFIED AND QUANTIFIED IN THE FUTURE														
							Total Load Reduction (lbs/yr):	***100,806***	***12,252***	***-***	***35,350***	***5,915***	***-***	***50,804***	***6,952***	***-***
							Total Existing Urban Load (lbs/yr)	174,015	9,061	11,250,209	174,015	9,061	11,250,209	174,015	9,061	11,250,209
							Reduction Achieved:	***58%***	***136%***	***-***	***20%***	***66%***	***-***	***29%***	***77%***	***-***
									Chesapeake Bay TMDL Reduction Goals		***35,309***	***2,860***	***-***	***50,442***	***4,086***	***-***

CHAPTER 4: SUBWATERSHED MANAGEMENT STRATEGIES

4.1 Introduction

This chapter describes the criteria and methodology used to rank the 5 subwatersheds comprising the Middle Gwynns Falls planning area (see Figure 4-1). The subwatershed ranking provides a tool for targeting restoration actions by location/water body. This chapter also summarizes management strategies and implementation priorities within each subwatershed. Individual subwatershed summaries include key subwatershed characteristics. More detailed information on a subwatershed basis can be found in the *Middle Gwynns Falls Watershed Characterization Report* included as Appendix E.

4.2 Subwatershed Prioritization

A ranking methodology was developed to prioritize subwatersheds within this study in terms of restoration need and potential. Subwatersheds were evaluated based on 15 criteria. Each criterion was scored from 1 to 4 with scores of 0 given if the criterion was not applicable. The sum of the criteria for each subwatershed was used to prioritize subwatersheds within this study in terms of restoration need and potential.

Subwatersheds are represented by an overall prioritization score on a scale of 60, where 0 denotes the least significant impacts to water quality and 60 corresponds to the greatest water quality improvement potential. The total prioritization score for a subwatershed is comprised of the following ranking criteria:

- Nitrogen Loads
- Phosphorus Loads
- Sediment Load
- Impervious Surfaces
- Neighborhood Restoration Opportunity/Pollution Source Indexes
- Neighborhood Downspout Disconnection
- Neighborhood Trash Management
- Institutional Site Index
- Forest Coverage
- Municipal Street Sweeping
- Municipal Stormwater Conversions
- Illicit Discharge Data
- Stream Buffer Improvement
- SSO Improvement
- Environmental Justice

Each criterion has a maximum possible score of 4. In general, subwatersheds were divided into quartiles based on supporting criterion data to yield an even distribution of the number of watersheds per possible score (i.e., 1, 2, 3, 4). In some cases, criterion data did not support dividing the subwatersheds into four equal parts. Examples include a distribution of data that is too clustered or cases where zero values were assigned to subwatersheds with no recommended action for a particular criterion.

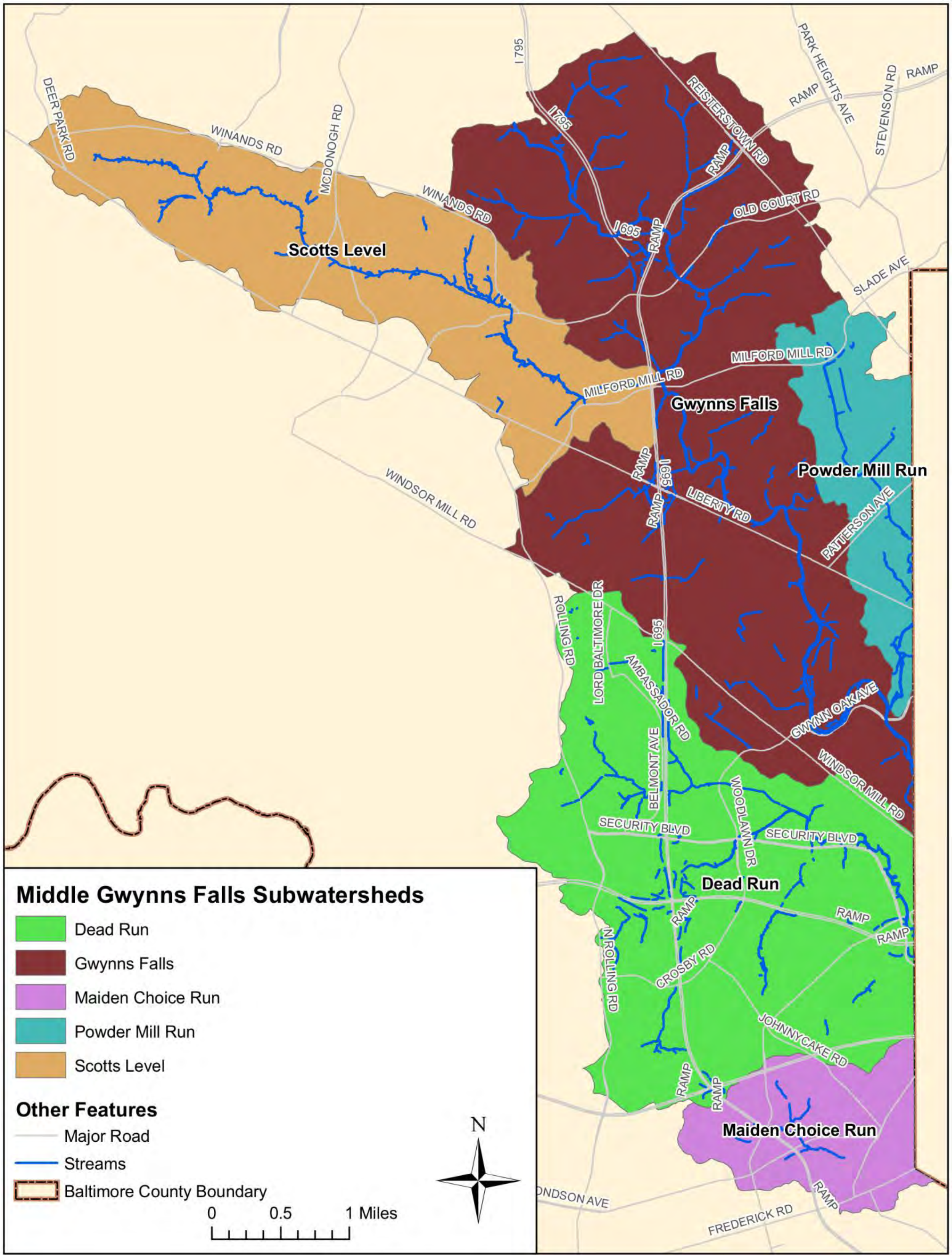

Figure 4-1: Middle Gwynns Falls Subwatersheds

Criteria used to calculate overall prioritization scores were selected considering SWAP goals and information compiled during watershed characterization and field efforts. Criteria and scoring designations are described in the sections below. Subwatershed restoration prioritization scoring and ranking results are summarized at the end of this section.

4.2.1 Nitrogen, Phosphorus, and Sediment Loads

One of the objectives to improve and maintain water quality and meet pollution reduction requirements in Middle Gwynns Falls is to reduce annual average total nitrogen, phosphorus, and sediment loads. Annual pollutant loads (lbs/year) for total nitrogen, phosphorus, and sediment were calculated for each subwatershed based on loading rates established by MDE and CBP for various land use types and subwatershed land use distributions. The pollutant loading analysis for the Middle Gwynns Falls watershed is explained in further detail in Section 3.4.1 and the *Watershed Characterization Report* (Appendix E).

For each subwatershed, annual nitrogen, phosphorus, and sediment loads were divided by the subwatershed's area. This represents pollutant loadings rates (lbs/acre/year) and allows a direct comparison between the 5 subwatersheds since they vary greatly in size. Subwatersheds with higher pollutant loading rates are higher priorities for restoration within the Middle Gwynns Falls. Therefore, higher pollutant loading rates are assigned high scores to denote greater water quality impacts and restoration need.

Subwatershed nitrogen loading rates ranged from 11.33 to 13.16 lbs/acre/year. The following point system was used to assign nitrogen load scores to the 5 subwatersheds based on the range and distribution of subwatershed nitrogen loading rates:

- ≥ 12.50 lbs/acres/year = 4 pts
- 11.76 – 12.49 lbs/acre/year = 3 pts
- 11.36 – 11.75 lbs/acre/year = 2 pts
- ≤ 11.35 lbs/acre/year = 1 pt

Subwatershed phosphorus loading rates ranged from 0.54 to 0.75 lbs/acre/year. The following point system was used to assign phosphorus load scores to the 5 subwatersheds based on the range and distribution of subwatershed phosphorus loading rates:

- ≥ 0.75 lbs/acres/year = 4 pts
- 0.66 – 0.74 lbs/acre/year = 3 pts
- 0.57– 0.65 lbs/acre/year = 2 pts
- ≤ 0.56 lbs/acre/year = 1 pt

Subwatershed sediment loading rates ranged from 660 to 959 lbs/acre/year. The following point system was used to assign sediment load scores to the 5 subwatersheds based on the range and distribution of subwatershed phosphorus loading rates:

- ≥ 900 lbs/acres/year = 4 pts
- 800 – 899 lbs/acre/year = 3 pts
- 700– 799 lbs/acre/year = 2 pts
- ≤ 699 lbs/acre/year = 1 pt

Nitrogen, phosphorus, and sediment loading rates and corresponding scores are summarized in Table 4-1 by subwatershed.

Table 4-1: Nitrogen and Phosphorus Load Scores

SUBWATERSHED	Nitrogen Loading Rate (lbs/acre/yr)	Nitrogen Load Score	Phosphorus Loading Rate (lbs/acre/yr)	Phosphorus Load Score	Sediment Loading Rate (lbs/acre/yr)	Sediment Load Score
Gwynns Falls	11.33	1	0.54	1	660	1
Powder Mill Run	11.61	2	0.56	1	692	1
Dead Run	13.11	4	0.75	4	959	4
Maiden Choice Run	13.16	4	0.69	3	857	3
Scotts Level	11.99	3	0.58	2	714	2

4.2.2 Impervious Surfaces

Various studies have shown a correlation between the amount of impervious surface within a watershed and water quality degradation. Impervious surfaces prevent precipitation from naturally infiltrating into the ground which prohibits the natural filtration of pollutants and conveys concentrated, accelerated stormwater runoff directly to the stream system. Consequently, stormwater runoff from impervious surfaces can cause stream erosion and habitat degradation from the high energy flow and is likely more polluted than runoff generated from pervious areas. Undeveloped watersheds with small amounts of impervious cover are more likely to have better water quality in local streams than urbanized watersheds with greater amounts of impervious cover.

As described in the *Watershed Characterization Report*, roads and buildings data layers were used to derive impervious surface areas and the percent impervious area for each subwatershed. Similar to the pollutant load criteria, percentages of impervious area for subwatersheds were used to assign scores as it allows a direct comparison between the 5 subwatersheds. Subwatersheds with higher percentages of impervious cover are higher priorities for restoration within Middle Gwynns Falls. Therefore, higher percentages of imperviousness are assigned high scores to denote greater water quality impacts and restoration need.

Impervious cover represents about 28.9% of the overall Middle Gwynns Falls watershed. Subwatershed percent impervious values range from approximately 23 to 39%. The Center for Watershed Protection (CWP) compiled stream research conducted in various parts of the country and developed a simple model that relates stream quality to percentage of impervious cover in a watershed. The following point system was used to assign percent impervious scores to the 5 subwatersheds based on CWP's Impervious Cover model (see Section 2.3.3 of the *Watershed Characterization Report*) and subwatershed impervious surface percentages:

- > 60% = 4 pts
- 26 – 60% = 3 pts
- 11 – 25% = 2 pts
- ≤ 10% = 1 pt

Percent impervious values and corresponding scores are summarized in Table 4-2 by subwatershed.

Table 4-2: Percent Impervious Scores

SUBWATERSHED	% Impervious	% Impervious Score
Gwynns Falls	23%	2
Powder Mill Run	25%	2
Dead Run	39%	3
Maiden Choice Run	33%	3
Scotts Level	26%	3

4.2.3 Neighborhood Restoration Opportunity/Pollution Source Indexes

As described in the *Watershed Characterization Report*, neighborhood pollution severity and restoration potential were rated during NSAs. The severity of pollution generated by a neighborhood is denoted by the Pollution Severity Index (PSI) and was rated as severe, high, moderate, or none. A neighborhood's potential for residential restoration projects was also rated as high, moderate, or low according to the Restoration Opportunity Index (ROI). Out of the 153 neighborhoods assessed, the majority were rated as both moderate for PSI and ROI. 17 were rated as high for both PSI and ROI, 11 were rated as a high PSI with a moderate ROI, and 31 were rated as a moderate PSI with a high ROI. Neighborhoods with high PSI and high ROI ratings represent the best areas to initially target for restoration. Because some neighborhoods were encompassed within multiple subwatersheds, those neighborhoods were counted for each subwatershed to portray a more accurate subwatershed ranking.

One subwatershed, Gwynns Falls, was given a score of four (4). Gwynns Falls intersects the highest number of neighborhoods, 71, and has the most neighborhoods rated as high for both PSI/ROI. Dead Run was given a score of three (3) because it contained the second highest number of neighborhoods rated as high for both PSI/ROI and 34 NSAs in total. Scotts Level contained no neighborhoods rated as high for both PSI/ROI but did contain the second most NSAs in the study area. The majority of the NSAs in Scotts Level were ranked as moderate for both PSI/ROI. Powder Mill Run was the only other subwatershed with multiple neighborhoods rated as high for both PSI/ROI but only contained 14 neighborhoods in total. Scotts Level and Powder Mill Run were both given a score of two (2). Finally, Maiden Choice Run only had one neighborhood rated as high for both PSI/ROI and the second fewest NSAs in total. Maiden Choice Run was given a score of one (1). NSA PSI/ROI scores are summarized in Table 4-3 by subwatershed.

Table 4-3: NSA PSI/ROI Scores

SUBWATERSHED	# of NEIGHBORHOODS FOR PSI/ROI RATINGS									NSA PSI/ROI Score
	High/ High	High/ Mod	High/ Low	Mod/ High	Mod/ Mod	Mod/ Low	None/ High	None/ Mod	None/ Low	
Gwynns Falls	7	6	1	17	22	4	2	7	5	4
Powder Mill Run	4	1	0	2	1	0	2	1	3	2
Dead Run	5	4	0	6	8	2	0	6	3	3
Maiden Choice Run	1	0	0	3	5	2	0	1	3	1
Scotts Level	0	0	0	3	32	2	0	2	0	2

4.2.4 Neighborhood Downspout Disconnection

Connected downspouts discharge rooftop runoff either directly to the storm drain system or to impervious surfaces. In both cases, there is little to no treatment of stormwater runoff before it reaches the stream system. Disconnected downspouts drain to pervious areas such as yards and lawns, rain barrels, or rain gardens, all of which allow rooftop runoff to infiltrate into the ground and enter streams through the groundwater system in a slower more natural fashion. Downspout disconnection is desirable because it decreases flow to local streams during storm events and reduces pollutant loads to streams.

Downspout disconnection was recommended for neighborhoods where at least 25 percent of the downspouts are connected to impervious area or directly to the storm drain system and where the average lot has at least 15 feet of pervious area available down gradient from the connected downspout for redirection. Similar to lawn fertilizer reduction, this criterion is used for subwatershed prioritization because it has a quantitative pollution reduction efficiency related to nutrient reduction goals.

The acres of rooftop addressed if downspout disconnection were initiated in the recommended neighborhoods were calculated in the *Watershed Characterization Report*. The percentage of subwatershed rooftop area addressed was also calculated and was used to compare the restoration potential among the 5 subwatersheds. Subwatersheds with the highest percentages of impervious rooftop acres addressed through downspout disconnection denote the greatest restoration potential and therefore, were scored the highest. Percentages of subwatershed areas addressed through downspout disconnection range from approximately 2 to 46%. The following point system was used to assign downspout disconnect scores to the 5 subwatersheds based on the distribution and range of percentages of subwatershed rooftop areas addressed:

- ≥ 41% = 4 pts
- 36 – 40% = 3 pts
- 31 – 35% = 2 pts
- ≤ 30% = 1 pt

Percentage of rooftop area addressed by downspout disconnection and corresponding scores are summarized in Table 4-4 by subwatershed.

Table 4-4: NSA Downspout Disconnect Scores

SUBWATERSHED	% Rooftop Area Addressed	NSA Downspout Disconnect Score
Gwynns Falls	39%	3
Powder Mill Run	31%	2
Dead Run	34%	2
Maiden Choice Run	46%	4
Scotts Level	2%	1

4.2.5 Neighborhood Trash Management

Trash is one of the major pollutants of concern and focuses of the Steering Committee's Goals in Middle Gwynns Falls. For this reason, NSA results for trash pollution sources and management opportunities were used as a criterion for prioritizing subwatershed. Trash management initiatives involve raising awareness of the trash issue and ways to solve it. Some ways to raise citizen awareness of trash as a problem include community cleanups, trash management education (e.g., presentations about recycling, reuse, and disposal options), storm drain markers, a watershed trash campaign, and/or targeted trash can inspection throughout a neighborhood.

Neighborhoods where junk or trash was observed in 10 percent of yards were recommended for trash management initiatives. Neighborhoods with less than 10 percent of yards with junk/trash but had other warning signs such as overflowing dumpsters or dumping in alleys or other common areas were also included as a potential source of trash pollution. The acres of land addressed if trash management was implemented in the recommended neighborhoods were calculated for each subwatershed in the *Watershed Characterization Report*. The percentages of subwatershed areas addressed via neighborhood trash management were also calculated. This was used to directly compare restoration potential among the 5 subwatersheds with respect to addressing trash. Subwatersheds with the highest percentages of area addressed through neighborhood trash management denote the greatest restoration potential and therefore, were scored the highest.

Percentages of subwatershed areas addressed through neighborhood trash management range from approximately 0 to 3 percent. The following point system was used to assign trash management scores to the 5 subwatershed based on the distribution and range of percentages of subwatershed areas addressed:

- ≥3% = 4 pts
- 2.4 – 2.9% = 3 pts
- 1.8 – 2.3% = 2 pts
- ≤ 1.7% = 1 pt

Percentage of area addressed by neighborhood trash management and corresponding scores are summarized in Table 4-5 by subwatershed. Subwatersheds with an area addressed value of 0% were assigned a score of zero (0).

Table 4-5: NSA Trash Management Scores

SUBWATERSHED	% Area Addressed	NSA Trash Management Score
Gwynns Falls	1.1%	1
Powder Mill Run	2.9%	3
Dead Run	3.0%	4
Maiden Choice Run	0.0%	0
Scotts Level	2.3%	2

4.2.6 Institutional Site Index

Institutions offer unique opportunities for watershed restoration. Typically, institutional properties encompass considerable portions of land including various natural resources. In addition, they offer the opportunity to engage a wide range of citizens in restoration activities. This raises citizen awareness while also providing water quality improvement benefits in the watershed. A total of 41 community-based facilities were surveyed during Institutional Site Investigations (ISIs) including faith-based facilities, community centers, municipal facilities (e.g., fire and rescue stations), schools, and care centers (e.g., nursing homes). The focus of ISIs is to identify potential restoration opportunities, educate the community and provide water quality benefits. Subwatersheds with more institutional sites present more opportunities for implementing restoration actions (e.g., tree planting, stormwater retrofits, community cleanups, etc.) and encouraging citizen participation. Public institutional sites are good candidates for initial restoration efforts because there are opportunities to make use of and build upon existing partnerships and in many cases, incorporate student projects. While private institutions also have restoration potential, they will require a different approach and the development of new partnerships to implement restoration efforts. For all of these reasons, subwatershed prioritization for this criterion was based on the number of institutions and considering public versus private ownership.

For purposes of this prioritization, publicly owned ISIs are given a greater score because they have the greatest restoration potential. The number of publicly owned institutions were summed and then multiplied by two to give them a weighted score. The number of privately owned institutions was then added to this number to give a total weighted number. The following point system was used to assign institutional site scores to the 5 subwatersheds based on the distribution and range ISIs addressed:

- ≥ 21 = 4 pts
- 14 – 20 = 3 pts
- 7 – 13 = 2 pts
- ≤ 6 = 1 pt

The total number of institutions including public versus private ISIs and corresponding institutional site index scores are summarized by subwatershed in Table 4-6.

Table 4-6: ISI Scores

SUBWATERSHED	# of Public ISIs	Weighted # of Public ISIs (x2)	# of Private ISIs	Total Weighted # of ISIs	ISI Score
Gwynns Falls	9	18	16	34	4
Powder Mill Run	2	4	0	4	1
Dead Run	5	10	3	13	2
Maiden Choice Run	1	2	4	6	1
Scotts Level	6	12	5	17	3

4.2.7 Forest Coverage

The old-growth forests that dominated the landscape of the Middle Gwynns Falls watershed have been almost wholly replaced by deforestation from development. Consequently, a monumentally negative impact has affected the hydrology of the uplands areas of the watershed, the hydraulics of its streams, and its forest habitats. As a major goal identified for the watershed is to increase tree and forest coverage, a category identified for the subwatershed prioritization related was based on the percentage of subwatershed forest coverage as described in the *Watershed Characterization Report*. Percentages of forest coverage area in the 5 Middle Gwynns Falls subwatershed range from approximately 30 to 47 percent.

For purposes of this prioritization, subwatersheds with smaller percentages of forest cover are given a greater score because of the greater likelihood that there is a higher percentage of area that can be converted to tree cover. The following point system was used to assign forest coverage scores to the five subwatersheds based on the range of percentages of in each subwatershed:

- ≤ 34% = 4 pts
- 35– 39% = 3 pts
- 40– 44% = 2 pts
- ≥ 45% = 1 pt

Forest coverage percentages and corresponding scores are summarized in Table 4-7 by subwatershed.

Table 4-7: Forest Coverage Scores

SUBWATERSHED	% of Subwatershed with Forest Cover	Forest Cover Score
Gwynns Falls	43%	2
Powder Mill Run	47%	1
Dead Run	30%	4
Maiden Choice Run	37%	3
Scotts Level	39%	3

4.2.8 Municipal Street Sweeping

Baltimore County provides street sweeping services throughout their jurisdiction to help remove trash, sediment and other organic matter such as leaves and grass clippings from the curb and gutter system and prevent them from entering the storm drain system and nearby streams. Street sweeping also reduces sediment and other pollutant loads such as oil and metals to the stream system. During the NSAs, neighborhoods where 25 percent or more of the curbs and gutters were covered with excessive trash, sediment, and/or organic matter were recommended for street sweeping.

As described in the *Watershed Characterization Report*, the miles of street addressed if street sweeping were implemented in the recommended neighborhoods was estimated by subwatershed. Subwatersheds with more miles of road that could be addressed through street sweeping denote the greatest restoration potential and therefore, were scored the highest. Miles addressed through street sweeping range from 2.3 to 37.0. The following point system was used to assign street sweeping scores to the 5 subwatershed based on the distribution and range of miles addressed:

- ≥ 26 miles = 4 pts
- 11 – 25 miles = 3 pts
- 4 – 10 miles = 2 pts
- ≤ 3 miles = 1 pt

Miles addressed by municipal street sweeping and corresponding scores are summarized in Table 4-8 by subwatershed.

Table 4-8: Municipal Street Sweeping Scores

SUBWATERSHED	Miles of Road Addressed	Street Sweeping Score
Gwynns Falls	37.0	4
Powder Mill Run	9.3	2
Dead Run	20.7	3
Maiden Choice Run	6.8	2
Scotts Level	2.3	1

4.2.9 Municipal Stormwater Conversions

Existing dry detention ponds within the Middle Gwynns Falls planning area were investigated for potential conversion to water quality management facilities. Dry ponds were assessed since they have the greatest potential for conversion to a type of facility that provides water quality benefits in addition to quantity control such as an extended detention facility. Dry extended detention ponds are designed to capture and retain stormwater runoff from a storm for a minimum duration to allow sediment and pollutants to settle out while also being able to provide flood control.

Fifteen (15) existing dry detention ponds were assessed for their potential to be converted to an extended detention facility. Information collected at each facility included the following: orifice, riser, ponding, debris, vegetation, adjacent land use, physical expansion capabilities, outfall, and downstream conditions. Out of the fifteen (15) detention ponds assessed, ten (10) were considered as having potential for conversion to an extended detention facility. All of the assessed ponds were noted as needing maintenance to maintain functionality.

Subwatershed scoring for stormwater conversion potential is based upon the potential for conversion along with horizontal and vertical expansion at dry ponds in the 5 subwatersheds. Two subwatersheds, Gwynns Falls and Dead Run, contained four (4) ponds that possessed the potential to be converted into a more beneficial facility for water quality treatment and were given a score of 3 points. Maiden Choice Run contained two (2) ponds with potential to be converted into a more beneficial facility for water quality treatment and were given a score of 2 points. . No ponds were assessed in the remaining two (2) subwatersheds, Powder Mill Run and Scotts Level, and they were given a score of 0 points.

The Gwynns Falls subwatershed contains seven (7) assessed detention ponds, with four (4) considered as having potential for conversion to an extended detention pond. In addition, two (2) ponds were found to have potential for horizontal expansion, and three (3) having potential for vertical expansion. SWM_C_441 is located at the intersection of Spring Mill Circle and Woodgreen Circle and treats 13.3 acres of residential development. This pond was recommended to be upgraded to provide additional water quality treatment and has the potential for horizontal and vertical expansion. Recommendations at this pond include the construction of a micropool at the pond inflow structure and the replacement of the impervious access road with a porous driveway material. SWM_C_715 is located at the end of Janper Court and treats runoff from 18.96 acres of apartment development. This pond was recommended to be upgraded to provide additional water quality treatment with potential vertical expansion. Major recommendations here include the construction of micropools at the pond inflows and the potential replacement of the 18” low-flow orifice with a smaller orifice size to retain runoff for longer periods.

SWM_C_967 is located off of Northmont Road and treats runoff from 52.80 acres of residential development. This pond was recommended to be upgraded to provide additional water quality treatment, but has no potential for vertical or horizontal expansion. The large area of the pond provides potential retrofit possibilities including installation of a pretreatment forebay at the pond inflow channel that could flow into shallow wetlands and then into a deep micropool in front of riser with submerged reverse slope low flow pipe. SWM_C_984 is located off of Windmill Circle and treats runoff from 41.61 acres of residential development. The pond is recommended to be upgraded to an extended detention facility with the potential for horizontal and vertical expansion. Major recommendations here include lengthing of the pond’s flow path, installation of pretreatment forebays, and conversion of a portion of the pond bottom into a shallow wetland. The three (3) remaining ponds that were assessed in the Gwynns Falls subwatershed, SWM_C_651, SWM_C_738, and SWM_C_1652, were found to have no conversion potential and were recommended for maintenance actions only.

The Dead Run subwatershed contains six (6) assessed detention ponds, with four (4) considered as having potential for conversion to an extended detention pond. In addition, three (3) ponds were found to have potential for horizontal expansion, and one (1) having potential for vertical expansion. SWM_C_334 is located at the end of Brigadoon Trail and treats runoff from 17.97 acres of residential development. This pond was recommended to be upgraded to provide additional water quality treatment, but contains no expansions potential. Major water quality improvements that could be implemented at this facility include the conversion of the existing triangular channels flowing to the pond into bioswales, the construction of forebays at the existing pipe inflows, and the conversion of the flow path in the pond to a grassy swale. SWM_C_432 is located at the end of Halfpenny Lane and treats runoff from 33 acres of residential development. This pond was recommended to be upgraded to provide additional water quality treatment and has potential for both horizontal and vertical expansion. Currently, the outlet pipe of the facility is blocked which has caused a permanent pool of water to form within the pond bottom. If flooding during larger events has not been an issue, there is the potential for the pond to be permanently converted to a stormwater wetland facility.

SWM_C_857 is located at the intersection of Security Boulevard and Lord Baltimore Drive and treats runoff from 11.71 acres of commercial development and parking lot. This pond was recommended to be upgraded to provide additional water quality treatment with the potential for horizontal expansion. Major recommendations at this facility include steeping the side slopes of the pond to a 3:1 slope for horizontal expansion and the construction of a micropool at the pond inflow. In addition, a bioretention area could be constructed at the inlet directly to the south of the pond to treat driveway runoff prior to it entering the pond. SWM_C_961 is located at the end of Kevsway Court and treats runoff from 64.88 acres of residential development. This pond was recommended to be upgraded to provide additional water quality treatment and has potential for both horizontal and vertical expansion. Major recommendations at this pond include construction of micropools at the pond inflows and the investigation of potential illicit connections to the facility's outlet structure. The two (2) remaining ponds that were assessed in the Dead Run subwatershed SWM_C_450 and SWM_C_817 were found to have no conversion potential and were recommended for maintenance actions only.

The Maiden Choice Run subwatershed contains two (2) assessed detention ponds, with both considered as having potential for conversion to an extended detention pond. In addition, both ponds were found to have potential for horizontal and vertical expansion. SWM_C_859 is located on a private road off of Northdale Road. The facility treats runoff from 20.35 acres of institutional development. Major recommendations at this facility include the construction of a micropool at the pond inflow and horizontal expansion to allow for conversion to and extended detention type of facility. SWM_C_1188 is located off of Maryland Avenue and treats runoff from 60.2 acres of residential and park development. The pond has a large drainage area, which is mostly pervious, and there is potential for extra capacity, although the treatment potential is questionable. Recommendations at this facility include the construction of a micropool at each of the pond inflow pipes and channels. In addition, grass channels that currently flow into the pond could be converted into bioswales to provide water quality treatment to runoff prior to entering the facility.

The remaining subwatersheds, Powder Mill Run and Scotts Level, contained no assessed dry detention ponds and were given a score of zero (0). Municipal stormwater conversion scores are summarized in Table 4-9 by subwatershed.

Table 4-9: Municipal Stormwater Conversion Scores

SUBWATERSHED	# of Dry Ponds	# of Ponds with Conversion Potential	# of Ponds with Horizontal Expansion Potential	# of Ponds with Vertical Expansion Potential	# of Ponds with Maintenance Needed	Municipal Stormwater Conversion Score
Gwynns Falls	7	4	2	3	7	3
Powder Mill Run	0	0	0	0	0	0
Dead Run	6	4	3	1	6	3
Maiden Choice Run	2	2	2	2	2	2
Scotts Level	0	0	0	0	0	0

4.2.10 Illicit Discharge Data

Baltimore County tracks illicit discharges through a program of routine outfall screening. Illicit discharges refer to leaking pipes or incorrectly connected pipes. The County has an outfall prioritization system based on data from the outfall screening. Under this system, major outfalls (greater than 3 feet in diameter) are assigned one of the following priority ratings: critical, high, low, or none. Critical outfalls are those with problems that require immediate correction and/or close monitoring, or outfalls with recurring problems. These are sampled the most frequently (4 times per year). On the other end of the rating scheme, outfalls that are not prioritized have insufficient data to determine a priority rating. More information regarding the County's outfall screening and prioritization system is included in the *Watershed Characterization Report.*

There are 119 major outfalls in Middle Gwynns Falls with a priority rating. Subwatersheds with the most illicit discharge data and highest prioritization ratings represent the best areas to target for restoration initially. Scotts Level contains the highest number of Priority 1 outfalls with seven (7) and received the highest score (4 points). The Gwynns Falls subwatershed contained the second highest number of Priority 1 outfalls with three (3) and received the second highest score (3 points). Powder Mill Run and Dead Run both contained two (2) outfalls that were rated as Prioirity 1 and were assigned the third highest scores (2 points). Finally, Maiden Choice Run had no Priority 1 outfalls and the fewest total number of major outfalls in total. Consequently, Maiden Choice Run was assigned a score of one (1) point.

The number of major outfalls associated with various County outfall prioritization ratings and corresponding illicit discharge data scores are summarized Table 4-10 by subwatershed.

Table 4-10: Illicit Discharge Data Scores

SUBWATERSHED	COUNTY OUTFALL PRIORITIZATION RATINGS				Illicit Discharge Data Score
	Priority 1 (Critical)	Priority 2 (High)	Priority 3 (Low)	Priority 0 (None)	
Gwynns Falls	3	7	26	8	3
Powder Mill Run	2	3	3	2	2
Dead Run	2	11	24	10	2
Maiden Choice Run	0	2	2	2	1
Scotts Level	7	9	8	3	4

4.2.11 Stream Buffer Improvements

Forested buffer areas along streams play a crucial role in improving water quality and flood mitigation since they can reduce surface runoff, stabilize stream banks, trap sediment, and provide habitat for various types of terrestrial and aquatic life including fish. They protect water bodies from pollutant loads while also providing bank stabilization and habitat. Maintaining healthy streams and forest buffers are important for reducing nutrient and sediment loadings to the Middle Gwynns Falls and it tributaries. When stream buffers are converted from forest to developed areas, many of these benefits are lost and stream health declines. Riparian buffer zones can be reestablished or preserved as a BMP to reduce land use impacts by intercepting and controlling pollutants entering a water body.

In the *Watershed Characterization Report*, the vegetative condition of stream buffers was analyzed based on a 100-foot buffer on either side of the stream system. Three classifications were used to classify stream buffer conditions: impervious, open pervious, or forested. For each subwatershed, acreages and percentages of stream buffer area were determined for the three classifications. Open pervious areas (e.g., mowed lawns) represent the greatest potential for stream buffer reforestation. Therefore, the percentages of open pervious buffer area were used to prioritize restoration potential among subwatersheds. Subwatersheds with greater percentages of open pervious buffer areas denote the greatest potential for stream buffer improvement and were scored the highest.

Open pervious buffer area percentages range from approximately 17% to 25%. The following point system was used to assign stream buffer improvement scores to the 5 subwatersheds based on the distribution and range of open pervious buffer area percentages:

- ≥ 25% = 4 pts
- 22 – 24% = 3 pts
- 19 – 21% = 2 pts
- ≤ 18% = 1 pt

Percentages of open pervious stream buffer areas and corresponding scores are summarized in Table 4-11 by subwatershed.

Table 4-11: Stream Buffer Improvement Scores

SUBWATERSHED	% Open Pervious Stream Buffer Area	Stream Buffer Improvement Score
Gwynns Falls	25%	4
Powder Mill Run	22%	3
Dead Run	25%	4
Maiden Choice Run	21%	2
Scotts Level	17%	1

4.2.12 SSO Improvement

As development has increased across the Middle Gwynns Falls watershed, the expansion of the public sewer system has followed that development. Over time, aging sewer infrastructure can leak, overflow, or fail completely causing raw sewage and the pollutants contained therein to enter local streams. With the issuance of a consent decree to Baltimore County by the USEPA in 2005, measures to bring the aging sewer system into compliance have begun to address some overflow issues in the watershed.

Additionally, as discussed in Section 1.3.2, a TMDL for bacteria was completed for the entire Gwynns Falls in 2007. In the *Watershed Characterization Report*, an analysis was performed on the sewage overflows that occurred in the Middle Gwynns Falls since 2000. This analysis was used to prioritize restoration potential among subwatersheds. Subwatersheds with greater average annual SSO volumes denote the greatest potential for SSO improvements and were scored the highest.

Average annual SSO volumes range from approximately 329 gallons/year to 157,082 gallons/year. The following point system was used to assign SSO improvement scores to the 5 subwatersheds based on the distribution and range of SSO annual volumes:

- ≥ 71,000 gallons/year = 4 pts
- 41,000 – 70,000 gallons/year = 3 pts
- 11,000 – 40,000 gallons/year = 2 pts
- ≤ 10,000 gallons/year = 1 pt

Volumes of annual SSO releases and corresponding scores are summarized in Table 4-12 by subwatershed.

Table 4-12: SSO Improvement Scores

SUBWATERSHED	# of SSO Events	Volume of SSO Events (gallons)	Average Volume of SSO Events (gallons)	SSO Improvement Score
Gwynns Falls	102	6,167,485	60,466	3
Powder Mill Run	65	3,428,702	52,749	3
Dead Run	37	531,391	14,362	2
Maiden Choice Run	71	11,152,830	157,082	4
Scotts Level	6	1,975	329	1

4.2.13 Environmental Justice Risk

In the report titled *Mapping Environmental Justice + Water Quality in Baltimore County*, EPS analyzed twelve different indicators in categories of social and demographic, human health, and watershed health to determine where an unequal distribution of environmental benefits and harms existed in different areas of the County. These indicators were used in the report to rank all the subwatersheds of Baltimore County in relation to Environmental Justice. Within the Middle Gwynns Falls watershed, 90 distinct block groups were analyzed of which 39 were categorized as high, 38 as medium, and 13 as low for Environmental Justice. Three of the subwatersheds, Powder Mill Run, Scotts Level, and Dead Run, were ranked within the top five subwatersheds in Baltimore County with the highest percentage of area ranked as high for EJ risk.

Subwatersheds with the highest coverage of high EJ risk area represent areas that are more susceptible to environmental harms. Therefore, the percentages of high EJ area were used to prioritize EJ risk scores among subwatersheds. Subwatersheds with greater percentages of high EJ risk areas denote the most susceptibility to environmental harms and were scored the highest.

High EJ risk area percentages of subwatersheds range from approximately 0% to 73%. The following point system was used to assign EJ Risk scores to the 5 subwatersheds based on the distribution and range of high EJ risk area percentages:

- ≥ 71% = 4 pts
- 64 – 70% = 3 pts
- 57 – 63% = 2 pts
- ≤ 56% = 1 pt

Percentages of high EJ risk areas and corresponding scores are summarized in Table 4-13 by subwatershed. Maiden Choice Run contained no areas ranked as high for EJ risk; therefore, this subwatershed was given a score of zero (0).

Table 4-13: Environmental Justice Risk Scores

SUBWATERSHED	% Environmental Justice Risk	Environmental Justice Score
Gwynns Falls	50%	1
Powder Mill Run	73%	4
Dead Run	62%	2
Maiden Choice Run	0%	0
Scotts Level	70%	3

4.2.14 Subwatershed Prioritization Summary

The 5 subwatersheds comprising Middle Gwynns Falls are ranked according to the total prioritization score (i.e., the sum of prioritization criterion scores). Subwatershed ranking results are summarized in Table 4-14 including criterion scores, total scores, and rankings by subwatershed.

Subwatersheds were placed into one of four priority categories based on ranking results: very high, high, medium, and medium-low. These results are summarized in Table 4-15 and illustrated in Figure 4-2.

Subwatershed prioritization scores range from 29 to 46 points. The following point system was used to assign prioritization categories to the 5 subwatersheds based on the distribution and range of prioritization scores:

- ≥ 40 = Very High
- 35 – 39 = High
- 30 – 34 = Medium
- ≤ 29 = Medium–Low

Table 4-14: Subwatershed Ranking Results

SUBWATERSHED	Nitrogen Load	Phosphorus Load	Sediment Load	% Impervious	NSA PSI/ROI	NSA Downspout Disconnect	NSA Trash Management	ISI Site Index	Forest Cover	Municipal Street Sweeping	Municipal Stormwater Conversion	Illicit Discharge Data	Stream Buffer Improvement	SSO Improvement	Environmental Justice	TOTAL SCORE	SUBWATERSHED RANK
Gwynns Falls	1	1	1	2	4	3	1	4	2	4	3	3	4	3	1	***37***	***2***
Powder Mill Run	2	1	1	2	2	2	3	1	1	2	0	2	3	3	4	***29***	***5***
Dead Run	4	4	4	3	3	2	4	2	4	3	3	2	4	2	2	***46***	***1***
Maiden Choice Run	4	3	3	3	1	4	0	1	3	2	2	1	2	4	0	***33***	***3***
Scotts Level	3	2	2	3	2	1	2	3	3	1	0	4	1	1	3	***31***	***4***

Table 4-15: Subwatershed Prioritization

Rank	Subwatershed	Total Score	Prioritization Category
1	Dead Run	46	Very High
2	Gwynns Falls	37	High
3	Maiden Choice Run	33	Medium
4	Scotts Level	31	Medium
5	Powder Mill Run	29	Medium-Low

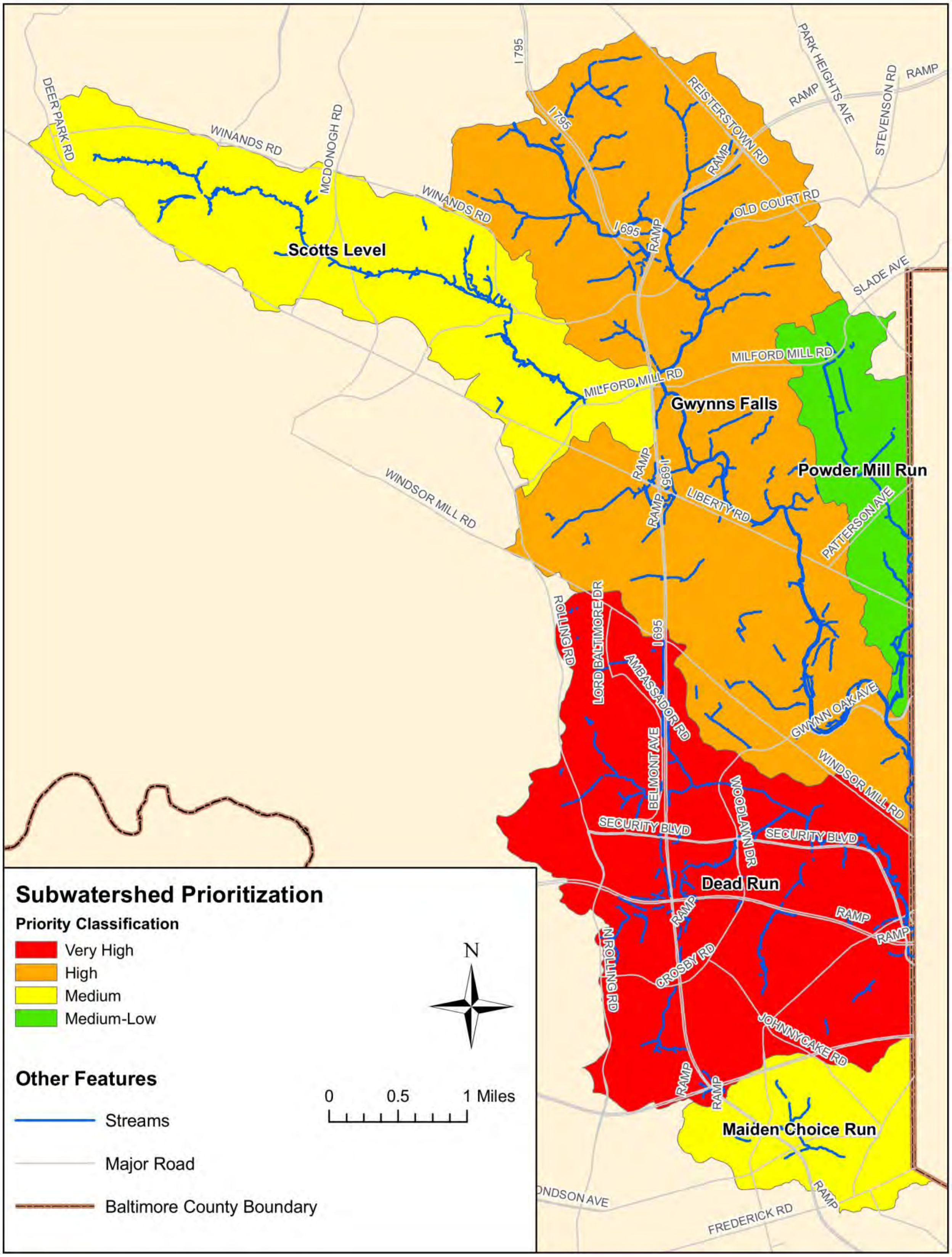

Figure 4-2: Middle Gwynns Falls Subwatershed Prioritization

4.3 Subwatershed Restoration Strategies

Restoration strategies for each subwatershed are presented in the following subsections. Subwatersheds are presented in the numerical order based on the unique ID numbers assigned during the field assessments and summarized in Section 4.3.1 of the *Watershed Characterization Report*. A description of key watershed characteristics is presented for each subwatershed including drainage area, stream length, population, land use/land cover, impervious cover, soils, and SWM facilities. Assessment results for neighborhoods, hotspots, institutions, illicit discharges, and stormwater conversions are also summarized for each subwatershed. Finally, a subwatershed management strategy including recommended citizen and municipal actions are presented at the end of each subsection.

Several of the assessment categories that were considered only examined a percentage of opportunities within a given subwatershed. These categories include hotspots and institutions. The objective of the assessments is to review a representative sample of the businesses and institutions in the watershed to identify the most likely opportunities to limit pollution sources and implement pollution reduction measures.

For example, because there are numerous operations that qualify as stormwater hotspots, not all could be individually evaluated during the uplands survey. The assessments are intended to represent common types of hotspot operations located throughout the watershed and help develop an overall strategy to encompass all hotspot operations.

4.3.1 Gwynns Falls

Gwynns Falls is the largest subwatershed in the Middle Gwynns Falls study area and is comprised largely of urban development (82% of the subwatershed area). The majority of the watershed is comprised of medium and high density residiential areas. Other urban uses include industrial, institutional, commercial, open urban, transportation and lower density residential. Forest (17%) makes up the remaining subwatershed area. Table 4-16 summarizes key subwatershed characteristics of Gwynns Falls.

Table 4-16: Key Subwatershed Characteristics – Gwynns Falls

Drainage Area	6164.9	acres	
	9.63	sq. mi.	
Stream Length	39.7	miles	
Population	40,577	(2000 Census)"	
Land Use/Land Cover		Very Low Density Residential:	1.3%
		Low Density Residential:	3.7%
		Medium Density Residential:	44.9%
		High Density Residential:	12.8%
		Commercial:	5.3%
		Industrial:	0.5%
		Institutional:	5.0%
		Open Urban:	6.9%
		Forest:	16.8%
		Agriculture:	0.4%
		Transportation	2.5%
Impervious Cover	23.3%	of watershed	
Soils		A Soils (low runoff potential):	6.3%
		B Soils:	25.9%
		C Soils:	48.7%
		D Soils (high runoff potential):	18.9%
		Water:	0.2%

4.3.1.1 Neighborhoods

A total of 60 distinct neighborhoods were identified and assessed within Gwynns Falls during the uplands assessment of Middle Gwynns Falls. Characteristics such as lot size, age, and type were used to delineate neighborhoods rather than subwatershed boundaries. As a result, some neighborhoods overlap multiple subwatersheds. Qualitative descriptions of neighborhoods and recommendations are included within the subwatershed restoration strategy for the subwatershed where the majority of the neighborhood resides. While descriptions are not repeated for neighborhoods overlapping multiple subwatersheds, calculations presented in the *Watershed Characterization Report* were based on the fraction of the NSA area within respective watersheds.

Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, rain gardens, storm drain marking, buffer improvement, tree planting, parking lot retrofits, street sweeping and public education (i.e., bayscaping, increasing lot tree canopy, and trash management). A summary of neighborhood recommended actions is presented in Table 4-17.

Table 4-17: NSA Recommendations – Gwynns Falls

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Trash Management	Buffer Improvement	# of Street Trees	# of Shade Trees	Parking Lot Retrofit	Street Sweeping	Notes
NSA_C_1	>1	X	X	X	X		X					0.4	
NSA_C_2	Multifamily	X		X	X	X				232			Open space for planting trees
NSA_C_3	1/8	X		X	X	X							
NSA_C_4	1/2	X	X		X	X		X					No inlets, drains directly to stream
NSA_C_5	1/4	X		X	X	X	X					0.3	Lots of sediment and nutrients draining from reservoir property
NSA_C_6	Multifamily	X		X	X	X							
NSA_C_7	<1/8		X	X	X	X					X	1.0	Land next to NSA is owned by Baltimore Co. and is a good opportunity for a BMP.
NSA_C_8	1/8	X	X	X	X	X							New houses being built in development
NSA_C_9	Multifamily	X				X				215	X		Potential for Bioretention in median area of Prairie Rose Place.
NSA_C_10	<1/4	X	X	X		X			72			5.6	Street tree planting on Scotts Level Rd.
NSA_C_11	Multifamily	X		X	X	X		X		30			Minor dumping on Weyanoke Ct.; Minor debris/sediment at inlet/curb
NSA_C_12	Multifamily	X	X	X	X	X				570	X	3.5	Many opportunities for tree planting and new BMP
NSA_C_13	1/2	X	X	X						35			Bus stop near NSA has potential for tree planting
NSA_C_14	Multifamily	X	X	X	X	X		X			X		Severe erosion in stream buffer. Apartment encroaches on stream. Potential for Grass swale between metro parking & Apt.;
NSA_C_15	Multifamily	X		X					8	41		1.2	Street tree planting on Molly Rd.
NSA_C_16	1/4	X		X	X	X			63				Street tree planting at end of Arrowhead Rd.
NSA_C_17	1/4	X		X	X	X			44				Street tree planting along Scotts Level Rd.
NSA_C_18	1		X	X		X							
NSA_C_19	Multifamily			X	X	X				49	X		Potential for Grass Swale
NSA_C_20	1/4	X	X	X	X	X			618			3.8	
NSA_C_21	<1/4	X	X	X	X	X		X		73			Open space tree planting or park creation at end of

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Trash Management	Buffer Improvement	# of Street Trees	# of Shade Trees	Parking Lot Retrofit	Street Sweeping	Notes
													Shamrock. owned by Baltimore Co.
NSA_C_22	1/8	X				X				89		1.8	Street sweeping recommended.
NSA_C_23	>1												Lots of landscaping and trees in community.
NSA_C_24	Multifamily		X	X	X	X				74	X		Potential for Grass swale along Dunhill Village Cir., Minor dumping behind dumpsters
NSA_C_25	1/8	X	X	X		X							
NSA_C_26	1/8	X							82	16			Street tree planting on Millford Mill Rd.
NSA_C_27	1/4	X		X	X	X			85				Street tree planting along one-side of Campfield Rd. and Sudbrook Rd.
NSA_C_28	1/3	X	X	X	X	X			52	9			Planting opportunity in medians off of Ricksway. Street tree planting on Leafydale Terrace, Leafydale Ct.
NSA_C_29	1/2	X	X										2 inlets in the entire NSA.
NSA_C_30	1/2		X	X				X	26				Street tree planting along Campfield. Houses encroaching on stream. Stream not completely forested.
NSA_C_31	1/2		X	X									Well maintained community.
NSA_C_32	1/4	X	X	X		X		X					Long-term cars parked on 7403 Allmont Rd. And 3322 Ripple Rd.
NSA_C_33	Multifamily			X	X	X				45			Some inlets are marked, but not all.
NSA_C_34	<1/4	X	X	X		X							
NSA_C_35	Multifamily		X	X	X	X	X	X		119	X	1.7	Potential for bioretention near playground (end of Rudsill Ct.)
NSA_C_36	1/4	X	X	X	X	X							
NSA_C_37	1/2	X	X	X				X	91				Street tree planting on Croydon Rd.
NSA_C_38	1/8	X	X	X	X	X			72	26			Open space planting along Marston Rd. Street tree planting along Croydon Rd.
NSA_C_39	1/8	X		X	X	X		X		126			Open space tree planting oppurtunity at Yataruba Dr. Stream buffer is not forested.
NSA_C_40	<1/4	X		X		X						4.3	Some inlets were stenciled with the new type of stencild.

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Trash Management	Buffer Improvement	# of Street Trees	# of Shade Trees	Parking Lot Retrofit	Street Sweeping	Notes
NSA_C_41	Multifamily	X		X	X		X			14	X		Potential for pavement removal. Dumping in several areas. Bioretention potential at end of Sunmar Court.
NSA_C_42	Multifamily	X		X		X				70		1.4	
NSA_C_43	1/4			X	X	X			56			3.9	Tree planting on one-side of Yararuba.
NSA_C_44	Multifamily	X		X				X		68	X		Bioretention potential at Townbrook dr. And Creastway Rd. Tree planting oppurtunity near pool at apartment complex.
NSA_C_45	<1/4	X	X	X						107			Median along Windsor Blvd good for tree planting. Open space along Oakside Cir.
NSA_C_46	Multifamily	X		X	X	X		X		96			Apartments are encroaching on stream and the stream is not buffered.
NSA_C_47	Multifamily			X	X					19			
NSA_C_48	Multifamily	X		X	X	X							
NSA_C_49	Multifamily	X		X	X					26	X		Grass or bioswale potential at end of Greenwich Place.
NSA_C_50	1/2	X	X	X	X			X					All around SWM facilities there is opportunities for tree planting
NSA_C_51	1/2	X		X		X						1.2	Some existing trees between sidewalk and roadway
NSA_C_53	1/8		X	X		X			88			3.1	Potential for tree planting on Clarendon Str. Inlets at p;der side of neighborhood filled with sediment and organic matter
NSA_C_63	<1/8	X		X	X	X			24	63		1.9	Open space tree planting at end of Robin Hill Rd. Part of Robin Hill Rd. Good for street tree planting.
NSA_C_64	1/8			X		X							Opportunity near school for SWM facility to treat parking lot.
NSA_C_65	1/8	X		X	X	X							
NSA_C_71	Multifamily	X		X	X	X		X	94	11			
NSA_C_72	1/8	X	X	X		X							
NSA_C_73	Multifamily	X		X	X			X	22	12	X	0.9	Concrete-lined stream is not buffered. Bioretention potential at Summit Ave.

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Trash Management	Buffer Improvement	# of Street Trees	# of Shade Trees	Parking Lot Retrofit	Street Sweeping	Notes
NSA_C_76	1/8				X	X							new community
NSA_C_77	1/8			X	X	X				35			

Over 45% of the neighborhoods in Gwynns Falls are recommended for rain gardens and public education related to increasing bayscaping and lot tree canopy. Most of the NSAs (75%) in Gwynns Falls were recommended for downspout disconnection; however for smaller lot sizes the most feasible disconnection method would be through the use of rain barrels to capture rooftop runoff. Over 85% of NSAs were recommended for storm drain marking. Fourteen (14) neighborhoods are recommended for buffer improvement that may be achieved through public education about the benefits of providing a stream buffer by reducing the amount of mowed lawn through tree and vegetation planting. Impervious cover removal is applicable at NSA_C_41 at the end of Sunmar Court. Other issues in Gwynns Falls neighborhoods included trash and necessity for street sweeping.

Parking lot retrofits are used to control stormwater runoff and prevent or reduce pollution through filtration. Eleven (11) neighborhoods were recommended for parking lot retrofits. Land next to NSA_C_7 is owned by Baltimore County and is a good opportunity for a BMP. Bioretention areas were recommended for NSA_C_9, NSA_C_12, NSA_C_35, NSA_C_41, NSA_C_44, and NSA_C_73. Grass swales or bioswales would work well for NSA_C_14, NSA_C_19, NSA_C_24, and NSA_C_49. Figure 4-3 shows the locations of potential stormwater retrofit opportunities at NSAs in Gwynns Falls.

Figure 4-3: Baltimore County Owned Land at NSA_C_7 (left) and Micro-Bioretention Oppurtunity near Playground at NSA_C_35 (right)

4.3.1.2 Hotspots

Nine (9) hotspot investigations were performed within Gwynns Falls. Table 4-18 summarizes the potential pollution sources found at each of the sites.

Table 4-18: HSI Results Summary – Gwynns Falls

HSI_ID	HSI Status*	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_C_101	Confirmed	Commercial	Gas Station	X	X	X	X	X	X	55-gal on grass; dumpster leaking
HSI_C_102	Potential	Transport-Related	Metro Stop Parking Lot	X		X		X		dumpster staining; trash; staining at bus stop
HSI_C_103	Potential	Commercial	Gas Station	X		X	X	X		Dumpster Trash spilled
HSI_C_104	Potential	Commercial	Gas Station	X		X	X	X		Fuel station uncovered; Dumpster trash spilled
HSI_C_105	Severe	Commercial	Gas Station and Car Care	X	X	X	X	X		55-gal drums on grass and leaking; haz mat; stored; cars leaking
HSI_C_106	Confirmed	Commercial	Gas Station and Car Care	X	X	X				55-gal drums outside, car staining
HSI_C_107	Not	Animal Facility	Animal Hospital			X				Parking lot poor; exc. imp.; dumpster lid open
HSI_C_108	Potential	Commercial	Car Wash	X		X		X		Parking lot full of stains; trash in gutters; dumpster to inlet; wash water to drains
HSI_C_109	Potential	Commercial	Gas Station	X	X	X				Dumpster Trash; 55-gal; outdoor propane

HSI_C_101 is a gas station facility located off of Reistertown Road in the Gwynns Falls subwatershed. Potential pollution activities include vehicle operations, and management of outdoor materials and waste. Vehicle operations at the site include fueling stations, which are covered. Specific observations made at this site include leakage from dumpsters and 55-gallon drums sitting directly on grass adjacent to the building.

HSI_C_102 is a 9.5 acre metro stop located off of Old Court Road. Potential pollution sources at this hotspot include vehicle operations and management of waste. Leakage from dumpsters, garbage and evidence of staining at the bus stop were observed at this site. Storm drain marking was evident for some storm drains in the parking lot area. Figure 4-4 illustrates the significance of the leakage from the dumpsters along with an example of storm drain marking at this site.

Figure 4-4: Leaking Dumpster (left) and Storm Drain Marking (right) at HSI_C_102

HSI_C_103 is a gas station facility located off of Liberty Road in the Gwynns Falls subwatershed. Potential pollution activities include vehicle operations and management of waste and turf/landscaping areas. Vehicle operations at the site include fueling stations, which are covered. Dumpsters at the site appeared to be leaking and were uncovered/overflowing, and minor staining was seen on pavement areas. Education and outreach at similar transport-related facilities would help address these potential pollution sources.

HSI_C_104 is a gas station facility located off of Liberty Road in the Gwynns Falls subwatershed. Vehicle operations, waste management, and the physical plant were noted at the hotspot. Vehicle operations at the site include both gas and diesel fueling stations. The diesel fueling stations was uncovered. In addition, dumpsters at the site were uncovered, garbage was observed and heating fuel for the building was uncovered.

HSI_C_105 is a gas station and car repair facility located off of Reisterstown Road in the Gwynns Falls subwatershed. Vehicle operations, waste management, storage of outdoor materials, and the physical plant were noted as potential pollutant sources at the hotspot. Vehicle operations at the site include fueling stations and car storage. The fueling stations are covered; however the cars being stored at the site are uncovered. Staining and the deteriorating condition of the parking lot were noted. In addition, multiple unmarked and uncovered rusted drums were being stored on the grass, dumpsters at the site were uncovered and leaking, downspouts were discharging to impervious areas, and garbage around the site was observed. Facilities that conduct car repairs are recommended to be educated on proper containment of pollutants used during its physical processes to prevent leaks from reaching storm drain networks and surface waters. Figure 4-5 illustrates the unmarked and uncovered drums that were being stored directly on the grass at this site.

Figure 4-5: Evidence of Unlabeled Barrels at HSI_C_105

HSI_C_106 is a gas station and car repair facility located off of Reisterstown Road in the Gwynns Falls subwatershed. Potential pollution activities include vehicle operations, storage of outdoor materials and management of waste. Vehicle operations at the site include fueling stations, which are covered. Staining of the parking lot and the storage of barrels outside were noted.

HSI_C_107 is an animal hospital located off of Reisterstown Road in the Gwynns Falls subwatershed. This hotspot is not a confirmed hotspot. The only pollution activity noted was waste management. The parking lot is in poor condition and dumpsters were observed uncovered along with evidence of staining on the ground.

HSI_C_108 is a car wash facility off of Reisterstown Road. At this hotspot, wash water from the car bays was draining out of the facility and directly to a nearby storm drain. This facility and other car washes should be inspected to ensure that illicit discharges such as wash water are contained and appropriately directed to the sanitary sewer as opposed to the storm sewer network. Also noted was substantial parking lot staining, trash in gutters, and dumpsters at the site draining directly to storm drains.

HSI_C_109 is a gas station facility located off of Reisterstown Road in the Gwynns Falls subwatershed. Potential pollution activities include vehicle operations, storage of outdoor materials, and waste management. Vehicle operations at the site include fueling stations, which are covered. Uncovered dumpsters at the site appeared to be leaking, and parking lot was deteriorating. In addition, a rusted 55-gallon drum was empty and uncovered near the dumpster and trash was observed around the vacuum and dumpster. Figure 4-6 exemplifies the trash around the dumpster and the 55-gallon drum rusting behind the dumpster.

Figure 4-6: Trash around Dumpster (left) and Rusted 55-Gallon Uncovered Drum (right) at HSI_C_109

4.3.1.3 Institutions

Nine (9) public and sixteen (16) private institutional sites were assessed for retrofit opportunities in Gwynns Falls during the uplands assessment of Middle Gwynns Falls. Table 4-19 summarizes recommendations for the institutional sites assessed in Gwynns Falls.

Table 4-19: ISI Recommendations – Gwynns Falls

Site ID	Name	Public/ Private	Nutrient Management	# Trees for Planting	Stormwater Retrofit	Downspout Disconnection	Impervious Cover Removal	Trash Management	Storm Drain Marking	Buffer Improvement	Notes
ISI_C_101	Ner Israel Rabbinical College	Private		476				X			Hazardous Mat.
ISI_C_102	Woodhome Country Club	Private	X	796				X	X	X	Unprotected stockpiles by buffer
ISI_C_103	North Oaks Retirement Community	Private		156				X	X		"Grease" Dumpster Leaking
ISI_C_104	Winand Elementary School	Public		245	X			X	X		
ISI_C_105	Old Court Middle School	Public		128	X			X	X		Dumpster Leaking into inlet
ISI_C_106	Courtland Gardens Nursing Center	Private							X		New Ex. SWM; Newly planted
ISI_C_107	Blessed Trinity Church Of Deliverence	Private		9		X					
ISI_C_108	Talmudical Academy Of Baltimore	Private		43	X	X	X	X	X		Drains clogged
ISI_C_109	St Paul's Evangelical Lutheran Church	Private		29		X			X		

Site ID	Name	Public/ Private	Nutrient Management	# Trees for Planting	Stormwater Retrofit	Downspout Disconnection	Impervious Cover Removal	Trash Management	Storm Drain Marking	Buffer Improvement	Notes
ISI_C_110	Milford Mill United Methodist Church	Private		140		X					
ISI_C_111	Bedford Elementary & Sudbrook Magnet Middle School	Public		103	X			X	X		
ISI_C_112	Hebbville Elementary School	Public		297	X		X	X	X		
ISI_C_113	Augsburg Lutheran Home And Village	Private		248				X	X		Leaking dumpster; 55-gal on grass; Construction materials present
ISI_C_114	Epworth United Methodist Chapel	Private		91		X			X		
ISI_C_115	Woodmoor Elementary School	Public		230				X	X	X	Leaking Dumpster; Ex. SWM; buffer plantings
ISI_C_116	Rising Sun First Baptist Church	Private							X		Bare Soil
ISI_C_117	Woodlawn Middle School	Public		989	X		X	X			
ISI_C_118	Woodlawn Memorial Cemetary	Private		448				X	X	X	Planting at buffer; Dumpster trash
ISI_C_119	Pikesville Senior Center	Public		4		X		X			Dumpster spilled; poor landscaping
ISI_C_120	St Charles Borromeos	Private			X			X	X		
ISI_C_121	Woodlawn Police Precinct 2	Public		19				X	X	X	Buffer planting; concrete stream
ISI_C_122	Woodlawn Senior Center	Public		39			X	X	X	X	Buffer planting; concrete stream
ISI_C_123	St Lukes Church	Private		8		X			X		
ISI_C_124	Ethiopian Orthodox Tewahdo Mekane	Private				X		X			Heating Oil Tank in Grass; Disconnect
ISI_C_125	Senior Center - Windsor Mill Road	Private		5				X			Dumpster Overflowing; Parking Lot breaking up

The twenty-five (25) institutions assessed in Gwynns Falls consist of a private college, a private country club, six (6) nursing homes/senior centers, three (3) public elementary schools, three (3) middle schools, eight (8) faith-based facilities, a private cemetery, a public police precinct, and a private academy serving kindergarten through high school. The majority of the sites showed evidence for the need for trash management education and storm drain marking while 80% of the institutional sites had opportunities for tree planting. Seven (7) institutional sites had opportunities for stormwater retrofits.

Impervious cover removal was recommended at four (4) sites. Buffer improvements are recommended at five (5) institutions which can be achieved through public education about the benefits of providing a stream buffer by reducing the amount of mowed lawn through tree and vegetation planting.

As noted previously, four institutions were noted as having the potential for removal of impervious surfaces. At ISI_C_108, there is a large parking-lot at the northern portion of the site that has portions that appeared unused. There is potential for removal or replacement with a porous surface to a large portion of the parking area. There is a gravel parking area along the western side of Washington Avenue at ISI_C_112 that could be removed.

At a public middle school (ISI_C_117), two areas of under-utilized pavement were observed that could be removed. A deteriorated track runway and jump pit could be removed in addition to a impervious pad on the northern side of the school building (Figure 4-7). An underutilized parking lot can potentially be removed or replaced with a porous paving surface at ISI_C_122. This parking lot is located on the northern portion of the site and is shown in Figure 4-7.

Figure 4-7: Impervious Removal Potential for ISI_C_117 (left), ISI_C_122 (right)

At ISI_C_104, a public school, two parking lots located at the northwest and eastern sides of the school drain curb and gutter systems and eventually to storm drain inlets. Both of these facilities were adjacent to turf areas that were lower in elevation and suitable for the placement of bioretention area facilities. Runoff from the tennis court facility is directed to a concrete channel that outlets into the adjacent grass field. A swale could be installed at this location to provide runoff treatment or a level spreader installed to encourage sheet flow and eventual infiltration within the grassed field downstream. Figure 4-8 provides a view of one of the parking lots along with the outlet for the tennis court facility.

ISI_C_105 is also a public school with potential for treatment of parking lot runoff. The parking lot on the southeastern side of the school currently drains to storm inlets which could be redirected to a flat grass shelf just below the parking area for the construction of a bioretention area. The parking area in the front of the school has the potential for redirection of flow into a bioretention area next to the northeastern entrance.

Figure 4-8: Potential Parking Lot Treatment (left) and Tennis Court Drainage Outlet (right) at ISI_C_104

At ISI_C_108, runoff drains from the southeast corner to northwest corner of the parking lot. This parking lot was also recommended for impervious cover removal and/or replacement with pervious pavers. Another solution for this parking lot would be the addition of a bioswale in the middle of the parking lot where parking spaces were not utilized. This location could treat the upper-half of the parking lot. Also, a micro-bioretention facility could be placed in the northwest corner to treat the rest of the runoff.

At ISI_C_111, the school bus loop and nearby parking lot were recommended for retrofits. At this site, runoff drains from northeast to southwest. There is a large grassy area at the end of the bus loop and western side of the parking lot that could accommodate the construction of bioretention areas. Also, the parking lot could benefit from a bioswale or bioretention area along the southern side. Figure 4-9 provides a view of two locations along the existing curb at these locations where existing inlets could be removed and runoff directed to a treatment device.

Figure 4-9: Potential Locations for Removal of Curb Inlets and Construction of Stormwater Retrofits at ISI_C_111

At ISI_C_112, the bus loop's grassed island could be converted into a bioretention area and the parking lot could benefit from a micro-bioretention.

At ISI_C_117, two parking lots were recommended for retrofits. A storm drain inlet present in the parking lot adjacent to the middle school could be converted to a bioretention facility. Grassed islands in the parking lot at the front of the school can be converted to bioswales.

At ISI_C_120, the parking lot drains from northeast to southwest, and runoff is then conveyed by curb/gutter to the storm drain system. Bioswales and bioretenation facilities could be created to treat the parking lot. Figure 4-10 provides a view of the potential retrofit areas at three (3) institutions.

Figure 4-10: Stormwater Retrofit Potential at ISI_C_111 (left), ISI_C_112 (center), and ISI_C_120 (right)

4.3.1.4 Illicit Discharges

Baltimore County tracks illicit discharges through a program of routine screening at major outfalls. The County uses a prioritization system based on this data where outfalls are assigned one of the following priority ratings: none (priority 0), low (priority 3), high (priority 2), critical (priority 1). Priority 1 outfalls have major problems that require immediate correction and/or close monitoring, or have recurring problems. These outfalls are sampled four times each year. Priority 2 outfalls have moderate to minor problems with the potential to become more severe. These are sampled once a year. Priority 3 outfalls have minor to no problems and are monitored on a 10-year cycle. Priority 0 outfalls lack sufficient data to determine a priority rating. More information on Baltimore County's Illicit Discharge Elimination program can be found in Section 3.4.4 of the *Watershed Characterization Report*.

Gwynns Falls contains three (3) Priority 1 outfalls which indicate major or reoccurring problems that require either immediate action or close monitoring. This subwatershed also contains seven (7) Priority 2 outfalls, twenty-six (26) Priority 3 outfalls, and eight (8) Priority 0 outfalls. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

4.3.1.5 Stormwater Conversions

Seven (7) detention ponds were assessed in Gwynns Falls and are summarized inTable 4-20.

Table 4-20: Detention Pond Conversion - Gwynns Falls

Site ID	Riser	Embankment	Vegetation	Fence Condition	Gate Condition	Water Quality Potential	Access	Flow Path	Connection	Horizontal Expansion Potential	Vertical Expansion Potential
SWM_C_441	Minor Maint.	Trees	Trees	Good	Locked	X	Easy	Short	Off	X	
SWM_C_651	Good	Trees	Wetland Veg.	Good	Unlocked		Easy	Long	Off		
SWM_C_715	Good	Trees	Turf	None	None	X	Easy	Short	Off		
SWM_C_738	Good	Trees	Wetland Veg.	Repairs Needed	None		Moderate	Short	Off	X	X
SWM_C_967	Damaged	Holes	Wetland Veg.	Good	Locked	X	Easy	Long	On		
SWM_C_984	Good	Erosion	Wetland Veg.	Repairs Needed	Unlocked	X	Easy	Long	On		
SWM_C_1652	Good	Trees	Wetland Veg.	None	None		Easy	Short	Off	X	X

SWM_C_441 is a publicly owned facility located at the intersection of Spring Mill Circle and Woodgreen Circle. This pond is designed to handle runoff from the 2- and 50-year events from 13.3 acres of residential development. Retrofit recommendations at this facility include the construction of a micropool at the pipe outfall at the bottom of the facility. In addition, if needed, there is potential for horizontal expansion at the south side of the pond to facilitate conversion to an extended detention facility. Figure 4-11 provides photographs of the impervious driveway access and vegetation issues at SWM_C_441.

Figure 4-11: Impervious Access Road (left) and Trees, Trash near Riser (right) at SWM_C_441

SWM_C_651 is a publicly owned facility located at the end of Lawnwood Circle. This pond is designed to handle runoff from the 2-, 10-, and 100-year events from 47.1-acres of residential development. This facility was not recommended for a water quality conversion but maintenance issues include the need for invasive species management, tree removal from the embankment, and removal of sediment outlet protection at the inflow pipe.

SWM_C_715 is a privately-owned facility located at the end of Janper Court. This pond is designed to handle runoff from the 2-, 10-, and 100-year events from 18.96 acres of apartment development. This pond was recommended for several water quality retrofits including construction of micro-pools at the inflow channels and analysis of decreasing the size of the 18" low-flow orifice to increase detention times. Figure 4-12 shows a photograph of the riser structure along with the flow paths towards that structure.

Figure 4-12: Riser with 18" Low Flow Pipe (left) and Grass Swale Leading to Riser (right) at SWM_C_715

SWM_C_738 is a publicly owned facility located at the intersection of Panacea Road and Bonnie Brae Road. This pond is designed to handle runoff from the 2-, 10-, and 100-year events from 16.62 acres of residential development. This pond was not recommended for water quality retrofits due to expansion constraints. Several maintenance actions are recommended including perimeter fence repair, tree removal, and upgrades to the low-flow channel.

SWM_C_967 is a publicly owned facility located off of Northmont Road. This pond is designed to handle runoff from the 2-, 10-, and 100-year events from 52.80 acres of residential development. This facility treats a large drainage area and was reported to have flowing water at most times of the year. This facility should be investigated to determine if the reported drainage area is accurate. The large area could allow the installation of pretreatment forebay at pond inflow channel that could flow into shallow wetlands and then into a deep micropool in front of riser with submerged reverse slope low flow pipe.

Figure-4-13: Invasive Species (left) and Control Structure (right) at SWM_C_967

SWM_C_984 is a publicly owned facility located subwatershed off of Windmill Circle. This pond is designed to handle runoff from the 2-, 10-, and 100-year events from 41.61 acres of residential development. This pond also has a very large drainage area which could allow the possibility of the installoation of pretreatment forebays, shallow wetlands, and deep micropools. In addition, the flow path is long but travels directly to the pond outfall. This path could be altered into more of a meandering planted channel to treat low flow volumes. Maintenance recommendations include the removal of downed branches blocking the inflow pipe.

Figure-4-14: Down Tree Branches at Pond Outfall (left) and Low Flow Channel (right) at SWM_C_984

SWM_C_1652 is a publicly owned facility located at the end of Metree Way. This pond is designed to handle runoff from the 2-, 10-, and 100-year events from 10 acres of residential development. This pond was not recommended for water quality retrofits due to expansion constraints. Maintenance recommendations include the removal and trees from the pond bottom and embankment along with treatment for animal burrows.

4.3.1.6 Proposed Water Quality Management Plan Projects

In 2004, Baltimore County, in conjunction with Baltimore City, completed an assessment of the entire Gwynns Falls watershed, the *Gwynns Falls Water Quality Management Plan* (DPW & DEPRM, 2004). To develop the report, a complete assessment of the watershed was performed including water quality modeling, stream stability assessments, forest assessments, and stormwater management assessments. These assessments were used to develop a catalog of over 120 water quality retrofit and/or improvement projects for the entire watershed. Table 4-21 provides a summary of eleven (11) potential projects in the Gwynns Falls subwatershed. More in depth descriptions of each of the projects can be found in Appendix K.

Table 4-21: Proposed WQMP Projects in the Gwynns Falls Subwatershed

Project Number	Subwatershed	Ownership	Project Type	Estimated Cost (2004 $s)*	Description
GFM-02	Gwynns Falls	Private	Riparian Buffer Enhancement	$43,250	RBE: 500 L.F. and 100 FT width
GFM-03	Gwynns Falls	Public	Riparian Buffer Enhancement	$90,000	RBE: 1,200 L.F. and 100 FT width
GFM-04	Gwynns Falls	Public	Riparian Buffer Enhancement	$90,000	RBE: 1,200 L.F. and 100 FT width
GFM-05	Gwynns Falls	Public	Riparian Buffer Enhancement & Stream Stabilization	$186,500	RBE: 1,100 LF and 100 FT width SS: 1,000 LF
GFM-06	Gwynns Falls	Private, Potentially Public Drainage Way	Riparian Buffer Enhancement & Stream Stabilization	$142,300	RBE: 750 LF and 100 FT width SS: 750 LF
GFM-07	Gwynns Falls	Private, Potentially Public Drainage Way	Riparian Buffer Enhancement & Stream Stabilization	$554,600	RBE: 700 LF and 100 FT width SS: 2,000 LF
GFM-08	Gwynns Falls	Private, Potentially Public Drainage Way	Outfall Retrofit & Stream Stabilization	$145,000	OR: Apron Repair & Energy Dissipator SS: 300 LF
GFM-09	Gwynns Falls	Private	Stream Stabilization	$155,000	SS: 500 LF
GFM-10	Gwynns Falls	Private Access Easement Required	SWM Conversion	$225,800	Conversion of SWM Pond to Extended Detention
GFM-15	Gwynns Falls	Private Access Easement Required	Outfall Retrofit & Stream Stabilization	$158,600	OR: Stilling Basin for Energy Dissipator SS: 300 LF
GFM-16	Gwynns Falls	Private Access Easement Required	Outfall Retrofit & Stream Stabilization	$130,000	OR: Stilling Basin for Energy Dissipator SS: 150 LF

4.3.1.7 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-17 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-17.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees.
4. Educate citizens about the benefits and importance of proper lawn care and bayscaping.
5. Educate citizens of neighborhoods indicated in Table 4-17 on proper trash management.

Municipal Actions

1. Investigate the potential for the installation of stormwater retrofits to the neighborhoods listed in Table 4-17.
2. Coordinate the installation of street trees within the public right-of-way and shade tree plantings in common areas of the neighborhoods listed in Table 4-17.
3. Begin street sweeping operations at the neighborhoods listed in Table 4-17.
4. Work with the HSIs indicated in Table 4-18 and similar businesses to implement appropriate practices for vehicle operations, outdoor materials storage and management of waste, their physical plant, landscapes, and stormwater.
5. Conduct tree plantings and impervious cover removal at the institutional sites list in Table 4-19. Educate those institutions that were noted for buffer improvements on the benefits of forested stream buffers.
6. Investigate the potential for installation of stormwater retrofits and conduct programs to provide install storm drain markings at the facilities in Table 4-19.
7. Provide education to institutions indicated in Table 4-19 on proper nutrient and waste management.
8. Investigate the potential to perform water quality conversion retrofits to dry detention ponds SWM_C_441, SWM_C_715, SWM_C_967, and SWM_C_984.
9. Perform needed maintenance to the dry detention stormwater facilities listed in Table 4-20.
10. Implement recommended water quality improvement projects recommended in Table 4-21 from the *2004 Gwynns Falls Water Quality Management Plan.*

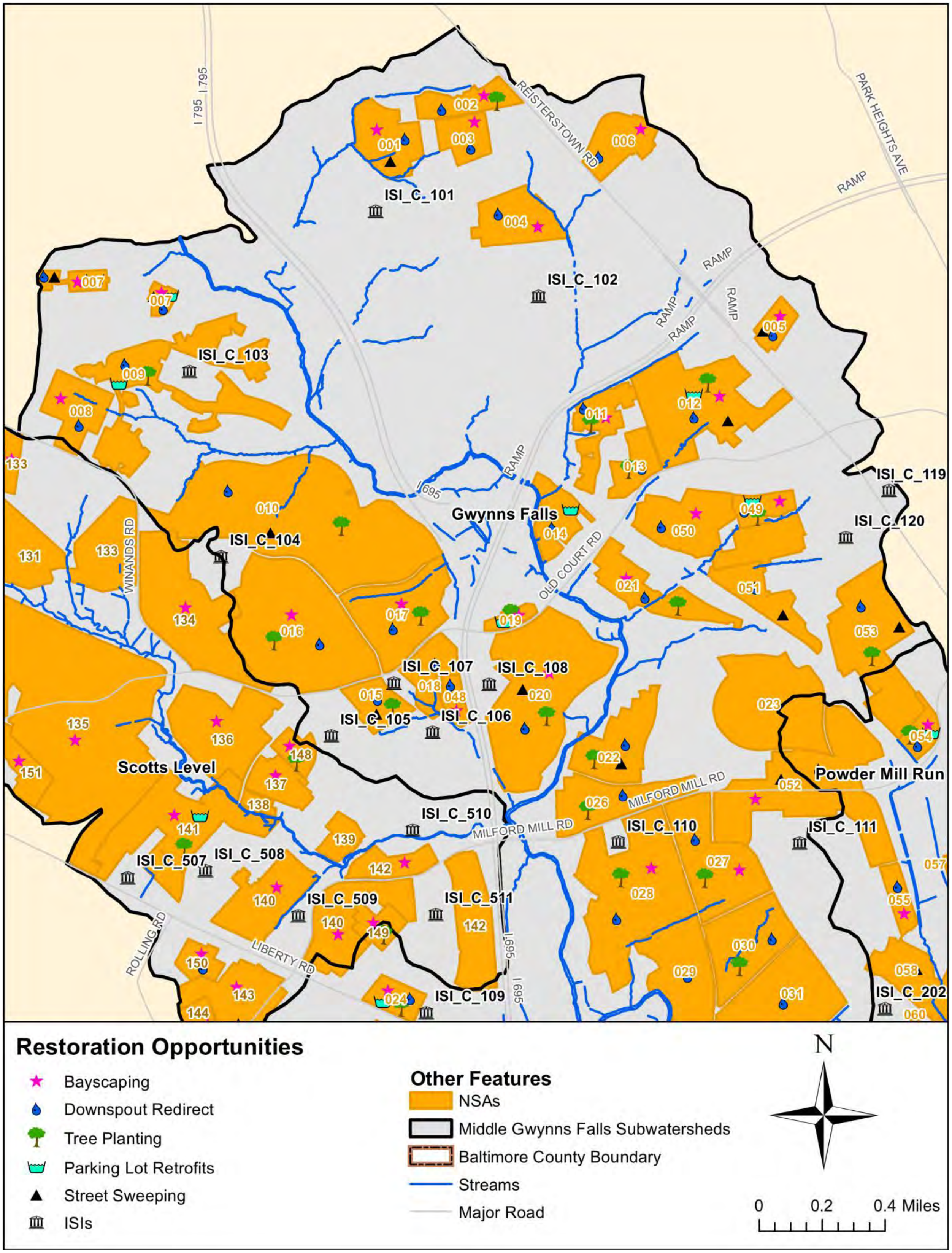

Figure 4-15: Restoration Opportunities in Northern Portion of Gwynns Falls

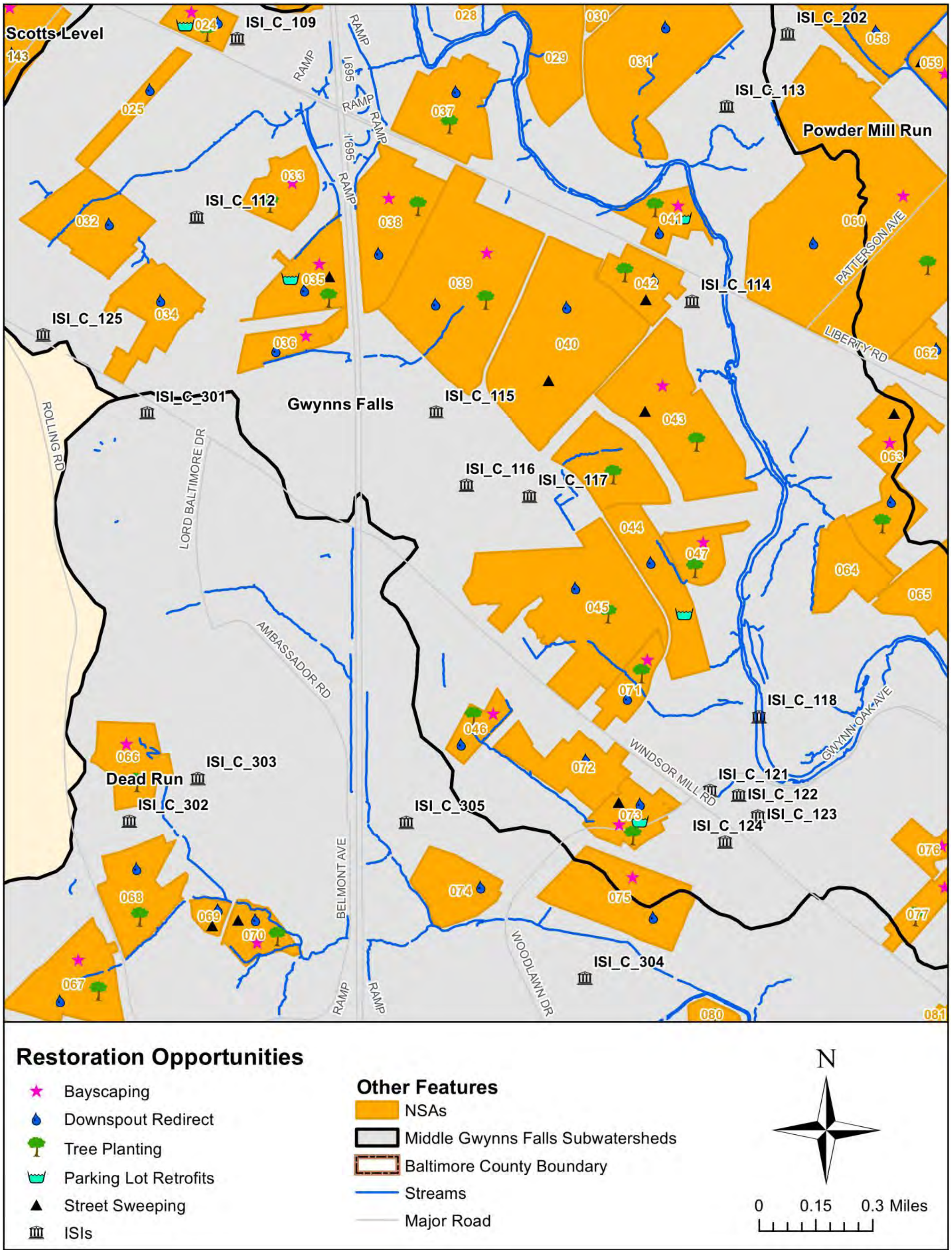

Figure 4-16: Restoration Opportunities in Southern Portion of Gwynns Falls

4.3.2 Powder Mill Run

Powder Mill Run is the fourth largest subwatershed in the Middle Gwynns Falls study area. 84% of Powder Mill Run is occupied by urban development including institutional, commercial, open urban, transportation and residential uses. Residential uses comprise 68% of the watershed area. The remaining subwatershed area is classified as forest. Table 4-22 summarizes key subwatershed characteristics of Powder Mill Run.

Table 4-22: Key Subwatershed Characteristics – Powder Mill Run

Drainage Area	958.0	acres	
	1.50	sq. mi.	
Stream Length	6.0	miles	
Population	7,651	(2000 Census)"	
Land Use/Land Cover	Very Low Density Residential:		0.0%
	Low Density Residential:		2.3%
	Medium Density Residential:		52.5%
	High Density Residential:		13.3%
	Commercial:		3.5%
	Industrial:		2.9%
	Institutional:		5.3%
	Open Urban:		1.4%
	Forest:		15.8%
	Agriculture:		0.0%
	Transportation		3.1%
Impervious Cover	24.9%	of watershed	
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		9.8%
	C Soils:		58.2%
	D Soils (high runoff potential):		32.0%
	Water:		0.0%

4.3.2.1 Neighborhoods

A total of ten (10) distinct neighborhoods were identified and assessed within Powder Mill Run during the uplands assessment of Middle Gwynns Falls. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, rain gardens, buffer improvement, tree planting, parking lot/alley retrofits, street sweeping and public education (i.e., bayscaping, storm drain marking, increasing lot tree canopy, pet waste management and trash management). Eight (8) NSAs fall into the area of high concern for environmental justice. Restoration opportunities at these neighborhoods should be prioritized highly. A summary of neighborhood recommended actions is presented in Table 4-23. Neighborhoods falling into the area of high concern for environmental justice are indicated with an asterisk beside their NSA ID.

Table 4-23: NSA Recommendations – Powder Mill Run

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Pet Waste Management	Trash Management	Buffer Improvement	# of Street Trees	# of Shade Trees	Parking Lot Retrofit	Alley Retrofit	Street Sweeping	Notes
NSA_C_52	1/8		X	X	X	X								4.7	
NSA_C_54	Multifamily	X		X	X	X		X		102	26	X			Opportunity for tree planting and SWM Facility.
NSA_C_55*	1/4		X		X										
NSA_C_56*	1/8			X	X	X		X		33				0.5	Tree planting on Brookmill Rd. Backyards have debris/trash. Residents are storing property outside.
NSA_C_57*	Multifamily		X	X	X	X				33	238	X	X		Alley retrofit behind apartments on Millbrook. Parking lot retrofit for Cobblestone Ct. with a good BMP location across from parking lots.
NSA_C_58*	1/4	X	X	X	X	X			X					3.7	
NSA_C_59*	1/8	X	X	X	X	X								1.3	Remove sediment and debris from gutters.
NSA_C_60*	1/8	X		X	X	X	X			62					Some inlets are stenciled, but worn off.
NSA_C_61*	<1/4		X	X	X	X									New development under construction.
NSA_C_62*	1/8	X		X		X									

Most of the neighborhoods in Powder Mill Run are recommended for public education related to bayscaping, increasing lot tree canopy, and storm drain marking. One (1) neighborhood, NSA_C_58, is recommended for buffer improvement that may be achieved through public education about the benefits of providing a stream buffer by reducing the amount of mowed lawn through tree and vegetation planting. NSA_C_54 and NSA_C_57 are classified as multifamily apartments and present opportunities for parking lot and alley retrofits through installation of bioretention areas near parking lots to provide treatment areas. Additionally, at NSA_C_57 there is an old abandoned parking lot that is a good candidate for either impervious cover removal or conversion into a best management practice to treat runoff (Figure 4-17).

Figure 4-17: Street Sweeping at NSA_C_55 (left) and Potential Impervious Cover Removal or BMP practice at NSA_C_57 (right).

Other issues encountered in Powder Mill Run included pet waste, trash, and sediment and debris in gutters. One (1) neighborhood, NSA_C_60, was recommended for public education related to pet waste. Two (2) neighborhoods, NSA_C_54 and NSA_C_56 were recommended for public education related to trash management. Street sweeping was recommended for NSA_C_52, NSA_C_56, NSA_C_58, and NSA_C_59 (Figure 4-17).

4.3.2.2 Hotspots

Three (3) hotspot investigations were performed within Powder Mill Run. The assessments include a car repair shop, metro stop parking lot, and a car dealership. Table 4-24 summarizes the potential pollution sources found at this site.

Table 4-24: HSI Results Summary – Powder Mill Run

HSI_ID	HSI Status*	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_C_201	Confirmed	Commercial	Car Repair	X	X	X	X			Used oil container with stains on lot; lot breaking up
HSI_C_202	Potential	Transport-Related	Metro Stop Parking Lot	X		X	X	X	X	Potential impervious removal; staining at bus stop; dumpster leaking
HSI_C_203	Potential	Commercial	Car Dealership	X	X	X	X			Uncovered heating oil; materials stored outside

HSI_C_0201 is a car repair center located off of Reisterstown Road in Powder Mill Run. Potential pollution sources at this hotspot include vehicle operations, storage of outdoor materials, physical plant management, and management of waste. The parking lot showed evidence of stains and much of it was deteriorating. Downspouts at the car repair shop were also observed to be discharging directly to impervious cover. Recommendations at this site include future education on proper waste and materials management.

HSI_C_0202 is a 42.5 acre metro stop located off of Roman Frasier Lane. Potential pollution sources at this hotspot include vehicle operations, physical plant management, turf/landscaping management, and management of waste. Open dumpsters and evidence of staining at the bus stop were observed at this site. HSI_C_0202 could benefit from impervious cover removal and stormwater retrofits. Potential stormwater retrofit sites were identified around the parking lot to treat runoff with bioretention areas. Storm drain marking was evident for some storm drains in the parking lot area. Figure 4-18 illustrates the significance of the staining at the bus stop along with the extent of the impervious area that could be treated with stormwater retrofits.

Figure 4-18: Staining at Bus Stop (left) and Impervious Surface (right) at HSI_C_0202

HSI_C_0203 is a car dealership located off of Liberty Road. Potential pollution sources at this hotspot include vehicle operations, and management of waste and outdoor materials. The parking lot appeared to have been recently re-sealed and in good condition. Open dumpsters, uncovered heating oil, and evidence of uncovered materials stored outside were observed at this site.

4.3.2.3 Institutions

Two (2) public institutional sites were assessed for retrofit opportunities in Powder Mill Run during the uplands assessment of Middle Gwynns Falls. Table 4-25 summarizes recommendations for institutional sites assessed in Powder Mill Run.

Table 4-25: ISI Recommendations – Powder Mill Run

Site ID	Name	Public/ Private	# Trees for Planting	Stormwater Retrofit	Impervious Cover Removal	Trash Management	Storm Drain Marking	Notes
ISI_C_201	Maryland State Police	Public	97			X	X	
ISI_C_202	Campfield Early Childhood Learning & Development Center	Public	183	X	X	X	X	Dumpster overflowing

ISI_C_201 is a Maryland State Police facility off of Milford Mill Road. Recommendations for water quality projects at this institution include education on proper trash management and storm drain marking. In addition, several tree planting areas were noted around the parking and driveway area on the front and back of the institution. An existing stormwater retrofit was identified that treats sheet flow with a grass-lined buffer. In addition, minor grass clippings were observed in the parking lot and dumpster lid was open.

ISI_C_202 is an early childhood learning and development center off of Alter Road. Recommendations for water quality projects at this institution include stormwater retrofit, impervious cover removal, and education on proper trash management and storm drain marking. In addition, a large tree planting area was noted around the back of the institution near the playground. A grassed area below the parking on the northeast side of the development center could be retrofit with a bioretention area or bioswale to collect runoff from the parking area. The parking lot was noted as stained and breaking-up in parts. There is excessive impervious cover area in the back of the development center that appeared unused and could potentially be removed. Overflowing dumpsters with stains leading to clogged inlets were evident at the institution. Figure 4-19 shows opportunities for impervious cover removal and tree plantings.

Figure 4-19: Potential Impervious Cover Removal (left) and Tree Planting Opportunity (right) at ISI_C_202

4.3.2.4 Illicit Discharges

Powder Mill Run contains two (2) Priority 1 outfalls which indicate major or reoccurring problems that require either immediate action or close monitoring. This subwatershed also contains three (3) Priority 2 outfalls, three (3) Priority 3 outfalls, and two (2) Priority 0 outfalls. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

4.3.2.5 Stormwater Conversions

No dry detention pond assessments were conducted in Powder Mill Run.

4.3.2.6 Proposed Water Quality Management Plan Projects

As part of the 2004 *Gwynns Falls Water Quality Management Plan*, retrofit and water quality improvement projects were identified in each of the subwatersheds of the Middle Gwynns Falls. Table 4-26 provides a summary of three (3) potential projects in the Powder Mill Run subwatershed. More in depth descriptions of each of the projects can be found in Appendix K.

Table 4-26: Proposed WQMP Projects in the Powder Mill Run Subwatershed

Project Number	Subwatershed	Ownership	Project Type	Estimated Cost (2004 $s)*	Description
PM-01	Powder Mill Run	Mostly Public Open Space	Riparian Buffer Enhancement, Stream Stabilization & Restoration	$701,261	RBE: 2,000 LF SR: 1,440 LF
PM-02	Powder Mill Run	Mostly Public Open Space	Riparian Buffer Enhancement, Stream Restoration & Stabilization, BMP Creation	$526,200	RBE: 950 LF SR: 490 LF
PM-03	Powder Mill Run	Private	Riparian Buffer Enhancement, Stream Stabilization & Utility Protection	$305,500	RBE: 2,050 LF SR: 350 LF

4.3.2.7 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-23 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-23.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees. Educate those neighborhoods that were noted for buffer improvements on the benefits of forested stream buffers.
4. Educate citizens about the benefits and importance of bayscaping and pet waste management.
5. Educate citizens of neighborhoods indicated in Table 4-23 on proper trash management.

Municipal Actions

1. Investigate the potential for the installation of stormwater retrofits to the neighborhoods listed in Table 4-23.
2. Coordinate the installation of street trees within the public right-of-way and shade tree plantings in common areas of the neighborhoods listed in Table 4-23.
3. Begin street sweeping operations at the neighborhoods listed in Table 4-23.
4. Work with the HSIs indicated in Table 4-24 and similar businesses to implement appropriate practices for vehicle operations, outdoor materials storage and management of waste, their physical plant, landscapes, and stormwater.
5. Conduct tree plantings and impervious cover removal at the institutional sites list in Table 4-25.
6. Investigate the potential for installation of stormwater retrofits and conduct programs to provide install storm drain markings at the facilities in Table 4-25.
7. Provide education to institutions indicated in Table 4-25 on proper waste management.
8. Implement recommended water quality improvement projects recommended in Table 4-26 from the *2004 Gwynns Falls Water Quality Management Plan.*

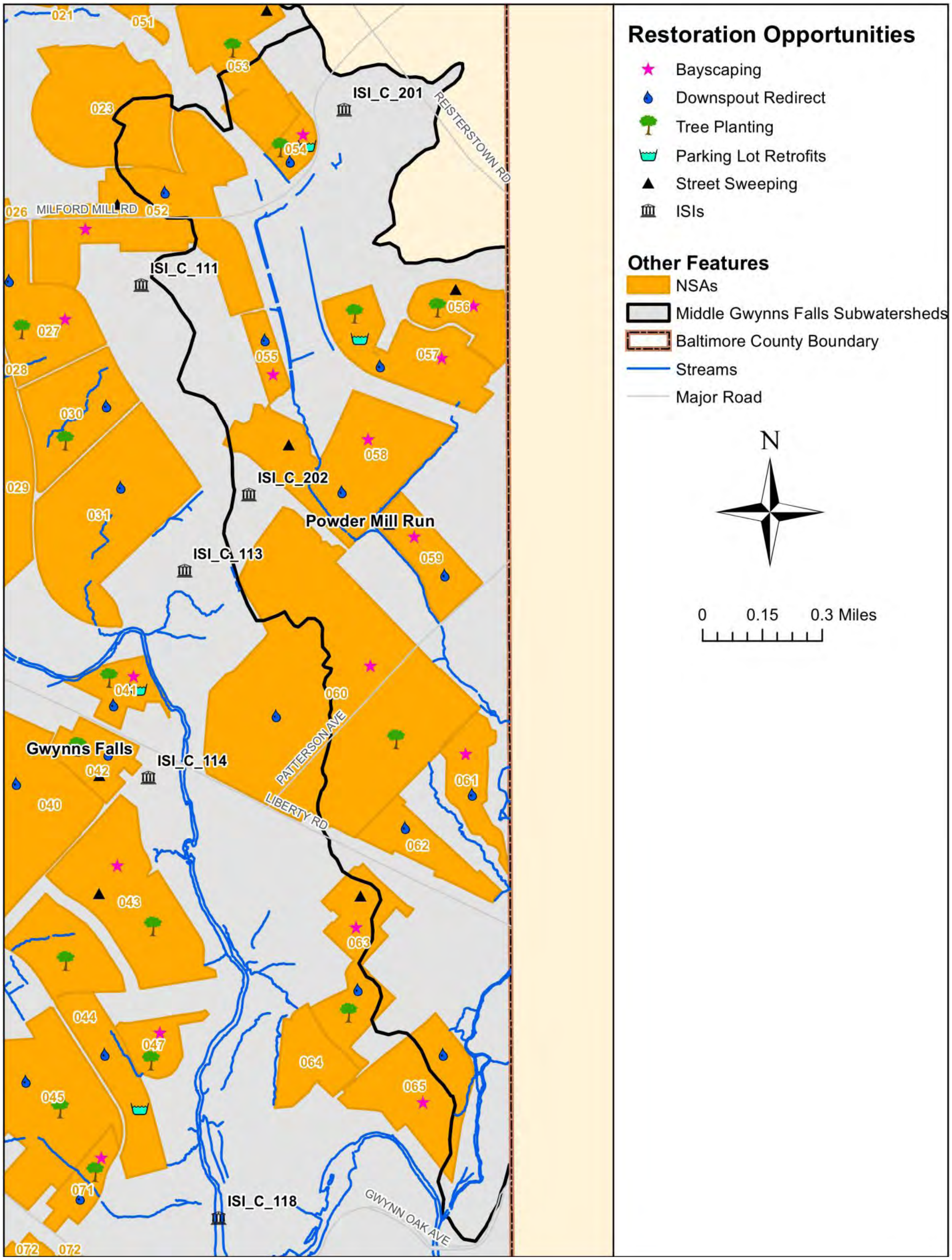

Figure 4-20: Restoration Opportunities in Powder Mill Run

4.3.3 Dead Run

Dead Run is the second largest subwatershed in the Middle Gwynns Falls study area. 92% of Dead Run is occupied by urban development including the highest percentages of commercial (14%), industrial (11%), and institutional (10%) coverage of any of the subwatersheds. In addition, 46% of the watershed is comprised of residential uses. The remaining subwatershed area is classified as forest, transportation, and open land. Table 4-27 summarizes key subwatershed characteristics of Dead Run.

Table 4-27: Key Subwatershed Characteristics – Dead Run

Drainage Area	4177.2	acres		
	6.53	sq. mi.		
Stream Length	18.2	miles		
Population	24,770	(2000 Census)"		
Land Use/Land Cover			Very Low Density Residential:	0.0%
			Low Density Residential:	2.0%
			Medium Density Residential:	23.8%
			High Density Residential:	20.4%
			Commercial:	14.0%
			Industrial:	11.1%
			Institutional:	9.9%
			Open Urban:	5.5%
			Forest:	8.1%
			Agriculture:	0.0%
			Transportation	5.1%
Impervious Cover	39.1%	of watershed		
Soils			A Soils (low runoff potential):	4.3%
			B Soils:	9.7%
			C Soils:	38.5%
			D Soils (high runoff potential):	47.6%
			Water:	0.0%

4.3.3.1 Neighborhoods

A total of thirty-two (32) distinct neighborhoods were identified and assessed within Dead Run during the uplands assessment of Middle Gwynns Falls. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, rain gardens, storm drain marking, buffer improvement, tree planting, parking lot retrofits, street sweeping and public education (i.e., bayscaping, increasing lot tree canopy, and trash management). A summary of neighborhood recommended actions is presented in Table 4-28.

Table 4-28: NSA Recommendations – Dead Run

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Trash Management	Buffer Improvement	# of Street Trees	# of Shade Trees	Parking Lot Retrofit	Street Sweeping	Notes
NSA_C_66	Multifamily			X	X	X		X		247			Stream buffer is not forested.
NSA_C_67	1/4	X		X	X	X		X	242				Entire NSA good for tree planting. Stream buffer partly vegetated and houses encroaching.
NSA_C_68	1/4	X	X	X		X			94				Street tree planting on Dogwood Rd. and Glen Spring Rd.
NSA_C_69	Multifamily	X		X		X						0.3	Street sweeping highly recommended.
NSA_C_70	Multifamily	X		X	X					57		0.8	Street sweeping highly recommended.
NSA_C_74	1/4		X	X		X							
NSA_C_75	<1/4	X		X	X	X							
NSA_C_78	1/8	X	X	X	X	X			542				
NSA_C_79	Multifamily	X		X	X	X				248	X		Apartments can do landscaping in front. Some areas of bare soil were noticed. Minor dumping near dumpsters.
NSA_C_80	1/4			X						85	X		Open space area for tree planting owned by Balt. Co. Bioretention potential at end of Sunny Ct.
NSA_C_81	1/8	X		X									Very old inlets.
NSA_C_82	Multifamily	X		X									Lids open at dumpsters. NSA has very good tree planting and landscaping.
NSA_C_83	Multifamily			X	X	X				68			Minor dumping in two areas.
NSA_C_84	<1/4		X	X	X	X			157				
NSA_C_85	1/8	X		X					150				
NSA_C_86	1/4		X			X			45	173			Open space for tree planting at Craigmont Rd. and Vida Dr. (owned by Baltimore Co.).
NSA_C_87	Multifamily	X				X	X			24	X		Opportunity for bioretention near parking lot. Minor dumping/trash around dumpster.
NSA_C_88	1/4			X									
NSA_C_89	Multifamily	X		X	X	X					X	0.7	
NSA_C_90	Multifamily	X			X	X	X		25	112		2.7	
NSA_C_91	1/8	X	X	X	X				395			11.8	Tree planting on Kent Ave, Southridge Rd, and Craigmont Rd.

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Trash Management	Buffer Improvement	# of Street Trees	# of Shade Trees	Parking Lot Retrofit	Street Sweeping	Notes
NSA_C_92	Multifamily					X				61			Trash around dumpsters. Dumpsters have no lids.
NSA_C_93	1/4	X		X	X	X		X					Inlets along Baltimore Street are stenciled (near Ingleside Ave.)
NSA_C_94	<1/8			X	X	X	X		72			1.0	Lots of trash and litter in Alley
NSA_C_95	<1/8	X		X		X			254			1.5	
NSA_C_96	<1/8	X		X		X			349				
NSA_C_97	1/8	X		X	X	X							
NSA_C_98	1/4		X	X	X				90				Tree planting on Chesworth Rd.
NSA_C_99	1/4	X	X	X		X	X			26		1.0	Some trash in yards.
NSA_C_100	1/4	X	X	X		X			68				Tree planting on Chesworth Rd.
NSA_C_101	Multifamily	X	X	X			X	X		169	X		Community has vegetable garden. Potential for bioretention near parking lot close to stream.
NSA_C_102	1/4	X		X	X		X					0.9	Trash on Wayman St.

Over 68% of the neighborhoods in Dead Run are recommended for downspout disconnection, and public education related to increasing lot tree canopy. Around 87% of the neighborhoods in Dead Run are recommended for storm drain marking. Four (4) neighborhoods are recommended for buffer improvement that may be achieved through public education about the benefits of providing a stream buffer by reducing the amount of mowed lawn through tree and vegetation planting. In addition, 40% of neighborhoods in this subwatershed were recommended for street tree planting and 15% of the neighborhoods were recommended for open space shade tree planting. NSA_C_80 represents an ideal opportunity for open space shade tree planting since the land at the end of Sunny Court is owned by Baltimore County. Figure 4-21 shows the potential open shade tree planting location at NSA_C_80. NSA_C_99 and several other neighborhoods showed evidence of trash or debris in common areas and yards.

NSA_C_101 is an apartment complex located at the end of Winters Lane off of Baltimore National Pike (US-40). A potential stormwater retrofit was identified at this neighborhood to treat runoff from the parking lot at the end of Winters Lane. The parking lot drains toward a stream and there is a sufficient grassed area adjacent and at an elevation below the parking area for the installation of bioretention area that could provide treatment to runoff. Figure 4-21 shows the potential stormwater retrofit aerial location at NSA_C_101.

Figure 4-21: Potential Open Space Shade Tree Planting Location (left) at NSA_C_80 and Potential Stormwater Retrofit Location (right) at NSA_C_101.

4.3.3.2 Hotspots

Thirteen (13) hotspot investigations were performed within Dead Run. Table 4-29 summarizes the potential pollution sources found at these sites.

Table 4-29: HSI Results Summary –Dead Run

HSI_ID	HSI Status*	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_C_301	Confirmed	Transport-Related	Bus Storage	X	X	X				Uncovered fueling; staining
HSI_C_302	Confirmed	Municipal	Gas and Electric	X	X	X	X	X	X	Outside material; Ex. SWM; Machine shop; Leaking vehicles
HSI_C_303	Confirmed	Transport-Related	Car Sales and Auto Repair	X	X	X	X		X	Ex.SWM; Unmarked Drums; Parking lot breaking up; Car parts outside
HSI_C_304	Confirmed	Commercial	Shopping Center/ Mall	X	X	X	X	X	X	Impervious Removal areas; trash; Ex. SWM Pond
HSI_C_305	Confirmed	Commercial	Hardware Store/ Garden Center	X	X	X	X			Mulch on parking lot; Trash
HSI_C_306	Potential	Commercial	Car Wash	X		X		X		Trash in inlet; runoff to private drain
HSI_C_307	Potential	Municipal	Maintenance Shop	X	X	X		X		Equipment stored on grass; dumpster leaking
HSI_C_308	Potential	Commercial	Gas Station	X	X	X		X		Dumpster overflowing; staining on lot; trash stored on ground
HSI_C_309	Confirmed	Industrial	Construction	X	X	X				Stream borders property; materials stored outside; messy lot
HSI_C_310	Confirmed	Industrial	Construction - Education	X	X	X				Lot sheet flows to stream; material stored in woods; organics on pavement
HSI_C_311	Confirmed	Commercial	Construction Materials		X	X	X	X		Outdoor stored Materials; Stream buffer; Trash
HSI_C_312	Potential	Commercial	Shopping Center		X	X	X	X	X	Grease dumpster leaking; lots of trash; Ex. SWM
HSI_C_313	Confirmed	Commercial	Hardware Store/ Garden Center	X	X	X	X	X		Garden area draining to inlet; trash; loading areas drain to inlet

Waste management is an issue at every single one of the hotspots assessed in Dead Run. Over 85% of the hotspots in Dead Run had potential pollution activities that included vehicle operations and outdoor materials and 61% of the hotspots had poor turf/landscape management. The four hotspots with existing stormwater treatment practices include HSI_C_302, HSI_C_303, HSI_C_304, and HSI_C_312.

HSI_C_311 is a building material corporation located at White Stone Road and Whitehead Road. This corporation stores large amounts of construction materials outside. The uncovered storage area is directly connected to the storm drain system. The hotspot consists of mostly impervious cover that directly drains into either the Dead Run Stream or the existing storm drain system. It is important, at this hotspot especially, that the stream buffer is sufficiently forested to properly filter out pollutants from impervious cover areas draining into Dean Run Stream.

HSI_C_304 is a large commercial shopping mall located between Security Boulevard and I-70. The site is 101.4 acres and consists almost entirely of impervious cover. A stormwater management pond exists at the northern end of the site. Significant issues at the site consisted of trash and uncovered leaky dumpsters. The site could benefit from further education on waste management. Two specific areas were recommended for impervious cover removal. These areas consist of a total of 4.4 acres of unused/abandoned parking lots located at the northwestern end of HSI_C_304. Figure 4-22 shows the overall site and locations of the two recommended areas for impervious cover removal.

Figure 4-22: Overall Site and Recommended Impervious Cover Removal Locations at HSI_C_304

4.3.3.3 Institutions

Eight (8) public institutional sites were assessed for retrofit opportunities in Dead Run during the uplands assessment of Middle Gwynns Falls. Table 4-30 summarizes recommendations for the institutional sites assessed in Dead Run.

Table 4-30: ISI Recommendations – Dead Run

Site ID	Name	Public/ Private	# Trees for Planting	Stormwater Retrofit	Downspout Disconnection	Trash Management	Storm Drain Marking	Buffer Improvement	Notes
ISI_C_301	Baltimore County Fire Station 3	Public				X	X		Uncovered Fueling;
ISI_C_302	John Paul Regional Catholic School	Private	132	X	X		X	X	Tree Planting by Stream
ISI_C_303	Temple Baptist Church Of Baltimore City	Private	144						Parking lot breaking up
ISI_C_304	Woodlawn High School	Public	1417			X	X	X	Uncovered fueling area
ISI_C_305	Church Of Christ In Woodlawn	Private			X		X		Ex. SWM diversion berm needs repair; Bare soil present
ISI_C_306	Southwest Academy For Arts & Sciences	Public	450	X		X	X		Dumpster drains to inlet
ISI_C_307	Johnnycake Elementary School	Public	44	X	X	X	X		Inlet clogged; Dumpster leaking
ISI_C_308	Edmonson Heights Elementary School	Public	128	X		X	X		

The eight (8) institutions assessed in Dead Run consist of a county fire station, a private catholic school, two churches, a public high school, a public charter school, and two public elementary schools. Five (5) of the sites showed evidence for the need for trash management education while six (6)public sites had opportunities for tree planting, seven (7) of the sites had opportunities for storm drain marking, four (4) sites for stormwater retrofits, and two (2) sites had opportunities for stream buffer improvements.

As noted previously, four (4) public sites were noted for potential stormwater retrofits. At ISI_C_302, there is a parking lot with over 200-spaces in front of the school that is not being treated by any type of stormwater control. Currently, the parking lot drains directly into the storm drain system. This public site offers a great opportunity to treat the parking lot runoff with either bioswales or sand filter along the edge of the parking lot.

At ISI_C_306, several stormwater retrofit opportunities exist to treat parking lot runoff. Bioswales can be installed around the student drop-off area to treat impervious cover. The parking lot at the southeastern portion of site can be treated with micro-bioretention facilities. At ISI_C_307, stormwater retrofits are applicable at two parking lots. A bioswale can be installed to treat the parking lot located at the northwestern portion of the site. For the parking lot off of Vanderwood Road, there is an opportunity for a micro-bioretention area on the east side of the parking lot to collect runoff. At ISI_C_308, the parking lot off of Sunset Ave presents an opportunity for either a micro-bioretention facility or bioswale along the left-hand side of the parking lot. Figure 4-23 provides a view of the potential retrofit areas at three (3) of the public institutions.

Figure 4-23: Stormwater Retrofit Potential at ISI_C_302 (left), ISI_C_306 (center), and ISI_C_307 (right)

ISI_C_302, ISI_C_306, and ISI_C_308 reside in areas of high concern for environmental justice, therefore implementation of restoration opportunities here should be a high priority. In addition, these sites were recommended for tree planting, stormwater retrofits, and storm drain marking.

4.3.3.4 Illicit Discharges

Dead Run contains two (2) Priority 1 outfalls which indicate major or reoccurring problems that require either immediate action or close monitoring. This subwatershed also contains eleven (11) Priority 2 outfalls, twenty-four (24) Priority 3 outfalls, and ten (10) Priority 0 outfalls. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

4.3.3.5 Stormwater Conversions

Six (6) detention ponds were assessed in Dead Run and are summarized in Table 4-31.

Table 4-31: Detention Pond Conversion - Dead Run

Site ID	Riser	Embankment	Vegetation	Fence Condition	Gate Condition	Water Quality Potential	Access	Flow Path	Connection	Horizontal Expansion Potential	Vertical Expansion Potential
SWM_C_334	Good	No Problems	Turf	Repairs Needed	Unlocked	X	Easy	Long	Off		
SWM_C_432	Damaged	Trees	Wetland Veg.	Repairs Needed	Unlocked	X	Difficult	Short	On	X	
SWM_C_450	Minor Maint.	Trees	Wetland Veg.	None	None		Difficult	Long	Off	X	X
SWM_C_817	Good	Trees	Wetland Veg.	Repairs Needed	None		Difficult	Short	Off		X
SWM_C_857	Good	No Problems	Wetland Veg.	Good	Locked	X	Easy	Long	Off		
SWM_C_961	Good	No Problems	Wetland Veg.	Good	Unlocked	X	Easy	Long	Off		

SWM_C_334 is a privately owned facility located at the end of Brigadoon Trail. This pond is designed to handle runoff from the 2-, 10-, and 100-year events from 17.97 acres of residential development. Runoff flowing to this facility currently travels through multiple outfalls that outlet into a grassed swale. The swale passes through the facility's perimeter fence and along an eroded flow path to the pond outlet structure. Water quality retrofit recommendations at this facility include the replacement of the existing grassed ditch with a bioswale facility for pretreatment of flows. At the entrance to the pond, forebays could be constructed that outlet into upgraded low flow channel to provide treatment of the first flush runoff volume. Maintenance recommendations include repairs to the fence at the inflow swale. Currently debris has collected there and the force of the water behind the debris has caused damage to the fence.

Figure 4-24: Channelized Grass Inflow (left) and Damaged Fence (right) at SWM_C_334

SWM_C_432 is a publicly owned facility located at at the end of Halfpenny Lane. This pond is designed to handle runoff from the 2-, 10-, and 100-year events from 33 acres of residential development. The site visit to this facility revealed that the outfall which is a headwall and pipe is blocked with sediment. This has caused water to permanently pond in the facility to form a wetland-like facility. Retrofit recommendations here are to investigate the potential for upgrading the pond to truly act as a wetland facility in the future. Pretreatment forebays could also be installed within the inflow ditch.

Figure-4-25: Invasive Species, Ponding (left) and Sediment Blocking the Downstream Outfall (right) at SWM_C_432

SWM_C_450 is a publicly owned facility located at the intersection of Woodlawn Drive and Jonas Way. This pond is designed to handle runoff from the 5- and 50-year events from 23 acres of residential development. This pond was not recommended for water quality retrofits due expansion constraints. Significant maintenance measures are recommended at this facility including stabilization of the pond slopes and inflow gabion outlet protection, protection at the outfall pipe from the pond, and the construction of a maintenance access to better reach the facility.

SWM_C_817 is a publicly owned facility located at the intersection of Johnny Cake Road and Rolling Cross Roads. This pond is designed to handle runoff from the 2-, 10-, and 100-year events from 13.34 acres of residential development. This pond was not recommended for water quality retrofits as it is being replaced in the future. The major finding at this facility was the presence of a large soil stockpile located adjacent to the facility. Sediment control measures around the stockpile were visibly failing and were causing sediment to drain into the facility.

SWM_C_857 is a privately owned facility located at the intersection of Security Boulevard and Lord Baltimore Drive. This pond is designed to handle runoff from the 2- and 25-year events from 11.71 acres of commercial development and parking lot. Water quality retrofit recommendations at this facility include construction of forebays at the ponds outfalls along with horizontal expansion to accommodate conversion to an extended detention facility. Storm drains the lead to the pond could be diverted to a small bioretention area to provide water quality treatment prior to entering the facility.

Figure-4-26: Dense Invasive Vegetation Around the Outlet Structure (left) and Curb Cut Inlet Configuration (right) Draining to SWM_C_857

SWM_C_961 is a privately owned facility located at the end of Kevsway Court. This pond is designed to handle runoff from the 2-, 10-, and 100-year events from 64.88 acres of residential development. This facility handles a large amount of drainage area and horizontal expansion potential was evident around the western and northern areas of the pond. Retrofit recommendations include construction of micropools at the ends of the pond's inflow pipes as well as conversion to an extended detention facility. In addition, two smaller pipes were found to be flowing directly into the outlet structure. It is recommended that these pipes be investigate to determine if they are illicit discharges. If not, they should be altered to outlet to the pond bottom instead of the outlet structure.

Figure-4-27: Undercutting and Erosion at Inflow Endsection (left) and Control Structure with Flowing Underdrains (right) at SWM_C_961

4.3.3.6 Proposed Water Quality Management Plan Projects

As part of the 2004 *Gwynns Falls Water Quality Management Plan*, retrofit and water quality improvement projects were identified in each of the subwatersheds of the Middle Gwynns Falls. Table 4-32 provides a summary of four (4) potential projects in the Dead Run subwatershed. More in depth descriptions of each of the projects can be found in Appendix K.

Table 4-32: Proposed WQMP Projects in the Dead Run Subwatershed

Project Number	Subwatershed	Ownership	Project Type	Estimated Cost (2004 $s)*	Description
DR-02	Dead Run	Public/Private Access Easement Required	BMP Creation	$386,500	Area within Western Hills Park has potential for BMP creation
DR-03	Dead Run	Public	Stream Restoration & BMP Creation	$883,400	SR: 1,200 LF Concrete Channel Removal
DR-07	Dead Run	Public	Stream Stabilization, Outfall Stabilization, & BMP Creation	$1,040,800	SR: 1,250 LF
DR-09	Dead Run	Private	Outfall Stabilization & BMP Creation	$415,800	

4.3.3.7 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-28 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-28.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees. Educate those neighborhoods that were noted for buffer improvements on the benefits of forested stream buffers.
4. Educate citizens about the benefits and importance of proper lawn care and bayscaping.
5. Educate citizens of neighborhoods indicated in Table 4-28 on proper trash management.

Municipal Actions

1. Investigate the potential for the installation of stormwater retrofits to the neighborhoods listed in Table 4-28.
2. Coordinate the installation of street trees within the public right-of-way and shade tree plantings in common areas of the neighborhoods listed in Table 4-28.
3. Begin street sweeping operations at the neighborhoods listed in Table 4-28.
4. Work with the HSIs indicated in Table 4-29 and similar businesses to implement appropriate practices for vehicle operations, outdoor materials storage and management of waste, their physical plant, landscapes, and stormwater.
5. Conduct tree plantings and downspout disconnections at the institutional sites list in Table 4-30. Educate those institutions that were noted for buffer improvements on the benefits of forested stream buffers.
6. Investigate the potential for installation of stormwater retrofits and conduct programs to provide install storm drain markings at the facilities in Table 4-30.
7. Provide education to institutions indicated in Table 4-30 on proper waste management.
8. Investigate the potential to perform water quality conversion retrofits to dry detention ponds SWM_C_334, SWM_C_432, SWM_C_857, and SWM_C_961.
9. Perform needed maintenance to the dry detention stormwater facilities listed in Table 4-31.
10. Implement recommended water quality improvement projects recommended in Table 4-32 from the *2004 Gwynns Falls Water Quality Management Plan.*

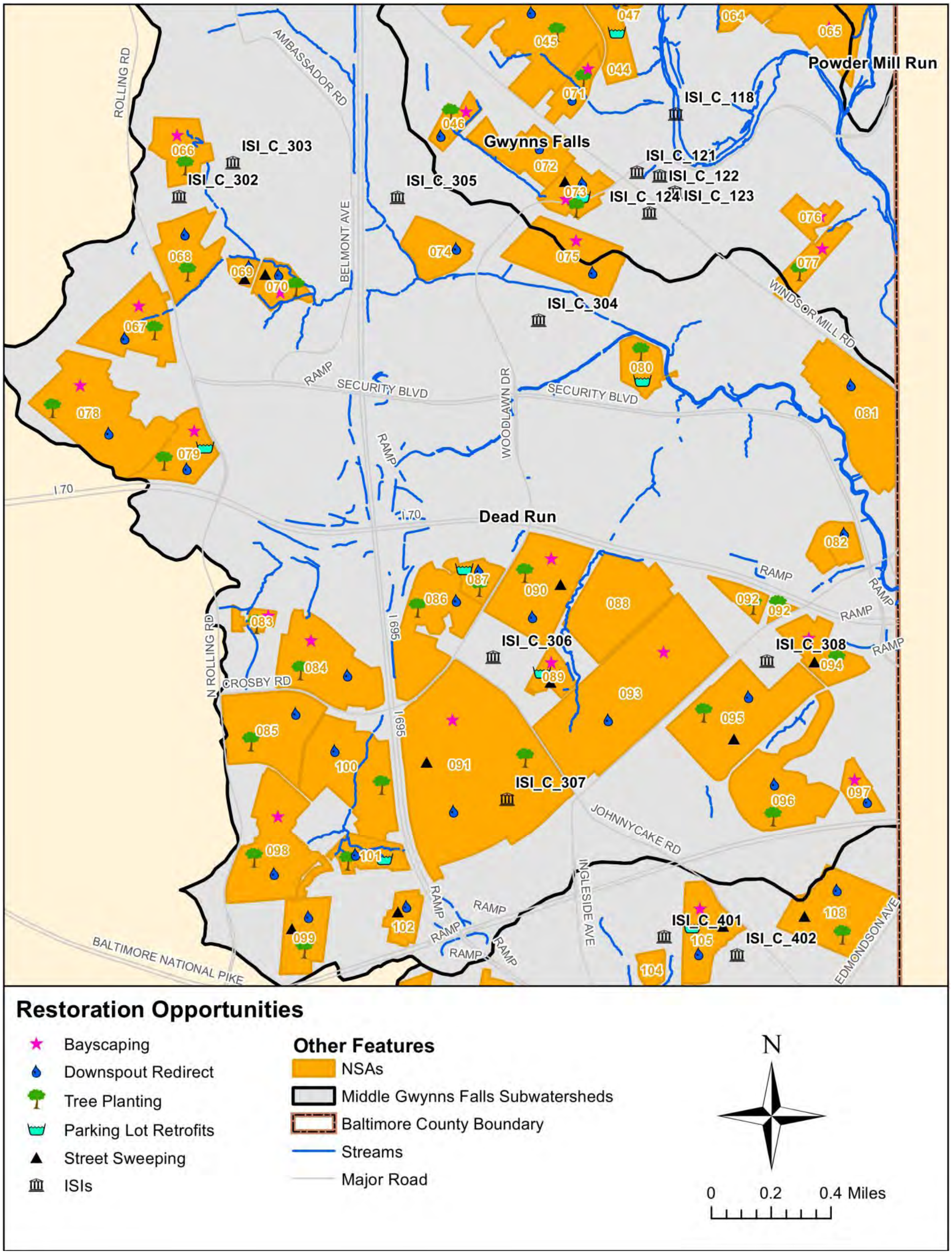

Figure 4-28: Restoration Opportunities in Dead Run

4.3.4 Maiden Choice Run

Maiden Choice Run is the smallest subwatershed in the Middle Gwynns Falls study area. Encompassing a large amount of residential and industrial area, Maiden Choice Run is almost entirely occupied by urban development (nearly 97%) including industrial, institutional, commercial, open urban, transportation, and residential uses. The remaining subwatershed area is classified as forest. Table 4-33 summarizes key subwatershed characteristics of Maiden Choice Run.

Table 4-33: Key Subwatershed Characteristics – Maiden Choice Run

Drainage Area	928.0	acres	
	1.45	sq. mi.	
Stream Length	1.7	miles	
Population	9,989	(2000 Census)"	
Land Use/Land Cover		Very Low Density Residential:	0.3%
		Low Density Residential:	3.2%
		Medium Density Residential:	50.7%
		High Density Residential:	20.5%
		Commercial:	12.0%
		Industrial:	0.4%
		Institutional:	3.6%
		Open Urban:	3.1%
		Forest:	3.1%
		Agriculture:	0.0%
		Transportation	3.2%
Impervious Cover	32.8%	of watershed	
Soils		A Soils (low runoff potential):	9.7%
		B Soils:	28.9%
		C Soils:	18.3%
		D Soils (high runoff potential):	43.1%
		Water:	0.0%

4.3.4.1 Neighborhoods

A total of fifteen (15) distinct neighborhoods were identified and assessed within Maiden Choice Run during the uplands assessment of Middle Gwynns Falls. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, rain gardens, storm drain marking, buffer improvement, tree planting, parking lot retrofits, street sweeping and public education (i.e., bayscaping and increasing lot tree canopy). A summary of neighborhood recommended actions is presented in Table 4-34.

Table 4-34: NSA Recommendations – Maiden Choice Run

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Buffer Improvement	# of Street Trees	# of Shade Trees	Parking Lot Retrofit	Street Sweeping	Notes
NSA_C_103	1/8	X	X	X	X	X						
NSA_C_104	Multifamily			X		X						
NSA_C_105	Multifamily	X		X	X					X	2.0	Opportunity for bioretention near Cedar Run Pl.
NSA_C_106	1/8	X	X	X		X	X		12			Houses encroaching on stream and stream not buffered.
NSA_C_107	Multifamily	X			X	X	X		61		0.2	Removal of pavement at old parking lot and possibly replace with gravel lot.
NSA_C_108	1/8	X		X				239			2.6	Street tree planting on Aldershot rd., North Bend Rd., and Plymouth Rd.
NSA_C_109	1/4	X	X	X				68				
NSA_C_110	Multifamily	X	X	X	X	X				X		Dumping in dumpster area. Potential for bioretention at end of first parking area.
NSA_C_111	1/8	X		X	X	X		18				Street tree planting along Edmondson Rd in the median
NSA_C_112	Multifamily				X	X			14			Open space tree planting possible in front of apartments.
NSA_C_113	<1/8	X		X			X					
NSA_C_114	Multifamily			X	X	X	X		30			Dumping near dumpster.
NSA_C_115	1/2		X	X								Some sediment in "v" ditch along roadway. A lot of trees in neighborhood
NSA_C_116	1/8	X	X	X				87	19		2.1	Open space tree planting opportunity at end of Dunmore Rd. About 40% of driveways had grass strip going down them.
NSA_C_117	1/8	X			X							Inlets marked on S. Symington

Most of the NSAs in Maiden Choice Run were recommended for downspout disconnection. For the smaller lot sizes in Maiden Choice Run, the most feasible disconnection method may be through the use of rain barrels to capture rooftop runoff. Increasing tree cover is a focus for neighborhoods in Maiden Choice Run as most of the neighborhoods were recommended for either an increase in lot canopy or were good candidates for street tree or open shade tree planting. Two neighborhoods, NSA_C_105 and

NSA_C_110, offer opportunities for parking lot retrofits to treat runoff from impervious surfaces (Figure 4-29). In addition, impervious cover removal was recommended for NSA_C_107 with the possibility to be replaced with a pervious surface.

Figure 4-29: Impervious Cover Removal at NSA_C_110 (left) and Open Shade Tree Planting Opportunity at NSA_C_116 (right).

4.3.4.2 Hotspots

Two (2) hotspot investigations were performed within Maiden Choice Run. These included a car dealership and a gas station/auto repair/car wash. Table 4-35 summarizes the potential pollution sources found at each of the sites.

Table 4-35: HSI Results Summary – Maiden Choice Run

HSI_ID	HSI Status*	Description		Vehicle Operations	Waste Management	Physical Plant	Turf/Landscape Management	Notes
HSI_C_401	Confirmed	Commercial	Car Dealership	X	X		X	Unmarked containers; staining on lot; dumpster leaking
HSI_C_402	Confirmed	Commercial	Gas Station, Auto Repair and Car Wash	X	X	X		Dumpster and car wash draining to Inlet, auto repair ok; inlet clogged

HSI_C_0401 is a car dealership located along Baltimore National Pike in Maiden Choice Run. This hotspot contained a variety of potential pollution activities including vehicle operations, outdoor material management, waste management, and turf/landscape management. Leakage and garbage was observed around the dumpsters and site. The parking lot facility showed signs of staining from vehicle leaks and unlabeled containers were stored at the site, reflecting the need for education on the items mentioned as areas of concern.

HSI_C_0402 is a gas station/auto repair/car wash off of Baltimore National Pike. At this hotspot, wash water from the car bays and dumpster is draining to a nearby storm drain. This facility and other car washes should be inspected to ensure that illicit discharges such as wash water are contained and appropriately directed to the sanitary sewer as opposed to the storm sewer network. Facilities that conduct car repairs are recommended to be educated on proper containment of pollutants used during its physical processes to prevent leaks from reaching storm drain networks. An inlet near the hotspot appeared to be clogged with sediment and debris and should be cleaned out. Figure 4-30 shows a clogged inlet and drainage flow from a leaking dumpster.

Figure 4-30: Evidence of Clogged Inlet and Leakage from Dumpster at HSI_C_0402

4.3.4.3 Institutions

One (1) public and four (4) private institutional sites were assessed for retrofit opportunities in Maiden Choice Run during the uplands assessment of Middle Gwynns Falls. Table 4-36 summarizes recommendations for the institutional sites assessed in Maiden Choice Run.

Table 4-36: ISI Recommendations – Maiden Choice Run

Site ID	Name	Public/ Private	# Trees for Planting	Stormwater Retrofit	Downspout Disconnection	Trash Management	Storm Drain Marking	Notes
ISI_C_401	Westowne Elementary School	Public	201	X		X	X	Bare Soil; dumpster drains to SD
ISI_C_402	Mount De Sales Academy	Private			X	X	X	Trash; Poor E&S Control construction practices
ISI_C_403	Christian Temple	Private			X		X	Bare Earth
ISI_C_404	Morning Star Baptist Church	Private	3		X	X	X	Dumpster drains to inlet; Parking lot breaking up
ISI_C_405	Forest Haven Nursing Home	Private			X			

ISI_C_401 is a public elementary school located on Harlem Lane. Recommendations at the site include open-space shade tree planting in the front and back of the site along with stormwater retrofits, storm drain marking and education on trash management. Also noted was bare soil under trees and dumpster drains toward storm drain system. Two potential stormwater retrofit sites were identified around the school to treat parking lot areas with bioretention.

ISI_C_402 is a private Catholic high school located at the intersection of Academy Road and Whitfield Road. This site was not conducive for additional stormwater retrofits or tree plantings. Impervious area on the site is treated by a detention pond. Water quality recommendations at the site include downspout disconnection and education on trash management and construction practices. Also observed at the site were unprotected stockpiles (Figure 4-31) and trash from construction, and poor erosion and control construction practices.

Both ISI_C_403 and ISI_C_404 are private faith-based institutions in the Maiden Choice Run subwatershed. At ISI_C_403, recommendations included downspout disconnection and storm drain marking. Approximately 33% of the impervious cover at this site is being treated by a dry grass swale with check dams (Figure 4-31). Areas of erosion with bare soil were seen at ISI_C_403. At ISI_C_404, there is a small opportunity for tree planting, downspout disconnection, and storm drain marking. Additional observations recorded at ISI_C_404 include a dumpster draining towards an inlet and a deteriorating parking lot. ISI_C_405 is a private nursing home off of Edmondson Avenue. The nursing home was recommended for downspout disconnection.

Figure 4-31: Unprotected Stockpile at ISI_C_402 (left) and Existing Dry Grass Swale at ISI_C_403 (right)

4.3.4.4 Illicit Discharges

Maiden Choice Run contains zero (0) Priority 1 outfalls. This subwatershed also contains two (2) Priority 2 outfalls, two (2) Priority 3 outfalls, and two (2) Priority 0 outfalls. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

4.3.4.5 Stormwater Conversions

Two (2) detention ponds were assessed in Maiden Choice Run and are summarized in Table 4-37.

Table 4-37: Detention Pond Conversion - Maiden Choice Run

Site ID	Riser	Embankment	Vegetation	Fence Condition	Gate Condition	Water Quality Potential	Access	Flow Path	Connection	Horizontal Expansion Potential	Vertical Expansion Potential
SWM_C_859	Damaged	No Problems	Trees	None	None	X	Easy	Short	Off	X	X
SWM_C_1188	Good	No Problems	Wetland Veg.	None	None	X	Easy	Long	Off	X	X

SWM_C_859 is a privately owned facility located at a private road off of Northdale Road. This pond is designed to handle runoff from the 2-, 10-, and 100-year events from 20.35 acres of institutional development. This pond was recommended for horizontal expansion, conversion to extended detention, and construction of micropools at the pond inflow pipes. In addition, a perimeter fence should be installed around the facility as it is located at a school facility and recreation equipment should be removed from the footprint of the facility.

Figure-4-32: Pond Embankment (left) and Control Structure with Missing Lid (right) at Detention Pond SWM_C_859

SWM_C_1188 is a publicly owned facility located off of Maryland Avenue. This pond is designed to handle runoff from the 5- and 100-year events from 60.2 acres of residential and park development. The facility currently has three large grassed swales and an inflow pipe delivering stormwater flow. There is potential for horizontal expansion and conversion to an extended detention facility, but the drainage area appeared to be largely pervious. It is recommended that the drainage area of this facility be analyzed thoroughly prior to any retrofit activities to determine the water quality improvement potential.

4.3.4.6 Proposed Water Quality Management Plan Projects

As part of the 2004 *Gwynns Falls Water Quality Management Plan*, retrofit and water quality improvement projects were identified in each of the subwatersheds of the Middle Gwynns Falls. Table 4-38 provides a summary of two (2) potential projects in the Maiden Choice Run subwatershed. More in depth descriptions of each of the projects can be found in Appendix K.

Table 4-38: Proposed WQMP Projects in the Maiden Choice Run Subwatershed

Project Number	Subwatershed	Ownership	Project Type	Estimated Cost (2004 $s)*	Description
MC-01	Maiden Choice Run	Private	Outfall Retrofit, Utility Protection/Relocation, & Stream Restoration & Stabilization	$272,000	SS: 600 LF
MC-02	Maiden Choice Run	Private	Stream Stabilization	$403,300	SS: 1,500 LF

4.3.4.7 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-30 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-30.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees. Educate those neighborhoods that were noted for buffer improvements on the benefits of forested stream buffers.
4. Educate citizens about the benefits and importance of proper lawn care and bayscaping.

Municipal Actions

1. Investigate the potential for the installation of stormwater retrofits to the neighborhoods listed in Table 4-23.
2. Coordinate the installation of street trees within the public right-of-way and shade tree plantings in common areas of the neighborhoods listed in Table 4-30.
3. Begin street sweeping operations at the neighborhoods listed in Table 4-30.
4. Work with the HSIs indicated in Table 4-35 and similar businesses to implement appropriate practices for vehicle operations and management of waste, their physical plant, and landscapes.
5. Conduct tree plantings and downspout disconnections at the institutional sites list in Table 4-36.
6. Investigate the potential for installation of stormwater retrofits and conduct programs to provide install storm drain markings at the facilities in Table 4-36.
7. Provide education to institutions indicated in Table 4-36 on proper waste management.
8. Investigate the potential to perform water quality conversion retrofits to dry detention ponds SWM_C_859 and SWM_C_1188.
9. Perform needed maintenance to the dry detention stormwater facilities listed in Table 4-37.
10. Implement recommended water quality improvement projects recommended in Table 4-38 from the *2004 Gwynns Falls Water Quality Management Plan.*

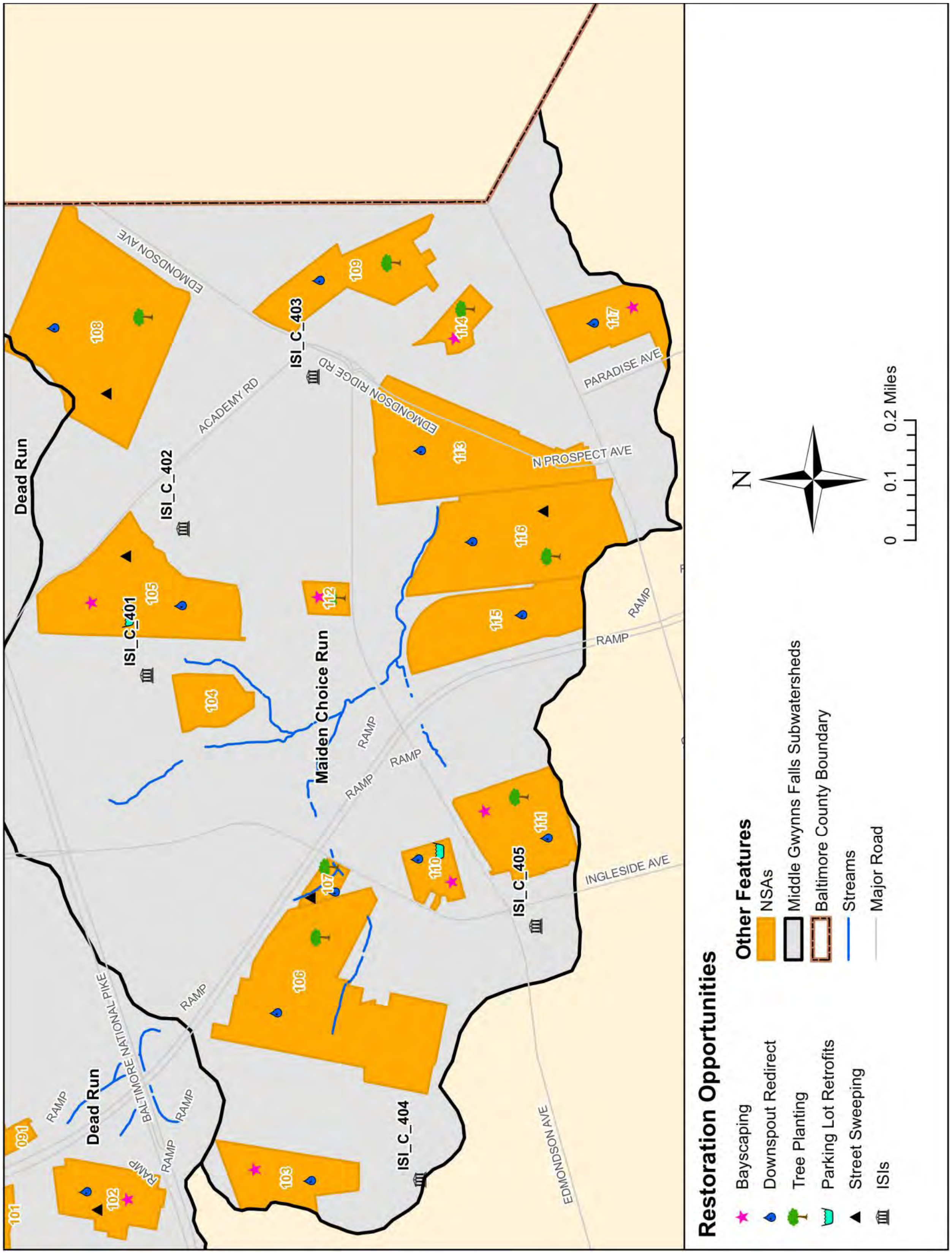

Figure 4-33: Restoration Opportunities in Maiden Choice Run

4.3.5 Scotts Level

Scotts Level is the third largest subwatershed in the Middle Gwynns Falls study area and is mostly comprised of residential area (nearly 73%). Institutional and commercial land uses are also present here, bringing the total urban coverage of Scotts Level to 88%. The remaining subwatershed area is classified as forest. Table 4-39 summarizes key subwatershed characteristics of Scotts Level.

Table 4-39: Key Subwatershed Characteristics – Scotts Level

Drainage Area	2653.2	acres	
	4.15	sq. mi.	
Stream Length	12.3	miles	
Population	23,852	(2000 Census)"	
Land Use/Land Cover	Very Low Density Residential:		0.2%
	Low Density Residential:		0.8%
	Medium Density Residential:		60.0%
	High Density Residential:		11.7%
	Commercial:		6.5%
	Industrial:		0.0%
	Institutional:		5.6%
	Open Urban:		2.9%
	Forest:		11.9%
	Agriculture:		0.0%
	Transportation		0.4%
Impervious Cover	25.8%	of watershed	
Soils	A Soils (low runoff potential):		5.4%
	B Soils:		38.1%
	C Soils:		30.0%
	D Soils (high runoff potential):		26.5%
	Water:		0.0%

4.3.5.1 Neighborhoods

A total of thirty-six (36) distinct neighborhoods were identified and assessed within Scotts Level during the uplands assessment of Middle Gwynns Falls. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, rain gardens, buffer improvement, tree planting, parking lot retrofits, street sweeping and public education (i.e., bayscaping, storm drain marking, increasing lot tree canopy, pet waste management and trash management). A summary of neighborhood recommended actions is presented in Table 4-40.

Table 4-40: NSA Recommendations – Scotts Level

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Pet Waste Management	Trash Management	Buffer Improvement	# of Street Trees	# of Shade Trees	Parking Lot Retrofit	Street Sweeping	Notes
NSA_C_118	<1/8			X		X							X	Shade tree planting in open area around development
NSA_C_119	<1/4		X	X										
NSA_C_120	<1/4	X		X		X				12				
NSA_C_121	<1/8			X		X				12	280			Shade tree planting area is east of development, owned by Baltimore Co., 1.4 acres
NSA_C_122	<1/8			X		X								Potential for rain gardens on end units and either side of dead end road
NSA_C_123	<1/8			X		X					12			Shade trees in common area in middle of neighborhood
NSA_C_124	<1/4			X	X	X								
NSA_C_125	<1/4		X	X	X	X				20				
NSA_C_126	<1/4		X	X	X	X	X							
NSA_C_127	<1/8			X		X					8			Shade trees: Joleon and Painted Tree
NSA_C_128	<1/4		X	X	X	X								
NSA_C_129	<1/4			X	X	X	X		X	10				Asphalt removal; create islands in cul-de-sacs on: Cassandra Ct. & Collier, Eastman Rd., #3733 Trent Rd.: street trees: Offutt, Collier Rd., Cassen
NSA_C_130	<1/4			X	X	X					40			Open space tree planting on Lumo Cir.
NSA_C_131	1/4		X	X	X	X								Asphalt removal: Brest Rd - end; Buffer encroachment: Wanda and Rouen (junk/debris)
NSA_C_132	<1/4		X	X	X	X								LT cars reported
NSA_C_133	<1/4			X	X	X								LT cars reported
NSA_C_134	<1/4			X	X	X								
NSA_C_135	<1/4			X	X	X								LT cars reported; Downy Dale buffer encroachment
NSA_C_136	<1/4			X	X				X					LT cars reported. Street trees: Byron, Parkfield
NSA_C_137	<1/8			X	X	X								
NSA_C_138	<1/8			X		X	X							
NSA_C_139	<1/8			X		X								
NSA_C_140	<1/4			X	X									LT cars reported
NSA_C_141	Multifamily			X	X	X		X	X		50	X		Virunga Ct. Inadequate buffer;

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnection	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Pet Waste Management	Trash Management	Buffer Improvement	# of Street Trees	# of Shade Trees	Parking Lot Retrofit	Street Sweeping	Notes
														nearly every dumpster uncovered
NSA_C_142	<1/4			X	X	X								LT cars reported
NSA_C_143	<1/4		X	X	X	X								Cars on grass on Millvale Rd. (no driveways); LT cars reported
NSA_C_144	<1/4			X	X	X								0
NSA_C_145	Multifamily			X	X	X					30			Shade trees: corner of Marriotsville and Cervine Lane
NSA_C_146	Multifamily	X		X	X	X			X			X		Slated for stream restoration by EPS Capital
NSA_C_147	Multifamily		X	X	X	X					50			Potential retrofit to keep roof water from flowing onto street
NSA_C_148	Multifamily			X	X	X					20			Shade trees: in central courtyard and on east side
NSA_C_149	Multifamily			X	X	X					10			0
NSA_C_150	Multifamily		X	X	X	X								0
NSA_C_151	Multifamily			X	X	X								0
NSA_C_152	Multifamily	X		X	X	X					25			Tree planting on north side of Brice Run Rd. By pool
NSA_C_153	<1/8			X	X	X						X		Asphalt removal in center of p. Lot - create a planted island

All of the neighborhoods in Scotts Level were recommended for public education related to storm drain marking. Over 70% of the neighborhoods were recommended for public education related to bayscaping and increasing lot tree canopy. About 25% of the neighborhoods assessed in Scotts Level were recommended for rain gardens. NSA_C_141 was recommended for education on trash management as evidence of debris and litter were seen in at least 10% of yards in this neighborhood. Additionally, NSA_C_118 was recommended for street sweeping. Three (3) neighborhoods were recommended for public education related to pet waste disposal. NSA_C_129, NSA_C_131, and NSA_C_153 are good candidates for impervious cover removal. Buffer improvements are recommended at NSA_C_129, NSA_C_136, NSA_C_141, and NSA_C_146 which can be achieved through public education about the benefits of providing a stream buffer by reducing the amount of mowed lawn through tree and vegetation planting.

Impervious cover removal is recommended at NSA_C_129, NSA_C_131, and NSA_C_153. At NSA_C_129, it is recommended that a portion of the asphalt be removed wherever there is a cul-de-sac or “asphalt bump-outs” and replaced with trees. “Asphalt bump-outs” exist on Trent Road, Eastman Road, Coller Road, Tirka Circle. At the end of Brest Road in NSA_C_131, asphalt removal is recommended. This area is currently an unused basketball court. There is potential for asphalt removal in the center of the parking lot at the end of Lykens Court at NSA_C_153.

The three neighborhoods recommended for parking lot retrofits are NSA_C_141, NSA_C_146, and NSA_C_153. At NSA_C_141, stormwater retrofits are plausible at the end and southside of Valley Terrace. At NSA_C_146, the entire apartment complex could benefit from parking lot retrofits such as infiltration trenches or micro-bioretention facilities. A planted island can be created in the area where asphalt is removed at NSA_C_153 for a parking lot retrofit.

4.3.5.2 Hotspots

Thirteen (13) hotspot investigations were performed within Scotts Level. Table 4-41 summarizes the potential pollution sources found in Scotts Level.

Table 4-41: HSI Results Summary – Scotts Level

HSI_ID	HSI Status*	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Storm Water	Notes
HSI_C_501	Potential	Commercial	RV Sales/Service	X					
HSI_C_502	Confirmed	Commercial	Bowling Alley			X			Trash by dumpster was cleaned up
HSI_C_503	Not	Commercial	Shopping Center						
HSI_C_504	Confirmed	Commercial	Shopping Center		X	X	X	X	Trash on site; trash dumped by Uhaul parking; 7+ cats living behind the stores
HSI_C_505	Potential	Commercial	Car Dealer	X	X	X	X	X	Potential IC removal (area along Burmont is failing); IC seems excessive
HSI_C_506	Potential	Commercial	Building Supply/ Equipment Rental	X	X	X			Lots of equipment on the ground uncovered
HSI_C_507	Not	Commercial	Shopping Center			X			
HSI_C_508	Potential	Commercial	Shopping Center			X			IC removal at Tawnmore/Rolling
HSI_C_509	Not	Commercial	Chinese Restaurant			X			Potential IC removal
HSI_C_510	Confirmed	Commercial	Shopping Center			X			IC removal of back parking lot
HSI_C_511	Not	Commercial	Shopping Center			X			
HSI_C_512	Potential	Commercial	Car Dealer (New And Used)	X	X	X	X	X	
HSI_C_513	Not	Industrial	Heating Oil Distribution Site			X			A model site

At seven (7) hotpots in Scotts Level, the only pollution activity identified was poor waste management. These hotspots could benefit from education related to proper waste management. At HSI_C_501, vehicle operations are an evident pollution activity where vehicles are maintained, repaired, washed and stored. Vehicles were noted to be stored outside and uncovered outdoor fueling areas were present. HSI_C_503 was determined to not be a confirmed hotspot.

HSI_C_504 is a shopping center off of Liberty Road with over 3.5 acres of impervious area. Materials were observed to be stored outside including several shipping containers behind the shopping center. Considerable amounts of trash were observed around the hotspot including overflowing dumpsters, trash on ground behind dumpsters, and significant dumping in the U-Haul parking lot. Much of the pavement showed significant signs of oil and grease. During large storms, runoff can pick up oil and grease, which can eventually drain into our local streams and bay area. At the north end of the shopping center, downspout disconnection is highly feasible.

HSI_C_505 is a car dealership located off of Liberty Road. Potential pollution activities at the site include vehicle operations, management of outdoor materials and waste, physical plant, and stormwater management. Vehicle operations at the site included maintenance and repair, fueling, washing, and storage. Vehicles are not being washed outdoors. The dumpster had no lid. Trash and construction materials were evident around the hotspot. Dumping was observed on the Burmont Avenue side of the site. HSI_C_505 could benefit from impervious cover removal and stormwater retrofits. The impervious cover area along Burmont Avenue is in disrepair and excessive. Potential stormwater retrofit sites were identified around the parking lot to treat runoff with bioretention swales.

HSI_C_512 is a car dealership located off of Liberty Road. Potential pollution activities at the site include vehicle operations, management of outdoor materials and waste, physical plant, and stormwater management. Vehicle operations at the site included maintenance and repair, fueling, washing, and storage. Tires and damaged vehicles are being stored uncovered outside. Observations included trash around the site and dumpsters not being covered. This hotspot could benefit from stormwater retrofits around the parking lot to treat runoff with bioretention swales. The parking lot is breaking up and in poor condition.

Impervious cover removal is practical at several other sites including HSI_C_508, HSI_C_509, and HSI_C_510. At HSI_C_508, over 0.5 acreage of excess pavement is present along Tawnmore Road and Rolling Road. An old and unused parking lot exists along Millvale Road behind HSI_C_509, which likely can be removed. Asphalt removal is possibly for the entire back parking lot at HSI_C_510.

4.3.5.3 Institutions

Eleven (11) public institutional sites were assessed for retrofit opportunities in Scotts Level during the uplands assessment of Middle Gwynns Falls. Table 4-42 summarizes recommendations for the institutional site assessed in Scotts Level.

Table 4-42: ISI Recommendations – Scotts Level

Site ID	Name	Public/ Private	Nutrient Management	# Trees for Planting	Stormwater Retrofit	Impervious Cover Removal	Trash Management	Storm Drain Marking	Buffer Improvement	Notes
ISI_C_501	Deer Park ES	Public	X	220			X			
ISI_C_502	Deer Park MS	Public	X	340			X	X		
ISI_C_503	Liberty Road Volunteer Fire Dept.	Private		156	X			X		
ISI_C_504	Church Lane ES	Public	X	520			X	X		
ISI_C_505	Randallstown HS	Public	X	400	X	X		X		
ISI_C_506	Mount Olive United Methodist Church	Private		15		X	X			
ISI_C_507	Greater Bethlehem Temple Church	Private		420	X					Remove added stone around parking lot
ISI_C_508	Scotts Branch ES	Public	X	80			X	X		
ISI_C_509	Chimes Inc.	Private		40					X	Request Chimes to stop mowing SW pond
ISI_C_510	Milford Mill Swim Club	Private				X	X		X	Owner is trying to sell property (in disrepair)
ISI_C_511	Milford Mill Academy HS	Public	X	200			X	X		Addition under construction

The eleven (11) institutions assessed in Scotts Level consist of three (3) elementary schools, a middle school, a volunteer fire department, two (2) high schools, two (2) churches, a non-profit group, and a swim club. Public schools represent unique opportunities to combine water quality improvement measures with student education/outreach. Most of the schools assessed are recommended for tree planting, storm drain marking, and trash management which are all ways to engage teachers and students. All sites except for ISI_C_510 had opportunities for tree plantings, with over 2,390 trees recommended for the institutional sites assessed in Scotts Level. Six (6) sites were recommended for nutrient management. Three (3) sites were recommended for stormwater retrofits and/or impervious cover removal. Seven (7) sites were recommended for education on trash management. Six (6) sites had opportunities for storm drain marking and two (2) for stream buffer improvements.

As noted previously, three institutions were noted as having the potential for removal of impervious surfaces. At ISI_C_505, the entry way at the front of the high school consists of impervious cover. There is an opportunity to replace this entry way with a newer pervious surface. At ISI_C_506, the parking lot behind the church is poor condition. This site represents a potential area for replacement of the impervious surface with pervious pavers. At ISI_C_510, an opportunity is present to remove a very large portion of impervious cover. This portion of impervious cover is over 1.25 acres. ISI_C_510 is in disrepair and the owner of the property is trying to sell the property.

Three different types of institutional facilities were recommended for stormwater retrofits. ISI_C_503 is recommended for a stormwater management retrofit to collect runoff from the back parking lot area of the volunteer fire department. Runoff currently drains towards a large open pervious area without any treatment, which would be a good location for either an infiltration trench or micro-bioretention. ISI_C_505 is a public high school with a large parking lot towards in the front of the school. At the moment, the parking lot drains to a single storm water inlet. Several opportunities exist to treat the parking lot runoff. One such opportunity is to add curb cuts that would allow runoff to drain into bioretention facilities near the woods and tennis courts. Another retrofit suggestion is to convert the inlet into a bioretention facility. At ISI_C_507, gravel was recently added on two sides of the parking lot for additional spaces. It is suggested to remove the stone around the parking lot and to re-plant the area with trees or shrubs.

Two institutions were recommended for stream buffer improvements. Stream buffers conserve the areas adjacent to streams and rivers. At ISI_C_509, the stream buffer is inadequate; however there is little room to expand the stream buffer, except for an area next to the parking lot. Also, at ISI_C_510 significant erosion is evident on the stream banks nearest to the building.

4.3.5.4 Illicit Discharges

Scotts Level contains seven (7) Priority 1 outfalls which indicate major or reoccurring problems that require either immediate action or close monitoring. This subwatershed also contains nine (9) Priority 2 outfalls, eight (8) Priority 3 outfalls, and three (3) Priority 0 outfalls. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

4.3.5.5 Stormwater Conversions

No dry detention pond assessments were conducted in Scotts Level.

4.3.5.6 Proposed Water Quality Management Plan Projects

As part of the 2004 *Gwynns Falls Water Quality Management Plan*, retrofit and water quality improvement projects were identified in each of the subwatersheds of the Middle Gwynns Falls. Table 4-43 provides a summary of six (6) potential projects in the Scotts Level subwatershed. More in depth descriptions of each of the projects can be found in Appendix K.

Table 4-43: Proposed WQMP Projects in the Scotts Level Subwatershed

Project Number	Subwatershed	Ownership	Project Type	Estimated Cost (2004 $s)*	Description
SL-01	Scotts Level	Public	Stream Restoration, Concrete Channel Removal, & Floodplain Wetland Creation	$775,000	SR: 3,100 LF FWC: 6 sites
SL-02	Scotts Level	Public	Stream Stabilization	$200,000	SS: 2,500 LF
SL-03	Scotts Level	Public	Stream Restoration, Concrete Channel Removal, & Floodplain Wetland Creation	$655,000	SR: 2,500 LF FWC: 6 sites
SL-04	Scotts Level	Private	SWM Retrofit/Conversion	$195,800	Conversion of SWM Pond to Extended Detention
SL-05	Scotts Level	Private	SWM Retrofit/Conversion	$165,800	Conversion of SWM Pond to Extended Detention
SL-06	Scotts Level	Public	Wetland Creation	$290,800	

4.3.5.7 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-40 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-40.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees. Educate those neighborhoods that were noted for buffer improvements on the benefits of forested stream buffers.
4. Educate citizens about the benefits and importance of proper lawn care, and bayscaping.
5. Educate citizens of neighborhoods indicated in Table 4-40 on proper trash and pet waste management.

Municipal Actions

1. Investigate the potential for the installation of stormwater retrofits to the neighborhoods listed in Table 4-40.
2. Coordinate the installation of street trees within the public right-of-way and shade tree plantings in common areas of the neighborhoods listed in Table 4-40.
3. Begin street sweeping operations at the neighborhoods listed in Table 4-40.
4. Work with the HSIs indicated in Table 4-41 and similar businesses to implement appropriate practices for vehicle operations, outdoor materials storage and management of waste, their physical plant, and stormwater.
5. Conduct tree plantings and impervious cover removal at the institutional sites list in Table 4-42. Educate those institutions that were noted for buffer improvements on the benefits of forested stream buffers.
6. Investigate the potential for installation of stormwater retrofits and conduct programs to provide install storm drain markings at the facilities in Table 4-42.
7. Provide education to institutions indicated in Table 4-42Table 4-19 on proper nutrient and waste management.
8. Implement recommended water quality improvement projects recommended in Table 4-43 from the *2004 Gwynns Falls Water Quality Management Plan.*

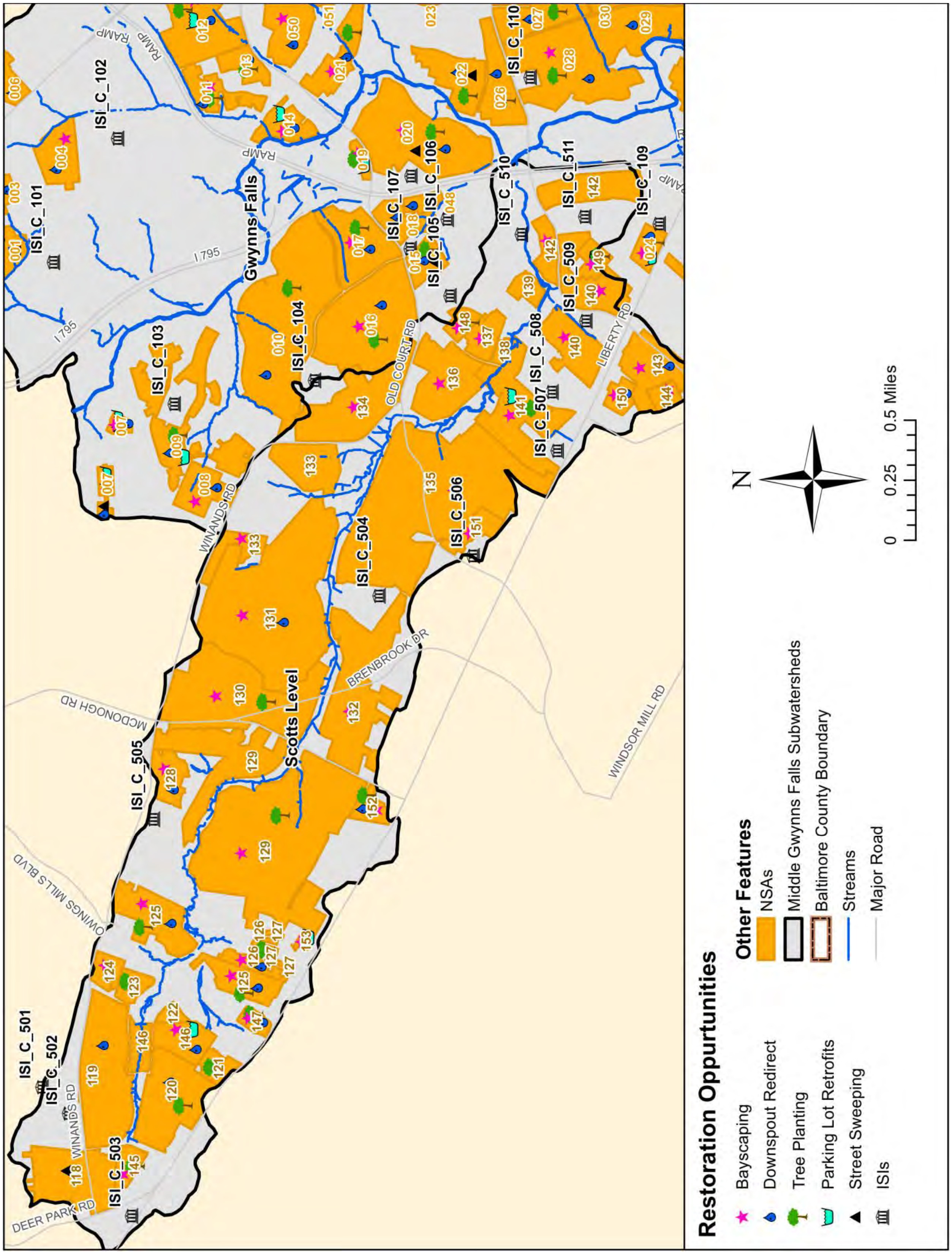

Figure 4-34: Restoration Opportunities in Scotts Level

CHAPTER 5: PLAN EVALUATION

5.1 Introduction

The Middle Gwynns Falls SWAP is based on an implementation schedule with an anticipated endpoint of 2025 and an intermediate milestone of 2017. This timeframe is necessary to implement restoration measures and meet the Chesapeake Bay TMDL. The ability to implement this plan within the specified timeframe is dependent upon the availability of staff and sufficient funding. The Middle Gwynns Falls SWAP Implementation Committee (an outgrowth of the Steering Committee) will meet twice per year to assess progress in meeting watershed goals and objectives and to discuss funding options. In addition, completed projects will be recorded in the County's annual NPDES report. An adaptive management approach will be used to meet watershed goals and objectives based on SWAP evaluation data. The Middle Gwynns Falls SWAP Implementation Committee will initiate a revision of the plan within six months if additional TMDLs are developed and approved or when a water quality issue arises.

Progress and success of the Middle Gwynns Falls SWAP will be evaluated during implementation based on the following: interim measurable milestones, pollutant load reduction criteria, implementation tracking, and monitoring. These evaluation components are described in the following sections.

5.2 Interim Measurable Milestones

Performance measures have been developed for each action listed in Appendix A and will be used to gage the progress and success of proposed restoration strategies. The progress and success of actions in Appendix A will be evaluated every year. Action strategies may be modified and/or new actions may be proposed based on this annual evaluation. New actions proposed will also be evaluated on a semiannual basis and modified as necessary to meet watershed goals and objectives.

5.3 Pollutant Load Reduction Criteria

Current pollutant load reduction scenarios and calculations for proposed actions are presented in Chapter 3. These are mainly based on pollutant removal efficiencies approved by the CBP for various nonpoint source BMPs. For actions not covered in CBP, reduction rates from the Maryland *Accounting for Stormwater Wasteload Allocations and Impervious Areas* draft document were used (2011). These pollutant removal efficiencies will continue to be used to measure progress in meeting the nutrient TMDL reduction goal (See Table 1-1). CBP-approved BMP removal efficiencies are summarized in the tables included in Appendix C. Actions and associated pollutant load reductions will be reevaluated if CBP revises or updates pollutant removal efficiencies within the 10-year timeframe to ensure that the nutrient TMDL reductions are met.

5.4 Implementation Tracking

Implementation of restoration actions for the Middle Gwynns Falls SWAP will be overseen by the Implementation Committee (an outgrowth of the Steering Committee). The committee will assess progress with individual actions related to the amount complete and the ease of implementation. Overall progress with meeting pollutant reductions will also be assessed. Adaptive management will allow the committee to discuss changes to the action schedule depending on the success of individual actions and the overall progress with the plan. If additional water quality issues arise, the Middle Gwynns Falls SWAP Implementation Committee will initiate revisions of the plan.

Progress and success of the Middle Gwynns Falls SWAP will be evaluated based on the following: interim measurable milestones, pollutant load reduction criteria, implementation tracking and monitoring. These evaluation components are described in the following sections.

5.5 Monitoring

Baltimore County currently conducts water quality monitoring programs within the Middle Gwynns Falls planning area. Additional monitoring is anticipated to assess the effectiveness of restoration projects and progress in meeting nutrient TMDL reductions.

5.5.1 Existing Monitoring

Baltimore County conducts chemical, biological, and illicit connection monitoring within the Middle Gwynns Falls watershed. These are described in detail in Chapter 3.4 of the *Watershed Characterization Report* (Appendix E) and listed below:

- Scotts Level Long-Term Monitoring - consists of flow, chemical, geomorphologic, and biological monitoring intended to monitor all restoration projects in Scotts Level above the in-stream monitoring site.
- Baltimore County Chemical Trend Monitoring – 40 monitoring sites throughout the County, 2 of which are located within the Middle Gwynns Falls watershed, provide information on ambient chemical conditions and assess trends in chemical concentrations and loads (EPS, 2013).
- Bacteria Monitoring – conducted at 4 sites in total (2 in Baltimore County and 2 in Baltimore City) and 1 site in the Middle Gwynns Falls watershed
- Biological Monitoring – conduct assessments based on the benthic macroinvertebrate community and fish assemblage to assess the ecological health of streams, assess the effectiveness of stream restoration projects, and provide data on the best streams in the County to serve as bench marks for other stream assessments (EPS, 2013).
- Illicit Discharge Detection and Elimination Program – Routine outfall screening and prioritization system to track and reduce illicit connections and discharges.
- Baltimore Ecosystem Study – research on the long-term ecological characteristics of the Gwynns Falls ecosystem as part of the National Science Foundation's Long-Term Ecological Research Program

5.5.2 SWAP Implementation Monitoring

SWAP implementation monitoring activities will focus on project specific monitoring and targeted subwatershed monitoring. Project specific monitoring will be indentified as restoration progresses. It will not be possible to monitor all restoration projects due to the number of actions proposed. Project specific monitoring will target activities with limited data regarding removal efficiencies such as bayscaping education. Subwatershed monitoring will measure overall improvement in water quality as a result of multiple restoration activities within a subwatershed. This will also be developed as restoration progresses. There is potential to coordinate a citizen-based stream watch program since existing water quality monitoring stations are limited in non-tidal portions of the Middle Gwynns Falls watershed. Monitoring activities will be coordinated among SWAP participants through participation in the Middle Gwynns Falls SWAP Implementation Committee.

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APPENDIX A:

Middle Gwynns Falls Action Strategies

Middle Gwynns Falls Action Strategies

This appendix presents the actions related to the goals and objectives presented in Chapter 2 of the Middle Gwynns Falls SWAP. A complete list of actions proposed for the watershed including timelines, performance measures, unit cost estimates, and responsible parties is included in Table A-1. In many cases, actions relate to multiple goals and objectives. Table A-2 indicates the goals and objectives targeted for each action. Some of the key columns included in Table A-1 are briefly described below.

Action

Actions developed to achieve watershed goals and objectives are grouped in Table A-1 according to the type of activity. Actions are grouped according to the following categories (and subcategories for restoration actions):

- Restoration Actions
  - Nutrient Reduction
  - Stormwater Management
  - Urban Tree Canopy
  - Trash Management
  - Tidal Waters
  - Stream Corridor Restoration
  - Land Preservation
  - Coordination
- Outreach & Awareness
- Monitoring
- Funding
- Reporting

Basis for Performance Measure

This column describes how performance measures were developed for each action. Performance measures were developed using the information in this column in conjunction with the action timeline.

Timeline

As part of the Chesapeake Bay TMDL, jurisdictions are required to track progress on 2 year intervals. To help facilitate this process, the proposed action items for this SWAP have been divided into columns representing the 2 year intervals. These columns denote the timeline over which an action will be performed.

Performance Measure

This column describes how the success/completion of a given action will be measured. In many cases, it is the numeric basis of the performance measure divided by the proposed timeline.

Unit Cost

Unit costs are used to develop overall cost estimates for proposed watershed action strategies (see Appendix B).

Responsible Party

Those responsible for ensuring the success/completion of a given action are denoted by a numeric code in this column. Responsible parties are indicated by numerals as follows:

1. Baltimore County
2. Blue Water Baltimore (BWB)
3. Maryland State Highway Administration (SHA)
4. SWAP Implementation Committee

	Action	Basis for Performance Measure	Performance Measure	Total Number Units	Period 1 7/13-6/15	Period 2 7/15-6/17	Period 3 7/17-6/19	Period 4 7/19-6/21	Period 5 7/21-6/23	Period 6 7/23-6/25	Unit Cost
RESTORATION ACTIONS											
	Nutrient Reduction										
1	Replace lawns with bayscapes in the 42 neighborhoods identified.	Conduct 12 bayscaping education events targeting 3-4 neighborhoods per event (392.1 acres of lawn identified for bayscaping x 2% participation rate = 7.84 acres)	7% participation x 392.1 acres	12 events	2 events	2 events	2 events	2 events	2 events	2 events	$500 / event
2	Continue municipal road maintenance street sweeping activities. Investigate the 34 neighborhoods recommended for street sweeping to implement activities and/or adjust frequency as needed.	76.1 miles of road within neighborhoods identified for street sweeping	100% participation x 76.1 miles	76.1 miles	76.1 miles	76.1 miles	76.1 miles	76.1 miles	76.1 miles	76.1 miles	Existing Staff
	Stormwater Management										
3	Investigate the potential conversion of 10 existing dry detention ponds to enhanced water quality treatment.	10 out of 15 existing detention ponds identified as having physical expansion capability x assume 100% projected participation = 10 conversions	10 conversions x 100% participation	10 conversions	1 conversions	3 conversions	3 conversions	3 conversions			$3,200 / acre
4	Investigate the feasibility of implementing stormwater retrofits to treat runoff from impervious surfaces (parking lots, alleys) in the 23 neighborhoods identified.	23 potential neighborhood sites identified	23 neighborhoods investigated	23 investigations	8 investigations	8 investigations	7 investigations				Existing Staff
5	Investigate the feasibility of implementing stormwater retrofits for parking lots and/or inlets at the 16 institutional sites identified (11 public, 5 private).	16 potential institution sites identified	16 institutions investigated	16 investigations	8 investigations	8 investigations					Existing Staff
6	Design and implement stormwater retrofits at feasible sites identified in Actions 4 and 5.	23 neighborhoods + 16 institutions = 39 sites identified x 50% participation rate = 20 stormwater retrofits	50% participation x 39 retrofit sites	20 sites		4 sites	4 sites	4 sites	4 sites	4 sites	$50,000 / retrofit
7	Work with institutional partners to reduce impervious cover at the 8 institutional sites identified (5 public, 3 private).	Maximum potential of 3.70 acres of impervious cover removal identified x 75% participation rate; Work with institutions to remove impervious cover and meet 2.78 acres reduction goal	75% participation x 3.70 acres	2.8 acres	1.4 acres	1.4 acres					$25,000 / acre
8	Develop and implement a downspout disconnection program. Use rainbarrels, rain gardens, and/or redirection for downspout disconnection in the 87 recommended neighborhoods.	205.8 acres of impervious rooftop identified x 43% participation rate = 138 acres	43% participation x 206 acres	89 acres	15 acres	15 acres	15 acres	15 acres	15 acres	15 acres	$300 / house
9	Design and implement the wetland creation project recommended in the Gwynns Falls Water Quality Management Plan	1 wetland creation site implemented	1 wetland creation project			1 wetland creation project					Varies
10	Design and implement BMP creation projects recommended in the Gwynns Falls Water Quality Management Plan	Maximum potential of 5 projects identified x 60% participation rate; 3 projects implemented	3 BMP creation projects			1 BMPcreation project		1 BMPcreation project		1 BMPcreation project	Varies
11	Assess all storm drain outfalls for retrofit	All storm drain outfalls assessed	492 outfalls assessed	Assess							$50,000 / retrofit
12	Design and implement retrofits to storm drain outfalls identified during the assessment.	33% of urban area addressed through retrofit	33% participation x 8619 acres	4261 acres	554 acres	1129 acres	645 acres	645 acres	645 acres	645 acres	$50,000 / retrofit
	Urban Tree Canopy										
12	Investigate the feasibility of planting riparian stream buffers on open pervious land.	384 acres of open pervious land identified within the 100-foot stream buffer through GIS analysis.	Feasible buffer planting sites identified	384 acres	192 acres investigated	192 acres investigated					Existing Staff
13	Reforest stream buffer at feasbile sites with a minimum width of 35 feet.	384 acres of open pervious stream buffer identified in the GIS analysis x 33% participation rate = 127 acres	33% participation x 384 acres	127 acres	11.5 acres	23.0 acres	23.0 acres	23.0 acres	23.0 acres	23.0 acres	$15,000 / acre
14	Encourage street and shade tree planting in the 82 recommended neighborhoods.	Maximum potential of 9,041 trees x (1 acre/135 trees) = 67 acres x 43% participation rate = 28.8 acres (or 3,888 trees)	43% participation x 67 acres	3,888 trees	648 trees	648 trees	648 trees	648 trees	648 trees	648 trees	$175 / tree
15	Encourage institutions to plant trees on available open space at the 41 sites identified.	Maximum potential of 9,693 trees x (1 acre/135 trees) = 71.8 acres x 65% participation rate = 46.7 acres (or 6,300 trees)	65% participation x 9,693 trees	6,300 trees	1050 trees	1050 trees	1050 trees	1050 trees	1050 trees	1050 trees	$175 / tree
16	Baltimore County shall continue to require riparian buffers and forest conservation for all new and re-development.	On-going, keep track of existing riparian buffer and forest preserved	Acres preserved	On-going	On-going	On-going	On-going	On-going	On-going	On-going	Existing Staff
17	Maintain trees planted at reforestation/tree planting sites.	Tree maintenance (watering, mowing, weeding, etc.) is required for the first 5 years to ensure successful growth; projected number of acres to be reforested/planted: 45+36+18.1+21.2+21.4= 142 acres (max 660 acres)	Maintain 152.5 acres	Maintain	Maintain	Maintain	Maintain	Maintain	Maintain	Maintain	$6,500 / acre
18	Improve forest health by removing exotic invasive species.	Remove 1 acres of exotic species per year	Remove 8 acres of exotic species	12.0 acres	2.0 acres	2.0 acres	2.0 acres	2.0 acres	2.0 acres	2.0 acres	$250 / acre
19	Continue revitalization and redevelopment of Baltimore County Communities incorporating an increase of parkland. Develop a tracking system and track associated load reductions	1,339 acres of redevelopment opportunity identified x 67% redevelopment	Redevelop 67% of 1,339 acres of urban area	897.2 acres	149.5 acres	149.5 acres	149.5 acres	149.5 acres	149.5 acres	149.5 acres	Existing Staff
	Trash Management										
20	Post no dumping signs in problem areas identified and enforce no dumping.	Signs posted; Upland sites identified with trash management/dumping issues: 13 neighborhoods + 38 hotspots + 35 institutions = 86 sites	Post 20% of signs per year	86 signs	22 signs	22 signs	21 signs	21 signs			$40 / sign

Responsible Parties

1. Baltimore County
2. BWB
3. SHA
4. SWAP Implementation Committee

Table A-2: Middle Gwynns Falls Action Strategies – Action Detail Matrix

	Action	Basis for Performance Measure	Performance Measure	Total Number Units	Period 1 7/13-6/15	Period 2 7/15-6/17	Period 3 7/17-6/19	Period 4 7/19-6/21	Period 5 7/21-6/23	Period 6 7/23-6/25	Unit Cost
21	Identify areas where additional trash cans, covered receptacles, and/or better maintenance measures are needed.	Assess bus stops and community parks in the watershed.	Problem areas identified and addressed	Identification	Identify						Existing Staff
22	Implement recycling and add separate receptacles for recycling on public properties such as parks.	Implement recycling in County parks	Address community parks	TBD	Implement	Implement					Existing Staff
23	Encourage and support community cleanups in neighborhoods.	13 neighborhoods identified as having trash management issues	2-3 community cleanups per year	30 cleanups	5 cleanups	5 cleanups	5 cleanups	5 cleanups	5 cleanups	5 cleanups	Existing Staff
24	Encourage and support waterway cleanups in streams.	Conduct annual stream cleanups.	1 cleanup per year	12 cleanups	2 cleanups	2 cleanups	2 cleanups	2 cleanups	2 cleanups	2 cleanups	
25	Support and expand Baltimore County's "Clean Green County" initiative	Average residential recycling rate of at least 50%	50% residential recycling rate	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
26	Develop and implement signs and educational material for the trash campaign in the watershed.	Develop signs and post throughout watershed;	Develop material, post signs	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	$9,000 / year
27	Develop a trash treaty for institutions, public properties and neighorhoods.	Develop signs and post throughout watershed	Develop material, post signs	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
28	Encourage institional partners, community groups, and patrons of public properties to sign and support a trash treaty.	Have sign-up events	1 sign-up event per year	12 events	2 events	2 events	2 events	2 events	2 events	2 events	Existing Staff
29	Develop a County-wide Trash Reduction Strategy and a trash reduction tracking mechanism	Trash Reduction Strategy and tracking mechanism developed by 2013	Develop Strategy & mechanism	Develop							Existing Staff
	Stream Corridor Restoration										
30	Identify eroded stream banks and channel alterations with feasible restoration potential among the sites identified in the 2004 *Gwynns Falls Water Quality Management Plan* .	Investigate potential stream restoration sites identified in the 2004 *Gwynns Falls Water Quality Management Plan* along with sites identified during Uplands Assessments	Feasible restoration sites identified	Identification	Identify	Identify					Existing Staff
31	Complete stream restoration projects at feasible sites identified in the 2004 Gwynns Falls Water Quality Management Plan. .	Complete stream restoration projects at 85% of sites identified in the 2004 Gwynns Falls Water Quality Management Plan.	85% participation x 19,930 L.F.	16,941 LF	8,470 LF	8,470 LF					Existing Staff
32	Identify eroded stream banks and channel alterations with feasible restoration potential among the sites identified with high unstable stable stream ratios.	Investigate potential stream restoration for reaches with high unstable stable stream ratios.	Feasible restoration sites identified	Identification	Identify	Identify					Existing Staff
33	Complete stream restoration projects at feasible sites with high unstable stable stream ratios.	Complete stream restoration projects at 50% of sites with high unstable stable stream ratios.	50% participation x 64,863 L.F.	32,432 LF			8,108 LF	8,108 LF	8,108 LF	8,108 LF	Existing Staff
32	Identify and upgrade eroded outfalls.	Complete outfall restoration projects at 75% of sites identified in the 2004 Gwynns Falls Water Quality Management Plan.	75% of Eroded Outfalls	75% of Eroded Outfalls		15% of Eroded Outfalls	15% of Eroded Outfalls	15% of Eroded Outfalls	15% of Eroded Outfalls	15% of Eroded Outfalls	Existing Staff
	Land Preservation										
33	Identify lands available for permanent conservation and preservation.	Develop a catalog of lands within the 100-foot stream and shoreline buffers available to permanent conservation and preservation.	Available land identified	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
34	Work with private property owners to undertake perpetual land conservation easements on currently undeveloped properties.	Identify and assist privately-owned properties within the 100-foot stream and shorline buffers move to permanent conservation and preservation	10% of available land parcels conserved	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
35	Acquire undeveloped parcels for permanent conservation and preservation	Identify forested parcels within the 100-foot stream and shorline buffers and facilitate perservation and conservation through agencies.	10% of available land parcels conserved	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
	Bacteria Reductions										
36	Identify areas where sanitary sewer overflows are occuring on a frequent basis.	Develop catalog of sanitary sewer overflows	Catalog Deveoped	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
37	Implement sewer repairs in areas of where frequent sanitary sewer overflows are occuring	Implement sewer repairs	Sewer Repairs Implemented	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
	Chloride Reductions										
38	Investigate measures to revise contract language between Baltimore County, State Highway Administration, and subcontractors to reduce excessive salt application on local roads and highways	Revise contract language to remove incentives for over-application of salts.	Contract language revised	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
OUTREACH & AWARENESS											
39	Distribute pollution prevention information to facilities falling within hotspot categories identified in the watershed and provide guidance/workshops Include working with business partners to cut off stream access in areas with dumping issues and encourage them to keep parking lots free of trash and debris.	22 hotspot sites assessed; Categories identified: shopping centers, auto-related facilities, industrial facilities, and construction facilities; Conduct 3 workshops and distribute outreach material	1 workshop every 3 years	3 workshops	1 workshop		1 workshop	1 workshop		1 workshop	$500 / workshop

Responsible Parties

1. Baltimore County
2. BWB
3. SHA
4. SWAP Implementation Committee

Table A-2: Middle Gwynns Falls Action Strategies – Action Detail Matrix

	Action	Basis for Performance Measure	Performance Measure	Total Number Units	Period 1 7/13-6/15	Period 2 7/15-6/17	Period 3 7/17-6/19	Period 4 7/19-6/21	Period 5 7/21-6/23	Period 6 7/23-6/25	Unit Cost
40	Form partnerships with community groups and discuss the BMP recommendations from the neighborhood assessments and implementation options.	91 neighborhoods assessed - target at least 3 neighborhoods per informational meeting	2 neighborhood meetings per year	26 meetings	4 meetings	4 meetings	4 meetings	4 meetings	4 meetings	4 meetings	$500 / meeting
41	Form partnerships with institutions and discuss the BMP recommendations from the institutional assessments and implementation options. Include implementing/enhancing recycling programs on their properties.	16 institutions recommended	2 institution meetings per year	16 meetings	4 meetings	4 meetings	4 meetings	4 meetings			Existing Staff
42	Work with community groups to install storm drain markers in the 138 recommended neighborhoods.	Install markers in 138 neighborhoods identified	11-12 neighborhoods per year	138 sites	23 sites	23 sites	23 sites	23 sites	23 sites	23 sites	$400 / event (site)
43	Work with institutional sites to install storm drain markers at the 37 recommended sites.	Install markers at 37 institutions identified	6 institutions per year	37 sites	6 sites	7 sites	6 sites	6 sites	6 sites	6 sites	$400 / event (site)
44	Conduct a tour of a completed water quality project/BMP on public property.	Conduct two tours of completed watershed restoration projects (e.g., stormwater retrofit)	1 tour per 5 years	3 tours	1 tour			1 tour			Existing Staff
45	Increase agency collaboration through in-house meetings	Conduct 4 meetings with County Economic Development agency	2 meetings per year		2 meetings						Existing Staff
46	Educate citizens of the negative effects of salt on the environment and encourage citizens to report more often.	Develop and distribute educational materials to the public	Eductation provided	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
MONITORING											
47	Continue to monitor and remove illicit connections through the Illicit Connections Program	Inspect all 10 of the non-prioritized outfalls within 2 years and the 19 priority 1 or 2 outfalls according to their designated inspection schedule	5 routine inspections per year	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
48	Continue monitoring hotspots through upland surveys in the watershed	Complete inspections on 10 hotspots and provide recommendations on pollution prevention measures	10 hotspot inspections per year	120 inspections	20 inspections	20 inspections	20 inspections	20 inspections	20 inspections	20 inspections	Existing Staff
49	Implement a Stream Watch program, a citizen-based program to increase the ability to monitor/identify sources of water quality and habitat degradation.	Implement a program based on number of stream miles with high unstable/stable stream ratios	20 miles of stream adopted	20 miles of stream	2 miles adopted	2 miles adopted	3 miles adopted	3 miles adopted	3 miles adopted	3 miles adopted	Existing Staff
50	Continue stormwater facility maintenance and inspection program	Assure continued function of Stormwater Facilities as required as part of the NPDES MS4 permit.	Continue routine inspections	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
51	Monitor nitrogen and phosphorus levels within the planning area	Complete annual monitoring of nutrient levels in the planning area	Annual monitoring	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
52	Work with State Agencies to track restoration projects and associated pollution reduction credits.	Compile a list or database of projects completed by MD state agencies within the watershed and determine pollution reduction credits for each	Database compiled and updated	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
53	Work with DNR to monitor deer population in the watershed	White-tailed deer populations monitored yearly and biannual reports are produced by Maryland Department of Natural Resources	Biannual reports	7 reports	1 report	1 report	1 report	1 report	1 report	1 report	Existing Staff
FUNDING											
54	Coordinate grant funding requests to secure funding and implement restoration projects to meet TMDL nutrient reductions requirements.	Seek a minimum of 1 grant per year to meet nutrient reduction goals within 13 years	1 grant proposal per year	13 proposals	2 proposals	2 proposals	2 proposals	2 proposals	2 proposals	2 proposals	Existing Staff
55	Support an increase in funding for the Baltimore County - Green Building Tax Credit Program as a model.	Work with Baltimore County Department of Economic Development to lobby for increase in funding	Lobby	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Existing Staff
56	Support an increase in funding requests for environmental education in the watershed	Seek a minimum of 1 grant per year to improve environmental education within 13 years	1 grant proposal per year	13 proposals	2 proposals	2 proposals	2 proposals	2 proposals	2 proposals	2 proposals	
57	Develop a stormwater management utility fee for Baltimore County.	Develop stormwater management utility fee by July, 2013	Fee developed by 7/13	1 Utility Fee	Developed						Existing Staff
58	Support an increase in applications for the Maryland Department of Natural Resources Land Conservation Programs including Program Open Space, Rural Legacy, and Maryland Environmental Trust	Submit a minimum of 1 application per year	1 application per year	13 applications	2 applications	2 applications	2 applications	2 applications	2 applications	2 applications	Existing Staff
REPORTING											
59	Middle Gwyns Falls Implementation Committee will meet to discuss implementation progress and assess any changes needed to meet the goals.	Conduct meetings in a semi-annual basis	2 meetings per year	26 meetings	4 meetings	4 meetings	4 meetings	4 meetings	4 meetings	4 meetings	Existing Staff
60	Develop a unified restoration tracking system to track progress toward meeting TMDL reduction requirements.	Tracking system currently being developed for similar SWAPs (e.g., Back River, Jones Falls)	Tracking system developed	On-going	On-going	On-going	On-going	On-going	Ongoing	Ongoing	Existing Staff
61	Update the status of citizen-based restoration projects and BMPs on an annual basis	Provide progress update in annual NPDES Report.	NPDES annual report	Annual Reports	2 Annual Reports	2 Annual Reports	2 Annual Reports	2 Annual Reports	2 Annual Reports	2 Annual Reports	Existing Staff
62	Continue to update status of County capital budget restoration projects and BMPs	Provide progress update in annual NPDES Report.	NPDES annual report	Annual Reports	2 Annual Reports	2 Annual Reports	2 Annual Reports	2 Annual Reports	2 Annual Reports	2 Annual Reports	Existing Staff

<u>Responsible Parties</u>

1. Baltimore County
2. BWB
3. SHA
4. SWAP Implementation Committee

Table A-2: Middle Gwynns Falls Action Strategies – Goal Objective Matrix

	Action	Respons. Party*	Goal 1					Goal 2						Goal 3					Goal 4			Goal 5			Goal 6			Goal 7		
			1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	1	2	3	1	2	3	1	2	3	1	2	3
	RESTORATION ACTIONS																													
	Nutrient Reduction																													
1	Replace lawns with bayscapes in the 42 neighborhoods identified.	1, 2	X	X		X	X												X				X	X					X	X
2	Continue municipal road maintenance street sweeping activities. Investigate the 34 neighborhoods recommended for street sweeping to implement activities and/or adjust frequency as needed.	1	X	X	X	X	X						X										X	X						
	Stormwater Management																													
3	Investigate the potential conversion of 10 existing dry detention ponds to enhanced water quality treatment.	1	X	X	X	X	X	X	X		X												X	X				X		
4	Investigate the feasibility of implementing stormwater retrofits to treat runoff from impervious surfaces (parking lots, alleys) in the 23 neighborhoods identified.	1	X	X	X	X	X	X	X		X												X	X				X		
5	Investigate the feasibility of implementing stormwater retrofits for parking lots and/or inlets at the 16 institutional sites identified (11 public, 5 private).	1	X	X	X	X	X	X	X		X												X	X				X		
6	Design and implement stormwater retrofits at feasible sites identified in Actions 4 and 5.	1	X	X	X	X	X				X												X	X				X		
7	Work with institutional partners to reduce impervious cover at the 8 institutional sites identified (5 public, 3 private).	1, 2, 4	X	X	X	X	X				X	X											X	X				X		
8	Develop and implement a downspout disconnection program. Use rainbarrels, rain gardens, and/or redirection for downspout disconnection in the 87 recommended neighborhoods.	1, 2, 4	X	X			X				X		X						X				X	X				X	X	X
9	Design and implement the wetland creation project recommended in the Gwynns Falls Water Quality Management Plan	1	X	X	X	X	X	X	X		X												X	X				X		
10	Design and implement BMP creation projects recommended in the Gwynns Falls Water Quality Management Plan	1	X	X	X	X	X	X	X		X												X	X				X		
11	Assess all storm drain outfalls for retrofit	1	X	X	X	X	X	X	X		X												X	X				X		
12	Design and implement retrofits to storm drain outfalls identified during the assessment.	1	X	X	X	X	X				X												X	X				X		
	Urban Tree Canopy																													
12	Investigate the feasibility of planting riparian stream buffers on open pervious land.	1	X	X	X	X	X															X	X	X	X		X			
13	Reforest stream buffer at feasbile sites with a minimum width of 35 feet.	1, 2, 4	X	X	X	X	X															X	X	X	X		X			
14	Encourage street and shade tree planting in the 82 recommended neighborhoods.	2	X	X	X	X	X						X						X						X		X			
15	Encourage institutions to plant trees on available open space at the 41 sites identified.	2	X	X		X	X												X	X					X					
16	Baltimore County shall continue to require riparian buffers and forest conservation for all new and re-development.	1	X	X	X	X	X						X									X	X	X	X		X			
17	Maintain trees planted at reforestation/tree planting sites.	1, 2, 4	X	X		X	X						X									X	X	X	X	X	X			
18	Improve forest health by removing exotic invasive species.	2	X	X			X															X	X	X	X	X				
19	Continue revitalization and redevelopment of Baltimore County Communities incorporating an increase of parkland. Develop a tracking system and track associated load reductions	1	X	X	X	X	X			X		X	X												X		X			
	Trash Management																													
20	Post no dumping signs in problem areas identified and enforce no dumping.	1													X															

Responsible Parties

1. Baltimore County
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Table A-2: Middle Gwynns Falls Action Strategies – Goal Objective Matrix

	Action	Respons. Party*	Goal 1					Goal 2						Goal 3					Goal 4			Goal 5			Goal 6			Goal 7		
			1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	1	2	3	1	2	3	1	2	3	1	2	3
21	Identify areas where additional trash cans, covered receptacles, and/or better maintenance measures are needed.	1													X															
22	Implement recycling and add separate receptacles for recycling on public properties such as parks.	1													X		X													
23	Encourage and support community cleanups in neighborhoods.	1, 2, 4												X	X	X														
24	Encourage and support waterway cleanups in streams.	1, 2, 4														X														
25	Support and expand Baltimore County's "Clean Green County" initiative	1, 2, 4												X	X	X	X	X			X									
26	Develop and implement signs and educational material for the trash campaign in the watershed.	1												X	X	X	X	X			X									
27	Develop a trash treaty for institutions, public properties and neighorhoods.	1, 2, 4												X	X	X	X	X			X									
28	Encourage institional partners, community groups, and patrons of public properties to sign and support a trash treaty.	1, 2, 4												X	X	X	X	X			X									
29	Develop a County-wide Trash Reduction Strategy and a trash reduction tracking mechanism	1												X	X		X	X			X									
	Stream Corridor Restoration																													
30	Identify eroded stream banks and channel alterations with feasible restoration potential among the sites identified in the 2004 *Gwynns Falls Water Quality Management Plan* .	1	X	X			X															X	X	X						
31	Complete stream restoration projects at feasible sites identified in the 2004 Gwynns Falls Water Quality Management Plan. .	1	X	X			X															X	X	X						
32	Identify eroded stream banks and channel alterations with feasible restoration potential among the sites identified with high unstable stable stream ratios.	1	X	X			X															X	X	X						
33	Complete stream restoration projects at feasible sites with high unstable stable stream ratios.	1	X	X			X															X	X	X						
32	Identify and upgrade eroded outfalls.	1	X	X			X															X	X	X						
	Land Preservation																													
33	Identify lands available for permanent conservation and preservation.	1								X																				
34	Work with private property owners to undertake perpetual land conservation easements on currently undeveloped properties.	1								X																				
35	Acquire undeveloped parcels for permanent conservation and preservation	1								X																				
	Bacteria Reductions																													
36	Identify areas where sanitary sewer overflows are occuring on a frequent basis.	1, 4				X																								
37	Implement sewer repairs in areas of where frequent sanitary sewer overflows are occuring	1				X																								
	Chloride Reductions																													
38	Investigate measures to revise contract language between Baltimore County, State Highway Administration, and subcontractors to reduce excessive salt application on local roads and highways	1, 3, 4			X																									
	OUTREACH & AWARENESS																													
39	Distribute pollution prevention information to facilities falling within hotspot categories identified in the watershed and provide guidance/workshops. Include working with business partners to cut off stream access in areas with dumping issues and encourage them to keep parking lots free of trash and debris.	1, 2, 4	X	X	X	X	X							X	X		X	X			X									

<u>Responsible Parties</u>

1. Baltimore County
2. BWB
3. SHA
4. SWAP Implementation Committee

Table A-2: Middle Gwynns Falls Action Strategies – Goal Objective Matrix

	Action	Respons. Party*	Goal 1					Goal 2						Goal 3					Goal 4			Goal 5			Goal 6			Goal 7		
			1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	1	2	3	1	2	3	1	2	3	1	2	3
40	Form partnerships with community groups and discuss the BMP recommendations from the neighborhood assessments and implementation options.	1, 2, 4	X	X	X	X	X												X										X	X
41	Form partnerships with institutions and discuss the BMP recommendations from the institutional assessments and implementation options. Include implementing/enhancing recycling programs on their properties.	1, 2, 4	X	X	X	X	X												X	X									X	X
42	Work with community groups to install storm drain markers in the 138 recommended neighborhoods.	1, 2, 4	X	X	X	X	X												X										X	X
43	Work with institutional sites to install storm drain markers at the 37 recommended sites.	1, 2, 4	X	X	X	X	X												X	X									X	X
44	Conduct a tour of a completed water quality project/BMP on public property.	1	X	X			X												X	X									X	X
45	Increase agency collaboration through in-house meetings	1	X	X	X	X	X																							
46	Educate citizens of the negative effects of salt on the environment and encourage citizens to report more often.	1			X														X	X									X	X
	MONITORING																													
47	Continue to monitor and remove illicit connections through the Illicit Connections Program	1	X	X	X	X	X																							
48	Continue monitoring hotspots through upland surveys in the watershed	1	X	X	X	X	X																							
49	Implement a Stream Watch program, a citizen-based program to increase the ability to monitor/identify sources of water quality and habitat degradation.	1, 2, 4	X	X			X																							
50	Continue stormwater facility maintenance and inspection program	1	X	X	X	X	X																							
51	Monitor nitrogen and phosphorus levels within the planning area	1	X	X	X	X	X																							
52	Work with State Agencies to track restoration projects and associated pollution reduction credits.	1	X	X	X	X	X																							
53	Work with DNR to monitor deer population in the watershed	1				X																								
	FUNDING																													
54	Coordinate grant funding requests to secure funding and implement restoration projects to meet TMDL nutrient reductions requirements.	1, 2, 4	X	X	X	X	X																							
55	Support an increase in funding for the Baltimore County - Green Building Tax Credit Program as a model.	1, 2, 4	X	X			X																							
56	Support an increase in funding requests for environmental education in the watershed	1, 2	X	X	X	X	X																							
57	Develop a stormwater management utility fee for Baltimore County.	1	X	X	X	X	X																							
58	Support an increase in applications for the Maryland Department of Natural Resources Land Conservation Programs including Program Open Space, Rural Legacy, and Maryland Environmental Trust	1, 2, 4	X	X			X																							
	REPORTING																													
59	Middle Gwyns Falls Implementation Committee will meet to discuss implementation progress and assess any changes needed to meet the goals.	4	X	X	X	X	X																							
60	Develop a unified restoration tracking system to track progress toward meeting TMDL reduction requirements.	1, 4	X	X	X	X	X																							
61	Update the status of citizen-based restoration projects and BMPs on an annual basis	1	X	X	X	X	X																							
62	Continue to update status of County capital budget restoration projects and BMPs	1	X	X	X	X	X																							

Responsible Parties

1. Baltimore County
2. BWB
3. SHA
4. SWAP Implementation Committee

APPENDIX B:

Cost Analysis and Potential Funding Sources

Cost Analysis and Potential Funding Sources

This appendix presents cost estimates and potential funding sources for the implementation of proposed restoration BMPs in the Middle Gwynns Falls SWAP. Each is described below.

Cost Analysis

The cost analysis is based on the actions detailed in Appendix A. Cost estimates are summarized in Tables B-1, B-2, and B-3. Table B-1 presents cost estimates based on the maximum implementation scenario described in Chapter 3. Table B-2 presents costs estimates based on the projected participation rates needed to achieve the 2017 reduction goals in nutrient loads from urban runoff, also described in Chapter 3. Table B-3 presents costs estimates based on the projected participation rates needed to achieve the 2025 reduction goals in nutrient loads from urban runoff. For each scenario, estimates are provided in 2013 dollars and represent total cost estimates for the anticipated implementation timeframe. Unit costs are based on a combination of local information and previous SWAPs completed for other local watersheds. BMP costs are not annualized over the implementation timeframe and do not include costs of existing staff. Costs are also presented in dollars per pound of nitrogen, phosphorus, and sediment removal for those BMPs where pollutant removal calculations were possible (refer to Chapter 3). This provides an additional tool for the assessment and selection of BMPs. The total cost of implementation exclusive of staffing costs is approximately $116,600,074 for maximum implementation and $49,368,643 based on projected participation rates for 2025.

Table B-1: Maximum Estimated Costs for Middle Gwynns Falls SWAP Implementation

Action	Unit Cost	Max Quantity	Max Total Cost	Max TN Load Reduction (lbs / yr)	Max TP Load Reduction (lbs / yr)	Max TSS Load Reduction (lbs / yr)	Max Cost / lb of TN Removal per year	Max Cost / lb of TP Removal	Max Cost / lb of TSS Removal
SWM Conversions	$ 3,200 / acre	335 acres	$ 1,071,296	677	23	145,837	$ 1,583	$ 45,604	$ 7
SW Retrofits	$ 50,000 / retrofit	39 retrofits	$ 1,950,000	259	27	55,373	$ 7,519	$ 71,764	$ 35
Impervious Cover Removal	$ 25,000 / acre	3.7 acre	$ 92,583	21	5	6,579	$ 4,318	$ 20,539	$ 14
Downspout Disconnection Program	$ 300 / house	15,774 houses	$ 4,732,200	1,785	187	381,051	$ 2,652	$ 25,307	$ 12
Reforest Stream Buffer	$ 15,000 / acre	384 acres	$ 5,756,186	3,369	99	76,467	$ 1,709	$ 58,050	$ 75
Neighborhood Tree Planting	$ 175 / tree	9,041 trees	$ 1,582,175	587	17	13,278	$ 2,694	$ 91,713	$ 119
Institutional Tree Planting	$ 175 / tree	9,693 trees	$ 1,696,275	630	18	14,235	$ 2,694	$ 91,713	$ 119
Tree Maintenance	$ 6,500 / acre	523 acres	$ 3,396,355	N/A	N/A	N/A	NA	NA	NA
Bayscaping Education	$ 500 / event	12 events	$ 6,000	770	26	0	$ 8	$ 234	$ -
Stream Restoration Projects	$ 350 / ln ft	84,793 ln ft	$ 29,677,593	16,959	5,766	26,285,868	$ 1,750	$ 5,147	$ 1
Wetland Creation Projects	$ 250,000 / project	1 project	$ 250,000	169	20	32,813	$ 1,478	$ 12,613	$ 8
BMP Creation Projects	$ 236,000 / project	5 projects	$ 1,180,000	963	50	186,844	$ 1,225	$ 23,524	$ 6
MS4 Retrofits	$ 5,000 / acre	12,913 acres	$ 64,564,471	43,504	3,171	7,312,636	$ 1,484	$ 20,359	$ 9
Remove Invasive Species	$ 250 / acre	12 acres	$ 3,000	N/A	N/A	N/A	NA	NA	NA
Post Signs	$ 40 / sign	86 signs	$ 3,440	N/A	N/A	N/A	NA	NA	NA
Pollution Prevention Workshops	$ 500 / workshop	3 workshops	$ 1,500	N/A	N/A	N/A	NA	NA	NA
Neighborhood BMP Meetings	$ 500 / meeting	26 meetings	$ 13,000	N/A	N/A	N/A	NA	NA	NA
ISI Recommendation Meetings	$ 500 / meeting	16 meetings	$ 8,000	N/A	N/A	N/A	NA	NA	NA
Storm Drain Markers	$ 400 / site	175 sites	$ 70,000	N/A	N/A	N/A	NA	NA	NA
Trash Campaign Materials	$ 9,000 / year	12 years	$ 108,000	N/A	N/A	N/A	NA	NA	NA
Waterway Cleanups	$ 1,000 / cleanup	30 cleanups	$ 30,000	N/A	N/A	N/A	NA	NA	NA
Water Quality Monitoring Report	$ 34,000 / report	12 reports	$ 408,000	N/A	N/A	N/A	NA	NA	NA
		Total:	***$ 116,600,074***	***69,693***	***9,410***	***34,510,980***			

Note: 'NA" denotes not assessed in the pollutant removal analysis.

Table B-2: 2017 Projected Estimated Costs for Middle Gwynns Falls SWAP Implementation

Action	Unit Cost	Proj. 2017 Quantity	Proj. 2017 Total Cost	Proj. 2017 TN Load Reduction (lbs / yr)	Proj. 2017 TP Load Reduction (lbs / yr)	Proj. 2017 TSS Load Reduction (lbs / yr)	Proj. 2017 Cost / lb of TN Removal per year	Proj. 2017 Cost / lb of TP Removal per year	Proj. 2017 Cost / lb of TSS Removal per year
SWM Conversions	$ 3,200 / acre	134 acres	$ 428,518	271	9	58,335	$ 1,583	$ 45,604	$ 7
SW Retrofits	$ 50,000 / retrofit	4 retrofits	$ 200,000	26	3	5,537	$ 7,712	$ 73,604	$ 36
Impervious Cover Removal	$ 25,000 / acre	2.8 acre	$ 69,437	16	3	4,934	$ 4,318	$ 20,539	$ 14
Downspout Disconnection Program	$ 300 / house	1,850 houses	$ 554,958	209	22	44,687	$ 2,652	$ 25,307	$ 12
Reforest Stream Buffer	$ 15,000 / acre	35 acres	$ 518,057	303	9	6,882	$ 1,709	$ 58,050	$ 75
Neighborhood Tree Planting	$ 175 / tree	1,296 trees	$ 226,778	84	2	1,903	$ 2,694	$ 91,713	$ 119
Institutional Tree Planting	$ 175 / tree	2,100 trees	$ 367,526	136	4	3,084	$ 2,694	$ 91,713	$ 119
Tree Maintenance	$ 6,500 / acre	60 acres	$ 388,004	N/A	N/A	N/A	NA	NA	NA
Bayscaping Education	$ 500 / event	4 events	$ 2,000	18	1	0	$ 111	$ 3,346	$ -
Stream Restoration Projects	$ 350 / ln ft	16,941 ln ft	$ 5,929,175	9,874	3,357	15,305,339	$ 600	$ 1,766	$ 0
Wetland Creation Projects	$ 250,000 / project	1 project	$ 250,000	169	20	32,813	$ 1,478	$ 12,613	$ 8
BMP Creation Projects	$ 236,000 / project	1 project	$ 236,000	193	10	37,369	$ 1,225	$ 23,524	$ 6
MS4 Retrofits	$ 5,000 / acre	1,683 acres	$ 8,415,979	5,671	413	953,202	$ 1,484	$ 20,359	$ 9
Remove Invasive Species	$ 250 / acre	4 acres	$ 1,000	N/A	N/A	N/A	N/A	N/A	N/A
Post Signs	$ 40 / sign	43 signs	$ 1,720	N/A	N/A	N/A	N/A	N/A	N/A
Pollution Prevention Workshops	$ 500 / workshop	1 workshops	$ 500	N/A	N/A	N/A	NA	NA	NA
Neighborhood BMP Meetings	$ 500 / meeting	8 meetings	$ 4,000	N/A	N/A	N/A	NA	NA	NA
ISI Recommendation Meetings	$ 500 / meeting	8 meetings	$ 4,000	N/A	N/A	N/A	NA	NA	NA
Storm Drain Markers	$ 400 / site	59 sites	$ 23,600	N/A	N/A	N/A	NA	NA	NA
Trash Campaign Materials	$ 9,000 / year	4 years	$ 36,000	N/A	N/A	N/A	NA	NA	NA
Waterway Cleanups	$ 1,000 / cleanup	10 cleanups	$ 10,000	N/A	N/A	N/A	NA	NA	NA
Water Quality Monitoring Report	$ 34,000 / report	4 reports	$ 136,000	N/A	N/A	N/A	NA	NA	NA
		Total:	***$ 17,803,253***	***16,971***	***3,854***	***16,454,085***			

Note: 'NA" denotes not assessed in the pollutant removal analysis.

Table B-3: 2025 Projected Estimated Costs for Middle Gwynns Falls SWAP Implementation

Action	Unit Cost	Proj. 2025 Quantity	Proj. 2025 Total Cost	Proj. 2025 TN Load Reduction (lbs / yr)	Proj. 2025 TP Load Reduction (lbs / yr)	Proj. 2025 TSS Load Reduction (lbs / yr)	Proj. 2025 Cost / lb of TN Removal per year	Proj. 2025 Cost / lb of TP Removal per year	Proj. 2025 Cost / lb of TSS Removal per year
SWM Conversions	$ 3,200 / acre	335 acres	$ 1,071,296	677	23	145,837	$ 633	$ 18,242	$ 3
SW Retrofits	$ 50,000 / retrofit	20 retrofits	$ 1,000,000	130	14	27,686	$ 1,542	$ 14,721	$ 7
Impervious Cover Removal	$ 25,000 / acre	2.8 acre	$ 69,437	16	3	4,934	$ 4,318	$ 20,539	$ 14
Downspout Disconnection Program	$ 300 / house	6,783 houses	$ 2,034,846	767	80	163,852	$ 723	$ 6,902	$ 3
Reforest Stream Buffer	$ 15,000 / acre	127 acres	$ 1,899,541	1,112	33	25,234	$ 466	$ 15,832	$ 21
Neighborhood Tree Planting	$ 175 / tree	3,888 trees	$ 680,335	253	7	5,709	$ 898	$ 30,571	$ 40
Institutional Tree Planting	$ 175 / tree	6,300 trees	$ 1,102,579	409	12	9,253	$ 898	$ 30,571	$ 40
Tree Maintenance	$ 6,500 / acre	202 acres	$ 1,313,672	N/A	N/A	N/A	NA	NA	NA
Bayscaping Education	$ 500 / event	12 events	$ 6,000	54	2	0	$ 37	$ 1,115	$ -
Stream Restoration Projects	$ 350 / ln ft	49,372 ln ft	$ 17,280,221	9,874	3,357	15,305,339	$ 600	$ 1,766	$ 0
Wetland Creation Projects	$ 250,000 / project	1 project	$ 250,000	169	20	32,813	$ 1,478	$ 12,613	$ 8
BMP Creation Projects	$ 236,000 / project	3 projects	$ 708,000	578	30	112,106	$ 408	$ 7,841	$ 2
MS4 Retrofits	$ 5,000 / acre	4,261 acres	$ 21,306,275	14,356	1,047	2,413,170	$ 586	$ 8,042	$ 3
Remove Invasive Species	$ 250 / acre	12 acres	$ 3,000	N/A	N/A	N/A	N/A	N/A	N/A
Post Signs	$ 40 / sign	86 signs	$ 3,440	N/A	N/A	N/A	N/A	N/A	N/A
Pollution Prevention Workshops	$ 500 / workshop	3 workshops	$ 1,500	N/A	N/A	N/A	NA	NA	NA
Neighborhood BMP Meetings	$ 500 / meeting	26 meetings	$ 13,000	N/A	N/A	N/A	NA	NA	NA
ISI Recommendation Meetings	$ 500 / meeting	19 meetings	$ 9,500	N/A	N/A	N/A	NA	NA	NA
Storm Drain Markers	$ 400 / site	175 sites	$ 70,000	N/A	N/A	N/A	NA	NA	NA
Trash Campaign Materials	$ 9,000 / year	12 years	$ 108,000	N/A	N/A	N/A	NA	NA	NA
Waterway Cleanups	$ 1,000 / cleanup	30 cleanups	$ 30,000	N/A	N/A	N/A	NA	NA	NA
Water Quality Monitoring Report	$ 34,000 / report	12 reports	$ 408,000	N/A	N/A	N/A	NA	NA	NA
		Total:	***$ 49,368,643***	***28,395***	***4,629***	***18,245,934***			

Note: 'NA" denotes not assessed in the pollutant removal analysis.

Potential Funding Sources

Funding sources for the implementation of the Middle Gwynns Falls SWAP includes local government funding for Baltimore County, monetary and time contributions to Blue Water Baltimore, and various grants as described below.

Baltimore County uses general funds to support staff, whose responsibility is to monitor and improve water quality through implementation of various programs including capital restoration projects. Baltimore County has a Waterway Improvement Capital Program that is funded by a combination of general funds and bonds. Approximately $4 million per year is allocated for various restoration projects throughout the County. Baltimore County provides grants to local watershed organizations through its Watershed Association Citizen Restoration Planning and Implementation Grant Program. These funds provide staffing for restoration project implementation and education and outreach programs.

In order to implement all of the actions listed in Appendix A and to meet the anticipated funding needs summarized in Table B-3, additional funding from grants will be required. Table B-4 presents potential funding sources to support the implementation of the Bear Creek/Old Road Bay SWAP including funding source, applicant eligibility, eligible projects, funding amount, cost share requirements, and grant cycle. The anticipated major grant funding sources include the following:

- ***The Chesapeake and Atlantic Coastal Bays Trust Fund:*** The Trust Fund was established to provide financial assistance to local governments and political subdivisions for the implementation of nonpoint source pollution control projects. These are intended to achieve the state's tributary strategy developed in accordance with the Chesapeake 2000 Agreement and to improve the health of the Atlantic Coastal Bays and their tributaries. The BayStat Program directs the administration of the Trust Fund, with multiple state agencies receiving moneys, including Maryland Department of Environment (MDE), Department of Natural Resources (DNR), Maryland Department of Agriculture (MDA), and Maryland Department of Planning (MDP).
- ***319 Non-point Pollution Grants:*** Federal money for restoration implementation is available annually through MDE.
- ***Bay Restoration Fund (MDE):*** This is a dedicated fund, financed by wastewater treatment plant users, to upgrade Maryland's wastewater treatment plants with enhanced nutrient removal technology. In addition, a similar fee paid by septic system users is utilized to upgrade onsite systems and to pay for cover crops to reduce nitrogen loading to the Bay. Proposed modifications to the fund will allow the fund to be used for implementation of stormwater restoration projects.
- ***Stormwater Pollution Control Cost Share Program (MDE):*** The Maryland Stormwater Pollution Control Cost-Share Program provides grant funding for stormwater management retrofit and conversion projects in urban areas developed prior to 1984. These projects reduce nutrients, sediments and other pollutant loads entering the state's waterways through the use of infiltration basins, infiltration trenches, vegetated swales, extended detention ponds, bioretention basins, wetlands and other innovative structures.
- ***Innovative Nutrient and Sediment Reduction Program (National Fish and Wildlife Foundation):*** The National Fish and Wildlife Foundation (NFWF), in partnership with U.S. Environmental Protection Agency (USEPA) and the Chesapeake Bay Program, will award

grants on a competitive basis to support the demonstration of innovative approaches to expand the collective knowledge about the most cost effective and sustainable approaches to dramatically reduce or eliminate nutrient and sediment pollution to the Chesapeake Bay and its tributaries.

- ***Chesapeake Bay Stewardship Fund:*** The goal of the Chesapeake Bay Stewardship Fund is to accelerate local implementation of the most innovative, sustainable and cost effective strategies to restore and protect water quality and vital habitats within the Chesapeake Bay watershed. The Stewardship Fund offers four grant programs: the Chesapeake Bay Small Watershed Grant Program; the Chesapeake Bay Targeted Watersheds Grant Program; the Chesapeake Bay Conservation Innovation Grant Program; and the Innovative Nutrient and Sediment Reduction Program. Major funding for the Chesapeake Bay Stewardship Fund comes from the USEPA, the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), the U.S. Department of Agriculture Forest Service (USFS), and the National Oceanic and Atmospheric Administration (NOAA).
- ***MD State Highway Administration (SHA) Transportation Enhancement Program (TEP)*****:** This is a reimbursable, federal-aid funding program for transportation-related community projects designed to strengthen the intermodal transportation system. The TEP supports communities in developing projects that improve the quality of life for their citizens and enhance the travel experience for people traveling by all modes. Among the qualifying TEP categories is environmental mitigation to address water pollution due to highway runoff or to reduce vehicle-caused wildlife mortality while maintaining habitat connectivity.
- ***Chesapeake Bay Trust:*** Provides grants through a variety of grant programs that focus on environmental education, urban greening, fisheries, and remediation of water quality issues. Specifically the Targeted Watershed Grant Program provides funding for on-the ground solutions that address the most pressing nonpoint source pollution challenges facing a small watershed, and that result in measurable improvements in water quality and wildlife habitat. The program also seeks to support cost effective approaches to Chesapeake Bay restoration actions at the small watershed scale and establish a replicable model of restoration that can be transferred and used throughout the region.

Table B-4: Middle Gwynns Falls SWAP Potential Funding Sources

Managing Agency	Funding Source	Application Eligibility	Eligible Projects	Funding Amount	Cost Share/ In - Kind	Project Period
American Forests	Global ReLeaf Program (American Forests)	All Public Lands or Public-Accessible Lands Local Government State Government	Public Lands Restoration Projects which include local organizations; Use innovative restorative practices with potential for general application; minimum 20 acre project area	$1 per tree planted	Covers tree planting costs YES	6 months (?)
Chesapeake Bay Trust	Targeted Watershed Initiative Grant Program	Non-profits 501(c) Institutions Soil/Water Conservation Districts Local Government	Involve local organizations; Address non-point source pollution; Projects related to water quality and habitat restoration	$50 to $200,000	0% YES	1-2 years
Chesapeake Bay Trust	Capacity Building Initiative Grant Program	Non-profits 501(c) with a board on which half the members participate meaningfully and at least one paid staff (or a part-time paid staff and volunteer)	Strengthen an organization through management operations, technology, governance, fundraising, and communications	$15,000 per year	0% YES	3 years
Chesapeake Bay Trust	Stewardship Grant Program	Non-profits 501(c) Schools/Universities Soil/Water Conservation Districts Local Government State Government	Raise awareness about watershed restoration; Design plans which educate citizens on things they can do to aid watershed restoration; Educate students about local watersheds; Projects geared towards watershed restoration and protection	$5,000 to $25,000	0% YES	1 Year
DNR	Clean Water Action Plan Nonpoint Source Program 319 Grant	Non-profits 501(c) Universities Soil/Water Conservation Districts Local Government State Government	Located in a Category I and Category III watershed as outlined in the MD unified watershed assessment; Establish cover crops; Address Stream restoration and riparian buffers	$5,000 to $40,000	40%	Annual
MDE	Bay Restoration Fund	Local Governments	Green Restoration Project	None specified	50% YES	None specified

Table B-4 (con't): Middle Gwynns Falls SWAP Potential Funding Sources

Managing Agency	Funding Source	Application Eligibility	Eligible Projects	Funding Amount	Cost Share/ In - Kind	Project Period
NFWF	Chesapeake Bay Small Watersheds Grant Program	Non-profits 501(c) Local Government	Community-based projects that improve the condition of local watersheds while building stewardship among citizens; watershed restoration, conservation, and planning	$20,000 to $200,000	25%	1-5 years (?)
NFWF	Chesapeake Bay Targeted Watersheds Grant Program	Non-profits 501(c) Universities Local Government State Government	Innovative demonstration type restoration projects	$400,000 to $1,000,000	25% YES	2-3 years
NRCS	Watershed Operations Program	Local Government State Government Tribes	Address watershed protection, flood mitigation, water quality, soil erosion, sediment control, habitat enhancement, and wetland creation and restoration	None specified	?	None specified
USEPA	Targeted Watersheds Grant Program - Capacity Building Grant Program	Non-profits 501(c) Institutions Local Government State Government	Promote organizational development of local watershed partnerships; Provide training and assistance to local watershed groups	$400,000 to $800,000	25% YES	2 years
USEPA	Targeted Watersheds Grant Program - Implementation Grant Program	Non-profits 501(c) Universities Local Government State Government	Watershed Restoration and/or Protection Projects (must include a monitoring component)	$600,000 to $900,000	25% YES	3-5 years

APPENDIX C:

Chesapeake Bay Program Pollutant Load Reduction Efficiencies and Maryland *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated.*

Non-Point Source Best Management Practices and Efficiencies currently used in Scenario Builder

Values in parentheses are in progress of official approval

Agriculture BMPs		*How Credited*	*TN Reduction Efficiency*	*TP Reduction Efficiency*	*SED Reduction Efficiency*
Nutrient Management		Landuse Change	N/A	N/A	N/A
Forest Buffers (varies by region; see Appendix 2)		Efficiency, Landuse Change	19-65%	30-45%	40-60%
Wetland Restoration (varies by region; see Appendix 2)		Efficiency	7-25%	12-50%	4-15%
Land Retirement		Landuse Change	N//A	N/A	N/A
Grass Buffers (varies by region; see Appendix 2)		Efficiency, Landuse Change	13-46%	30-45%	40-60%
Non-Urban Stream Restoration		Mass reduction/length	0.02 lb/ft	0.003 lb/ft	2 lb/ft
Tree Planting		Landuse Change	N/A	N/A	N/A
Carbon Sequestration/Alternative Crops		Landuse Change	N/A	N/A	N/A
Conservation Tillage		Landuse Change	N/A	N/A	N/A
Continuous No-Till (varies by region; see Appendix 2)		Efficiency	(10-15%)	(20-40%)	(70%)
Enhanced Nutrient Management		Efficiency	(7%)	(N/A)	(N/A)
Decision Agriculture		Efficiency	(4%)	(N/A)	(N/A)
Conservation Plans	High-till	Efficiency	8%	15%	25%
	Low-till	Efficiency	3%	5%	8%
	All hay	Efficiency	3%	5%	8%
	Pasture	Efficiency	5%	10%	14%
Cover Crops (see Appendix 1)		Efficiency	Varies	Varies	Varies
Commodity Cover Crops (see Appendix 2)		Efficiency	Varies	Varies	Varies
Stream Access Control with Fencing		Landuse Change	N/A	N/A	N/A
Alternative Watering Facility		Efficiency	5%	8%	10%
Prescribed Grazing/PIRG		Efficiency	9%	24%	30%
Horse Pasture Management		Efficiency	N/A	20%	40%
Animal Waste Management Livestock		Efficiency	75%	75%	N/A
Animal Waste Management Poultry		Efficiency	75%	75%	N/A
Barnyard Runoff Control		Efficiency	20%	20%	40%
Loafing Lot Management		Efficiency	20%	20%	40%
Mortality Composters		Efficiency	40%	10%	N/A
Water Control Structures		Efficiency	33%	N/A	N/A
Poultry Phytase		Application Reduction	N/A	N/A	N/A
Swine Phytase		Application Reduction	N/A	N/A	N/A

Dairy Precision Feeding and Forage Management	Application Reduction	N/A	N/A	N/A
Poultry Litter Transport	Application Reduction	N/A	N/A	N/A
Ammonia Emissions Reduction (interim)	Application Reduction	15-60%	N/A	N/A
Poultry Litter Injection (interim)	Efficiency	25%	0%	0%
Liquid Manure Injection (interim)	Efficiency	25%	0%	0%
Phosphorus Sorbing Materials in Ditches (interim)	Efficiency	40%	0%	0%
Resource BMPs	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***
Forest Harvesting Practices	Efficiency	50%	60%	60%
Dirt & Gravel Road Erosion & Sediment Control – Driving Surface Aggregate + Raising the Roadbed	Mass reduction/length	0	0	2.96lb/ft
Dirt & Gravel Road Erosion & Sediment Control – with outlets	Mass reduction/length	0	0	3.6lb/ft
Dirt & Gravel Road Erosion & Sediment Control – outlets only	Mass reduction/length	0	0	1.76lb/ft
Urban BMPs	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***
Forest Conservation	Landuse Change	N/A	N/A	N/A
Urban Growth Reduction	Landuse Change	N/A	N/A	N/A
Impervious Urban Surface Reduction	Landuse Change	N/A	N/A	N/A
Forest Buffers	Efficiency, Landuse Change	25%	50%	50%
Tree Planting	Landuse Change	N/A	N/A	N/A
Abandoned Mine Reclamation	Landuse Change	N/A	N/A	N/A
Wet Ponds and Wetlands	Efficiency	20%	45%	60%
Dry Detention Ponds and Hydrodynamic Structures	Efficiency	5%	10%	10%
Dry Extended Detention Ponds	Efficiency	20%	20%	60%
Infiltration Practices w/o Sand, Veg.	Efficiency	80%	85%	95%
Infiltration Practices w/ Sand, Veg.	Efficiency	85%	85%	95%
Filtering Practices	Efficiency	40%	60%	80%
Erosion and Sediment Control	Efficiency	25%	40%	40%
Nutrient Management	Efficiency	17%	22%	N/A
Street Sweeping	Efficiency	3%	3%	9%
Urban Stream Restoration	Load reduction/length	0.02lb/ft	0.003lb/ft	2lb/ft
Septic Connections	Systems Change	N/A	N/A	N/A

Septic Denitrification		Efficiency	50%	N/A	N/A
Septic Pumping		Efficiency	5%	N/A	N/A
Bioretention	C/D soils, underdrain	Efficiency	25%	45%	55%
	A/B soils, underdrain	Efficiency	70%	75%	80%
	A/B soils, no underdrain	Efficiency	80%	85%	90%
Vegetated Open Channels	C/D soils, no underdrain	Efficiency	10%	10%	50%
	A/B soils, no underdrain	Efficiency	45%	45%	70%
Bioswale		Efficiency	70%	75%	80%
Permeable Pavement w/o Sand, Veg.	C/D soils, underdrain	Efficiency	10%	20%	55%
	A/B soils, underdrain	Efficiency	45%	50%	70%
	A/B soils, no underdrain	Efficiency	75%	80%	85%
Permeable Pavement w/ Sand, Veg.	C/D soils, underdrain	Efficiency	20%	20%	55%
	A/B soils, underdrain	Efficiency	50%	50%	70%
	A/B soils, no underdrain	Efficiency	80%	80%	85%

Appendix 2 **BMPs**	**Hydrogeomorphic Region(s)**	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***
Forest Buffers	Appalachian Plateau Siliciclastic Non-Tidal	54%	42%	56%
	Blue Ridge Non-Tidal; Mesozoic Lowlands Non-Tidal; Valley and Ridge Carbonate Non-Tidal	34%	30%	40%
	Coastal Plain Dissected Uplands Non-Tidal	65%	42%	56%
	Coastal Plain Dissected Uplands Tidal; Coastal Plain Lowlands Tidal; Coastal Plain Uplands Tidal; Piedmont Crystalline Tidal	19%	45%	60%
	Coastal Plain Lowlands Non-Tidal	56%	39%	52%
	Piedmont Crystalline Non-Tidal	56%	42%	56%
	Coastal Plain Uplands Non-Tidal	31%	45%	60%
	Piedmont Carbonate Non-Tidal	46%	36%	48%
	Valley and Ridge Siliciclastic Non-Tidal	46%	39%	52%
Grass Buffers	Appalachian Plateau Siliciclastic Non-Tidal	38%	42%	56%
	Blue Ridge Non-Tidal; Mesozoic Lowlands Non-Tidal; Valley and Ridge Carbonate Non-Tidal	24%	30%	40%
	Coastal Plain Dissected Uplands Non-Tidal	46%	42%	56%
	Coastal Plain Dissected Uplands Tidal; Coastal Plain Lowlands Tidal; Coastal Plain Uplands Tidal; Piedmont Crystalline Tidal	13%	45%	60%

	Coastal Plain Lowlands Non-Tidal	39%	39%	52%
	Piedmont Crystalline Non-Tidal	39%	42%	56%
	Coastal Plain Uplands Non-Tidal	21%	45%	60%
	Piedmont Carbonate Non-Tidal	32%	36%	48%
	Valley and Ridge Siliciclastic Non-Tidal	32%	39%	52%
Wetland Restoration (Ag & Urban)	Appalachian Plateau Siliciclastic Non-Tidal	7%	12%	4%
	Coastal Plain Dissected Uplands Non-Tidal; Coastal Plain Dissected Uplands Tidal; Coastal Plain Lowlands Tidal; Coastal Plain Uplands Tidal; Coastal Plain Lowlands Non-Tidal; Coastal Plain Uplands Non-Tidal	25%	50%	15%
	Blue Ridge Non-Tidal; Mesozoic Lowlands Non-Tidal; Valley and Ridge Carbonate Non-Tidal; Piedmont Crystalline Tidal; Piedmont Crystalline Non-Tidal; Piedmont Carbonate Non-Tidal; Valley and Ridge Siliciclastic Non-Tidal	14%	26%	8%
Continuous No-till	Coastal Plain Dissected Uplands Non-Tidal; Coastal Plain Dissected Uplands Tidal; Coastal Plain Lowlands Tidal; Coastal Plain Uplands Tidal; Coastal Plain Lowlands Non-Tidal; Coastal Plain Uplands Non-Tidal	10%	20%	70%
	Appalachian Plateau Siliciclastic Non-Tidal; Blue Ridge Non-Tidal; Mesozoic Lowlands Non-Tidal; Valley and Ridge Carbonate Non-Tidal; Piedmont Crystalline Tidal; Piedmont Crystalline Non-Tidal; Piedmont Carbonate Non-Tidal; Valley and Ridge Siliciclastic Non-Tidal	15%	40%	70%
Cover Crop Early Drilled Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	45%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	34%	15%	20%
Cover Crop Early Other Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	38%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	29%	15%	20%
Cover Crop Early Aerial Soy Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	31%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	24%	15%	20%
Cover Crop Early Aerial Corn Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	18%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	14%	15%	20%
Cover Crop	Coastal Plain/Piedmont Crystalline/Karst Settings*	41%	7%	10%

Standard Drilled Rye (Low-till gets only TN efficiency)	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	31%	7%	10%
Cover Crop Standard Other Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	35%	7%	10%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	27%	7%	10%
Cover Crop Late Drilled Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	19%	N/A	N/A
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	15%	N/A	N/A
Cover Crop Late Other Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	16%	N/A	N/A
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	12%	N/A	N/A
Cover Crop Early Drilled Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	31%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	24%	15%	20%
Cover Crop Early Other Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	27%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	20%	15%	20%
Cover Crop Early Aerial Soy Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	22%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	17%	15%	20%
Cover Crop Early Aerial Corn Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	12%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	10%	15%	20%
Cover Crop Standard Drilled Wheat (Low-till gets only TN	Coastal Plain/Piedmont Crystalline/Karst Settings*	29%	7%	10%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	22%	7%	10%

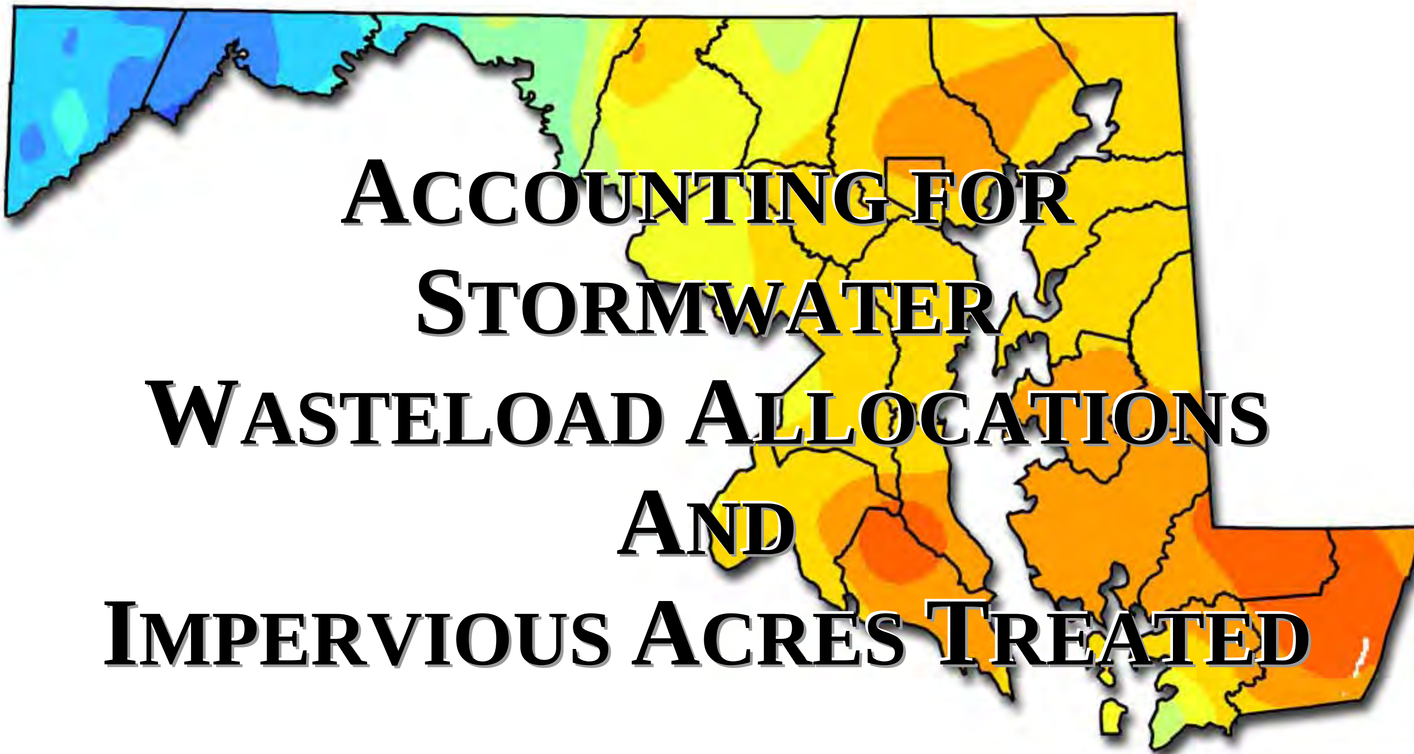
efficiency)				
Cover Crop Standard Other Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	24%	7%	10%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	18%	7%	10%
Cover Crop Late Drilled Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	13%	N/A	N/A
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	10%	N/A	N/A
Cover Crop Late Other Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	11%	N/A	N/A
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	9%	N/A	N/A
Cover Crop Early Drilled Barley (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	38%	20%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	29%	20%	20%
Cover Crop Early Other Barley (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	32%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	25%	15%	20%
Cover Crop Early Aerial Soy Barley (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	27%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	20%	15%	20%
Cover Crop Early Aerial Corn Barley (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	15%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	12%	15%	20%
Cover Crop Standard Drilled Barley (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	29%	7%	10%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	22%	7%	10%

Cover Crop Standard Other Barley (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	24%	7%	10%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	19%	7%	10%
Commodity Cover Crop Early Drill Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	17%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	15%	(N/A)	(N/A)
Commodity Cover Crop Early Other Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	12%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	7%	(N/A)	(N/A)
Commodity Cover Crop Early Aerial Soy Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	15%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	12%	(N/A)	(N/A)
Commodity Cover Crop Early Aerial Corn Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	7%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	6%	(N/A)	(N/A)
Commodity Cover Crop Standard Drill Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	15%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	11%	(N/A)	(N/A)
Commodity Cover Crop Standard Other Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	12%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	7%	(N/A)	(N/A)
Commodity Cover Crop Late Drill Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	7%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	6%	(N/A)	(N/A)
Commodity Cover Crop Late Other Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	13%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	11%	(N/A)	(N/A)
Commodity Cover Crop Early Drill Barley	Coastal Plain/Piedmont Crystalline/Karst Settings*	9%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	6%	(N/A)	(N/A)

Commodity Cover Crop Early Aerial Soy Barley	Coastal Plain/Piedmont Crystalline/Karst Settings*	6%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	5%	(N/A)	(N/A)
Commodity Cover Crop Early Aerial Corn Barley	Coastal Plain/Piedmont Crystalline/Karst Settings*	13%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	11%	(N/A)	(N/A)
Commodity Cover Crop Standard Drill Barley	Coastal Plain/Piedmont Crystalline/Karst Settings*	15%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	11%	(N/A)	(N/A)
Commodity Cover Crop Standard Other Barley	Coastal Plain/Piedmont Crystalline/Karst Settings*	12%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	10%	(N/A)	(N/A)
Commodity Cover Crop Standard Other Rye	Coastal Plain/Piedmont Crystalline/Karst Settings*	18%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	14%	(N/A)	(N/A)
Commodity Cover Crop Early Other Barley	Coastal Plain/Piedmont Crystalline/Karst Settings*	15%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	11%	(N/A)	(N/A)

*Coastal Plain Dissected Uplands Non-Tidal; Coastal Plain Dissected Uplands Tidal; Coastal Plain Lowlands Tidal; Coastal Plain Uplands Tidal; Coastal Plain Lowlands Non-Tidal; Coastal Plain Uplands Non-Tidal; Valley and Ridge Carbonate Non-Tidal; Piedmont Carbonate Non-Tidal

** Appalachian Plateau Siliciclastic Non-Tidal; Mesozoic Lowlands Non-Tidal; Piedmont Crystalline Tidal; Piedmont Crystalline Non-Tidal; Valley and Ridge Siliciclastic Non-Tidal; Blue Ridge Non-Tidal



ACCOUNTING FOR STORMWATER WASTELOAD ALLOCATIONS AND IMPERVIOUS ACRES TREATED

GUIDANCE FOR NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM STORMWATER PERMITS

JUNE (DRAFT) 2011

MARYLAND
DEPARTMENT OF THE ENVIRONMENT

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I. Introduction

National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system permits in Maryland require the restoration of a certain percent of a jurisdiction's impervious surface area, e.g., 20%, that has little or no stormwater management. How to calculate impervious surface requirements and treatment credits has generated numerous questions. This document standardizes procedures for the reporting of traditional, new, and alternative best management practices (BMPs) and the impervious area they control.

With the inclusion of total maximum daily loads (TMDLs) and specifically the Chesapeake Bay TMDL in municipal stormwater permits, the answer to "what constitutes restoration?" becomes fairly easy to answer. This means meeting TMDL requirements and water quality criteria. This document provides information on how to calculate stormwater baseline loads and BMP pollutant removal efficiencies for showing progress toward meeting stormwater waste load allocations (WLA) for NPDES accounting purposes. Implementing water quality improvement projects on a certain percent of a locality's impervious surface area each permit term sets the schedule for meeting the Chesapeake Bay TMDL.

A primary goal of this guidance is to expand the list of traditional urban BMPs with a suite of alternative water quality practices. By developing a comprehensive matrix of practices and consistent accounting measures, the Maryland Department of the Environment (MDE) brings greater certainty to the local planning and budgeting processes. Local governments can weigh the cost associated with implementing different practices and choose the most efficient option for meeting pollutant load reductions. Also included in this document is a method for translating the pollutant load reductions associated with alternative stormwater practices into equivalent impervious acres treated. This will tie the implementation of these BMPs and meeting stormwater WLAs and impervious area restoration requirements together under one permit.

This guidance will continue to evolve as stormwater science, program implementation, and Chesapeake Bay modeling improve. Maryland counties, municipalities, and agencies are encouraged to participate fully in this endeavor by exploring and monitoring alternative approaches to stormwater management. The data gathered may be used to update and improve Maryland's stormwater management matrix of options for achieving water quality. Finally, while the principles and methods presented here are primarily geared toward meeting NPDES permit impervious surface requirements and Chesapeake Bay stormwater WLAs, they are relevant and applicable for use for any EPA approved TMDL.

II. Modeling Methods

1. Model Selection: Computer models can aid local jurisdictions in establishing stormwater baseline pollutant loads, planning restoration work, and showing progress toward meeting WLAs. Maryland's Assessment and Scenario Tool (MAST) developed for the Chesapeake Bay Program (CBP) and the Hydrological Simulation Program -- Fortran (HSPF), the Stormwater Management Model (SWMM), and spreadsheet versions like the Watershed Treatment Model (WTM) are acceptable for use by Maryland's NPDES localities. MAST is the only model that relates directly to the CBP model and where pollutant removal credits may be assured under the Bay's TMDL.

Other models and results can be compared to the Bay model on a proportional basis for NPDES accounting purposes. For example, while different models will likely generate different baseline pollutant loads in pounds, the reductions from implementing water quality improvement projects will be comparable on a percent reduction basis. In order to develop greater consistency among the models, local governments will need to use the same pollutant loading rates that were used to develop the Bay TMDL. Also, consistent BMP pollutant removal efficiencies need to be used to ensure equitable accounting among jurisdictions. Websites with documentation on the use of various models may be found in Appendix A.

2. CBP Loading Rates: Jurisdictions shall use the pollutant loading rates derived from the CBP Model, Version 5.3.0, for total nitrogen (TN), total phosphorus (TP), and total suspended sediment (TSS) along with land use data to calculate the stormwater loads discharged from municipal storm drain systems. These rates, found in Table 1, were used for developing stormwater WLAs in the Chesapeake Bay TMDL, and local use of these data will ensure consistency. For ease in modeling, Maryland used a weighted pollutant load average for all CBP urban land covers (impervious high density, impervious low density, pervious high density, and pervious low density) in its Watershed Implementation Plan (WIP).

Table 1. CBP Annual Urban Runoff Loads Per Acre

Parameter	Urban Impervious			Urban Pervious			All Urban
	high density	low density	average	high density	low density	average	weighted average
TN (lbs)	10.48	11.22	10.85	9.10	9.76	9.43	9.96
TP (lbs)	2.01	2.06	2.04	0.55	0.58	0.57	0.97
TSS (tons)	0.44	0.47	0.46	0.07	0.07	0.07	0.18

(Adapted from CBP Model, Version 5.3.0, 2011)

These pollutant loads are specific to the Chesapeake Bay TMDL. Other water bodies are likely to have different pollutant loads than those used for Chesapeake Bay. A jurisdiction's analysis needs to be consistent with the loads found in each particular TMDL.

3. BMP Efficiency Matrices: This guidance provides two BMP efficiency matrices for computer model input values. One contains traditional stormwater retrofits, i.e., wet ponds, bioretention, and filtering practices, and efficiencies provided in the CBP Model. A second matrix contains alternate urban practices, i.e., stream restoration, street sweeping, and septic system upgrades, that can be used to meet stormwater WLAs. Together these matrices provide local governments with numerous options for meeting NPDES stormwater WLAs and impervious cover restoration requirements.

III. Establishing Baselines

1. Municipal Separate Storm Sewer System: Local jurisdictions need to account for and map the storm drain system that they own or operate. Title 40 of the Code of Federal Regulations (CFR), 122.26 (b) (8) defines a municipal separate storm sewer system as "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) *owned or operated* by a State, city, town, borough, county, parish, district, association, or other public body." Emphasis added.

The storm drain system within a jurisdiction's boundary is typically a mix of ownership, which includes parts of local, State, and federal systems. How a locality accounts for these various entities when defining what it "owns or operates" is important. Because stormwater management for private property in Maryland is locally administered for plan approval, inspection, and enforcement, these facilities are inherently a part of a locality's storm drain system. Some State and federal property, certain small municipalities, and industrial facilities are regulated under other NPDES stormwater permits and the storm drain systems in these entities may be excluded from a locality's responsibility. Any stormwater discharge, however, that passes through a county or municipal storm drain system or appurtenance becomes, at the very least, the shared responsibility of that locality.

2. Land Use Data are integral for estimating stormwater WLAs and assessing impervious surfaces for restoration. Local governments should use the best land use data that are available to them and can be generated from the same source from year to year. This will ensure consistent annual analysis regarding imperviousness, acres treated, retrofit goals, and permit compliance. An exception to this may be when technology allows for the current land use data to be further refined or improved. For example, some jurisdictions use local land use maps along with impervious surface coefficients to estimate impervious cover. If in the future, more accurate data can be derived from aerial views and geographic information system (GIS) application, then the more accurate data should be used. Because this may cause slight increases or decreases in reported impervious acres, local governments will need to document any changes to baseline data. When it comes to the Chesapeake Bay TMDL, there will be scale issues that may cause urban land cover to be over or under-estimated. These differences can be reconciled through the use of the stormwater management by era approach described later in this document.

3. Stormwater WLA: Urban land use data shall be used in conjunction with the approved TMDL pollutant loading rates to calculate local baseline stormwater pollutant loads. Typically, the year in which the monitoring data were gathered to support the TMDL should be used as the baseline year. Local stormwater program and restoration efforts implemented after the baseline year, and the associated pollutant load reductions, can then be measured against the stormwater WLAs to determine if benchmarks and water quality criteria are being met. EPA approved TMDLs may be found at http://www.mde. State.md.us/programs/Water/TMDL/Pages/Programs/WaterPrograms/tmdl/index.aspx.

4. Impervious Cover: Jurisdictions will need to determine the total impervious surface area that they are legally responsible for and delineate the portions that are either treated to the maximum extent practicable (MEP), partially treated, or untreated and available for retrofit. This assessment will provide the baseline from which the 20% restoration requirement may be calculated. A good place to start is 2002 because this is when Maryland regulations and local ordinances began requiring BMPs to address a specific suite of volumes [recharge (Re_v), water quality (WQ_v), and channel protection (Cp_v)] and it can therefore be justified that water quality treatment has been provided to the MEP.

Development after 2002 should not be counted toward impervious surfaces that need to be restored. BMPs from this stormwater program era are deemed state-of-the-art and need to be maintained, but will provide limited opportunity for water quality improvement. Hence, the regular implementation of stormwater management since 2002 may not be used for fulfilling restoration requirements. When local data for 2002 do not exist, jurisdictions should use the most appropriate land use year and document how it reflects the implementation of state-of-the-art BMPs according to the *2000 Maryland Stormwater Design Manual* (the *Manual*).

5. Water Quality Facilities: Stormwater BMPs implemented before 2002 that provide water quality treatment will need to be considered. For example, commonly used BMPs during this time included infiltration trenches and basins, wetlands facilities, and extended-detention structures, which all provide some water quality benefits. On the other hand, detentions facilities (dry ponds) that were designed primarily for flood control provide very little water quality.

Structural BMPs implemented prior to 2002 can be credited for treatment of impervious area based on the volume treated in relation to the *Manual's* WQ_v, or one inch of rainfall. If BMPs were designed to a criterion less than the WQ_v, impervious area credits should be pro-rated based on the proportion of the volume treated. These areas may provide significant retrofit opportunities, where meeting the full WQ_v will increase the jurisdiction's impervious area treatment credit.

In order to claim credit, local jurisdictions will need to document how BMPs implemented before 2002 provide water quality. Documentation may include State or local policies and ordinances established to implement water quality BMPs in conjunction with Maryland's Urban BMP database (Appendix B), which may be used to verify BMP type and maintenance status. An example of how a locality may use State policy in this regard would be to reference, *Design Procedures for Stormwater Management Extended Detention Structures* (MDE, 1987).

By delaying one inch of rainfall over 24 hours, extended detention facilities improve the settling of pollutants and provide channel protection. If a local jurisdiction can document the use of this approach before 2002 for individual BMPs and each has been properly maintained, then the full WQ_v may be claimed for these facilities. Each jurisdiction should provide MDE with specific information on the policies or local ordinances used to account for water quality BMPs implemented before 2002 and the impervious acres treated.

6. Stormwater Management by Era: Maryland's Urban BMP Database has records for over 33,000 facilities statewide, yet only 22,000 have complete information on drainage area and year built. The under-counting of BMPs has contributed to a flawed analysis regarding Maryland's stormwater management programs that have been implemented since the early 1980's. To better reflect actual program implementation, BMPs may be recorded in four stormwater management eras when facility data are incomplete.

Based on distinct regulatory eras in Maryland with known BMP performance criteria, pollutant removal efficiencies have been developed that directly correlate to these eras (MDE, 2009). By combining these era efficiencies with the CBP's annual estimate for urban land cover, a better representation of program implementation can be achieved. The stormwater management by era approach was used in the development of Maryland's WIP for meeting Chesapeake Bay TMDLs and will be valuable for local planning and analysis as well. The major stormwater management eras and associated pollutant load reduction efficiencies are depicted in Figure 1.

a. Local Data Gaps: Local governments should use the information reported on Maryland's Urban BMP Database (Appendix B) for TMDL assessments. This database has been in use since the inception of stormwater management in Maryland and contains valuable empirical data on BMPs implemented across the State. Jurisdictions should further concentrate efforts to gather specific drainage area and other pertinent data during routine program updates and BMP maintenance inspections. Because individual BMP efficiencies tend to be greater than the conservatively estimated efficiencies for Maryland's early regulatory eras, there is a strong incentive for local governments to compile more accurate BMP data. Where these data are lacking however, counties and municipalities may use the CBP's annual estimate for urban land cover along with the stormwater management by era efficiencies to reflect the local implementation of BMPs.

b. Reconciling Local and CBP Scale Data: CBP methods for estimating urban land cover are based on a larger scale analysis than local data. While the CBP data are continually being improved to better reflect local land cover data, they tend to over or under-estimate actual urban land and impervious cover. When an over-estimation occurs, local jurisdictions can use the CBP annual data for land developed and the stormwater management by era efficiencies to reconcile these differences. Table 2 shows hypothetical CBP data for 1995 and 1996. In each year, urban land cover grew by 1,000 acres. The local urban BMP database for those same years however, shows 900 and 950 acres of BMP implementation, respectively. In this case, the stormwater management by era BMP category may be used to reconcile the difference between the CBP urban land cover and local land use. For 1995, 100 acres were added to this category and for 1996, 50 acres were added.

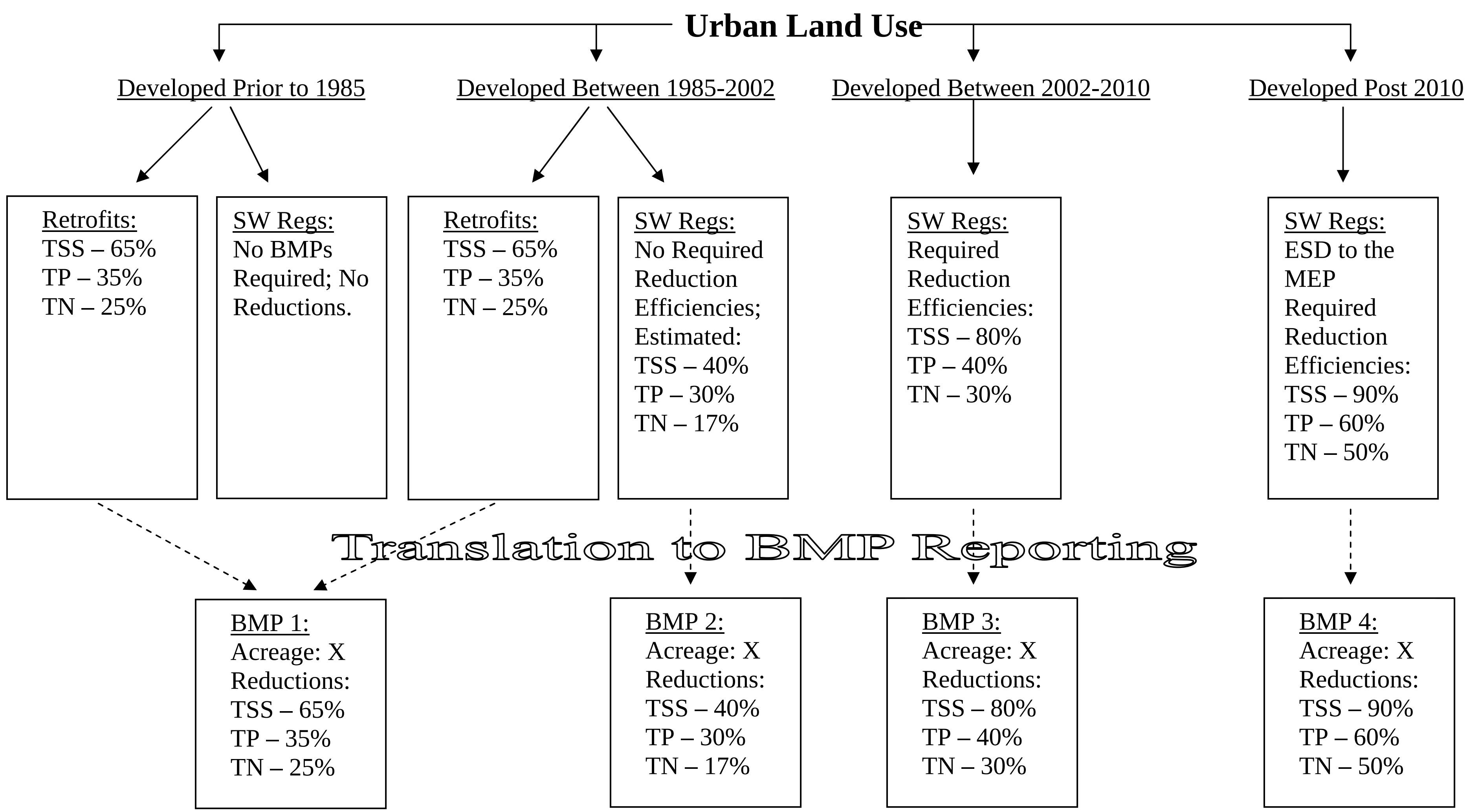
Table 2. Stormwater Management by Era Accounting Approach

Year	**CBP Urban Acres**	**Local Urban BMP Database Acres**					**SWM by Era Acres**	**Total Local Acres**
		Extended Detention	Wet Ponds	Filtering	Infiltration	Local Total		
1995	1,000	300	400	100	100	900	100	1,000
1996	1,000	300	400	100	150	950	50	1,000

(Adapted from MDE Stormwater Management by Era, 2009)

To obtain the latest available CBP Model land cover data for each jurisdiction by year, local governments may contact MDE or the Bay Program.

Figure 1. Stormwater Management by Era



7. New Development: As stated above, impervious area caused by development after 2002 will not be required to be restored provided that current State regulations are met. This is because the design criteria in the *Manual* results in more than sufficient stormwater management and there will be limited opportunity for improving water quality through retrofitting. Moreover, Maryland's Stormwater Management Act of 2007 requires implementation of environmental site design (ESD) to the MEP. ESD is a performance-based approach mandating the control of the one-year frequency storm event, about 2.6" per 24 hours. The goal of the MEP standard is to replicate the runoff characteristics of "woods in good conditions" and stormwater systems meeting current requirements are considered sufficient to off-set pollutant load increases caused by land use changes.

From a data management perspective, ESD to the MEP should be viewed as a systems-approach for meeting volume requirements. Where the MEP standard is met using ESD, each development site should be recorded as a single entry in MDE's Urban BMP database. There will however, be some instances where a combination of ESD techniques and conventional stormwater management practices are used to control new development runoff. In those cases, localities should take care to avoid double accounting for each new development by keeping track of the drainage area and impervious acreage unique to ESD and structural BMPs.

IV. Structural Restoration Credits

1. ESD and BMP Retrofits

The water quality objective for stormwater retrofit design is to manage the largest volume of runoff possible. Numerous constraints inherent to the urban environment, though, make full ESD implementation impractical. Meeting the design standards for structural BMPs specified in the *Manual* can be difficult as well. Subsequent to discussion within the State's NPDES stormwater community, structural BMP retrofits shall be designed to meet the *Manual's* WQ_v criteria.

The WQ_v criteria has been a fundamental regulatory requirement for stormwater management in Maryland since 2000. Additionally, many of the CBP approved BMP efficiencies are based upon designs that treat the volume from one inch of rainfall. Retrofit opportunities that achieve less than the WQ_v should be pursued where they make sense. These retrofits, however, will need to be pro-rated based on the WQ_v treated. Structural stormwater retrofit credits can be applied individually or across an entire watershed.

a. Individual Project Credit: Retrofits shall be credited according to the following criteria:

- An acre for acre impervious credit will be given when a structural BMP is specifically designed to provide treatment for the full WQ_v (one inch), or
- A proportional acreage of credit will be given when less than the WQ_v is provided: (percent of the WQ_v achieved) x (drainage area impervious acres)

Table 3. Retrofit of a Dry Pond Constructed Circa 1985

original design	=	2 and 10 year peak management
impervious acre drainage area	=	15 acres
retrofit design	=	1 inch, or WQ_v
impervious acre credit	=	15 acres
retrofit design	=	0.5 inch
impervious acre credit	=	7.5 acres, (50% of WQ_v * 15 acres)

(Adapted from the 2000 Maryland Stormwater Design Manual)

b. Watershed Implementation Credit: There will be instances where BMP retrofits provide greater than one inch of volume control. These BMPs should receive additional credit. One way to do this is to calculate the one inch rainfall volume over an entire watershed. Using a larger watershed perspective, structural BMPs above and below one inch of rainfall management can be equitably credited toward the overall goal of treating the watershed to the MEP.

2. Redevelopment can play a significant role in reducing stormwater pollutants. First, redevelopment limits the expansion of Maryland's urban footprint, preserving undeveloped resource lands. Second, redevelopment usually occurs in older urban environments, replacing unmanaged impervious surfaces with the controls mandated in the *Manual*. Stormwater management requirements for redevelopment are outlined in the Code of Maryland Regulations (COMAR 26.17.02.05D), and discussed in the *Manual* (Supplement 1, pages 5.117 – 5.120). These specify that some combination of impervious area reduction and water quality treatment needs to be provided.

When water quality treatment practices are provided for redevelopment, the existing impervious area treated may be credited toward restoration requirements. In most cases the credit will be equivalent to 50% of the existing impervious area for the project (per COMAR). However, when additional volume above the regulatory requirements is provided, additional credit will be accepted on a proportional basis as described in Section IV.1. above. Also, if new development results in the management of existing impervious area, i.e. < 40% according to the *Manual*, then these formerly unmanaged areas may be credited toward the impervious acre restoration requirement.

3. Existing Roads and Subdivisions: Many roads and subdivisions, including those built before 1985, have vegetated swale systems or sheetflow conditions that filter and treat stormwater runoff. Many of these existing features approximate the ESD designs found in Maryland's *Manual*. Each jurisdiction should conduct a systematic review of existing roads and subdivisions to determine the extent of water quality treatment already provided and to identify opportunities for retrofitting.

Land use designation may play a significant role in selecting areas that may already be adequately managed. For example, public roads and subdivisions in predominantly rural areas with low population densities, e.g., 1 dwelling unit per 5 acres or greater, will be more likely to have water quality design features equivalent to those defined in the *Manual*. If these areas can be shown to provide adequate water quality and sufficient documentation is provided to MDE, then the impervious acres can be excluded from the jurisdiction's total impervious area requiring management.

4. Step Pool Storm Conveyance: There are several stormwater management practices, such as the Step Pool Storm Conveyance system (SPSC), used for retrofitting that are not listed in the *Manual*. According to Anne Arundel County’s Design Guidelines for SPSC (2010), these are “open-channel conveyance structures that convert, through attenuation ponds and a sand seepage filter, surface storm flow to shallow groundwater flow.” When these practices are used as retrofits to capture the runoff from one inch of rainfall, the pollutant removal efficiencies from the most similar BMP type may be used. In this case, the SPSC performs very similar to a filtration practice, and therefore, the pollutant removal efficiencies for micro-bioretention can be applied to the drainage area treated. Other innovative practices that capture one inch of rainfall may also be considered for MDE approval pending further study and results of field implementation.

5. Recording Structural BMP Retrofits: NPDES stormwater permits require that all stormwater retrofit data be recorded on a stormwater restoration database (Appendix C). A comprehensive list of structural BMPs can be found in Table 4. All BMP efficiencies are derived from the CBP unless otherwise noted. BMP definitions and design criteria can be found in Maryland's *Manual*, materials that support the CBP's approved BMP efficiencies, and within the body of this guidance document. Impervious acres treated shall be calculated from the approved plans for each retrofit. BMP drainage areas need to be GIS-mapped as polygon shape files and linked to the restoration database. The GIS mapping of these retrofits shall be used by localities to demonstrate how the 20% impervious cover restoration requirement is being met and also to prevent the double reporting of structural BMPs. Additionally, local governments shall use the previously calculated baseline pollutant loads, BMP implementation rates, and the efficiencies provided in Table 4 to show progress toward meeting NPDES stormwater WLAs.

Table 4. Structural BMP Retrofit Matrix

BMP Practice	TN	TP	TSS
CBP Structural BMPs			
Dry Detention Ponds	5%	10%	10%
Hydrodynamic Structures	5%	10%	10%
Dry Extended Detention Ponds	20%	20%	60%
Wet Ponds and Wetlands	20%	45%	60%
Infiltration Practices	80%	85%	95%
Filtering Practices	40%	60%	80%
Vegetated Open Channels	45%	45%	70%
Erosion and Sediment Control	25%	40%	40%
Stormwater Management by Era			
Development Between 1985 - 2002	17%	30%	40%
Urban BMP Retrofit	25%	35%	65%
Development Between 2002 and 2010	30%	40%	80%
Development After 2010	50%	60%	90%
ESD to the MEP from the *Manual*			
Green Roofs	50%	60%	90%
Permeable Pavements	50%	60%	90%
Reinforced Turf	50%	60%	90%
Disconnection of Rooftop Runoff	50%	60%	90%
Disconnection of Non-Rooftop Runoff	50%	60%	90%
Sheetflow to Conservation Areas	50%	60%	90%
Rainwater Harvesting	50%	60%	90%
Submerged Gravel Wetlands	50%	60%	90%
Landscape Infiltration	50%	60%	90%
Infiltration Berms	50%	60%	90%
Dry Wells	50%	60%	90%
Micro-Bioretention	50%	60%	90%
Rain Gardens	50%	60%	90%
Grass, Wet, or Bio-Swale	50%	60%	90%
Enhanced Filters	50%	60%	90%
Additional Structural BMP Guidance			
Redevelopment (MDE)	50%	60%	90%
Existing Roadway Disconnect (MDE)	50%	60%	90%
Step Pool Storm Conveyance (MDE)	50%	60%	90%

(Adapted from CBP Urban BMP Efficiencies, and Stormwater Management by Era, MDE 2009)

V. Alternative Restoration Credits

This section presents alternative BMPs that will give jurisdictions greater flexibility toward meeting stormwater permit requirements. These BMPs can be grouped into four main categories. First are stormwater practices that have been recently approved by the CBP, e.g., street sweeping, stream restoration, and nutrient management. Second are practices that can be derived easily from documenting changes in land use and CBP loading rates, e.g., impervious surface reduction, tree planting, and reforestation. Third are practices not traditionally used for stormwater management, but will be allowed as an option for mitigating the effects from uncontrolled development, e.g., septic system upgrades and shoreline erosion control.

The fourth category includes alternative BMPs that have been proposed by Maryland's NPDES municipalities for further examination like education, sub-soiling, trash removal, pet waste management, outfall stabilization, floodplain restoration, river bank stabilization, disconnection of illicit discharges, and bio-reactor carbon filter. These options may be used for fulfilling NPDES stormwater restoration requirements when clear performance criteria are set and monitoring data documenting pollutant removal capability are submitted to MDE for approval.

1. Street Sweeping removes the buildup of pollutants that have been deposited along the street or curb, using mechanical or vacuum-assisted sweeper trucks. Localities can use one of two methods to compute the projected nutrient and sediment reductions associated with street sweeping.

a. Mass Loading Approach: For the mass loading approach, the street dirt collected is measured in tons at the landfill or ultimate point of disposal and converted to pounds. The TSS load is then estimated by multiplying the total particulate dry mass collected by 30%, or the fraction of material reflecting the particle size that dominates TSS (Law et al., 2008). The pounds of TN and TP can be calculated by multiplying the TSS load by 0.0025 and 0.001, respectively.

b. Street Lane Approach: For the street lane approach, a jurisdiction reports the number of lane miles they have swept during the course of the year. The following formula is used to convert lane miles swept into acres:

$$\frac{\text{(miles swept) x (5,280 ft/mile) x (lane width ft)}}{\text{43,560 ft/acre.}}$$

The total acres swept is multiplied by the annual nutrient and sediment load for impervious surfaces, or 10.85 lbs/acre for TN, 2.04 lbs/acre for TP, and 0.46 tons/acre for TSS to arrive at a baseline load. The baseline load can be multiplied by the pollutant removal efficiencies shown in Table 5 to determine the load reduction associated with street sweeping.

The sediment and nutrient reductions are based on the sweeping technology in use, with lower reductions for mechanical sweeping and higher reductions for vacuum-assisted or regenerative air sweeping technologies. The reductions only apply to an enhanced street sweeping program

Table 5. Street Sweeping Pollutant Removal Efficiencies

Technology	TN	TP	TSS
Mechanical	4%	4%	10%
Regenerative/Vacuum	5%	6%	25%

(CBP Street Sweeping Efficiencies, 2011)

where the streets are located in commercial, industrial, central business district, or high density residential neighborhoods and they are swept on a regular basis, e.g., twice per month.

2. Catch Basin Cleaning and Storm Drain Vacuuming are systematic water quality based storm drain programs where routine cleanouts are performed on targeted infrastructure that have high accumulation rates. Municipal inspections of the storm drain system can be used to identify priority areas. The projected nutrient reduction associated with enhanced storm drain cleanout programs are calculated using the mass loading approach described above for street sweeping.

3. Impervious Surface Elimination: Eliminating impervious surfaces and replacing them with vegetation will greatly improve urban hydrology and water quality. A credit for this practice is based on the pollutant load reduction expected when land cover is converted from impervious to pervious or forest. Two scenarios are shown in Table 6. One is the conversion of urban impervious to pervious, and the other is the conversion of urban impervious to forest. The difference in pollutant loads between land covers can be used to calculate pollutant load reduction efficiencies that may be used for NPDES stormwater permit accounting.

Table 6. Pollutant Reduction Efficiencies Associated with Impervious Surface Elimination

Conversion from	TN (lbs/acre/yr)	TP (lbs/acre/yr)	TSS (tons/acre/yr)
Urban Impervious	10.85	2.04	0.44
Pervious	9.43	0.57	0.07
Efficiency	13%	72%	84%
Conversion from	**TN (lbs/acre/yr)**	**TP (lbs/acre/yr)**	**TSS (tons/acre/yr)**
Urban Impervious	10.85	2.04	0.44
Forest	3.16	0.13	0.03
Efficiency	71%	94%	93%

(Adapted from CBP Model, Version 5.3.0, 2011)

4. Tree Planting and Reforestation: When localities convert urban land to forest, significant hydrologic and water quality benefits accrue. Tree planting typically occurs piecemeal across the urban landscape whereas reforestation usually occurs on a much larger scale. In either case, to claim these credits a survival rate of 100 trees per acre or greater is necessary with at least 50% of the trees being 2 inches or greater in diameter at 4 ½ feet above ground level. (Maryland Department of Natural Resources, 2009). Because contiguous parcels of one acre or greater may be difficult to locate for an urban tree planting program, an aggregate of smaller sites may be used.

The same method described above for impervious surface elimination can be used for tree planting and reforestation. For example, a credit is based on the pollutant load reduction expected when land cover is converted from urban to forest. Examples of converting urban pervious and impervious land cover to forest are shown in Table 7 along with the expected pollutant reduction efficiencies. These efficiencies will be accepted for NPDES stormwater permit accounting.

Table 7. Tree Planting and Reforestation Pollutant Load Reduction Efficiencies

Conversion from	TN (lbs/acre/yr)	TP (lbs/acre/yr)	TSS (tons/acre/yr)
Urban Pervious	9.43	0.57	0.07
Forest	3.16	0.13	0.03
Efficiency	66%	77%	57%
Conversion from	**TN (lbs/acre/yr)**	**TP (lbs/acre/yr)**	**TSS (tons/acre/yr)**
Urban Impervious	10.85	2.04	0.44
Forest	3.16	0.13	0.03
Efficiency	71%	94%	93%

(Adapted from CBP Model, Version 5.3.0, 2011)

5. Stream Restoration has been used throughout Maryland to address a wide range of problems observed in urban streams. As a watershed is developed, changes in the natural flow regime contribute to stream instability, erosion and sediment pollution, and degraded water quality. Stream restoration techniques are used to address these impacts and re-establish a healthy aquatic ecosystem.

Stream restoration includes a number of different approaches that recognize complex interactions within the stream ecosystem in order to contribute to a wide array of watershed benefits. An individual project will utilize the most appropriate practices to address site conditions and local constraints. These practices may include: physical grading to re-establish a stable channel pattern and reconnect the stream with the floodplain; introducing habitat features such as step-pools, woody debris, or riparian vegetation; and integrating structural approaches such as rock walls or riprap. Stream restoration projects that enhance ecosystem functions and environmental benefits will qualify for pollutant removal and impervious area treatment credit.

a. Local Monitoring Studies: Some of Maryland's local jurisdictions have monitored to quantify pollutant removal benefits from stream restoration projects. The most notable of these is the Spring Branch Stream Study by Baltimore County. In addition, Baltimore City and Maryland State Highway Administration (SHA) have used empirical methods for estimating pollutant load reductions for site specific situations. The method used for the Baltimore City and SHA monitoring included bank pin data and sediment samples for pre-restoration conditions to predict bank erosion and nutrient loading rates.

The Spring Branch Study however, is the only project known to quantify both sediment and nutrient reductions based on pre and post-restoration monitoring. These efficiencies were used as the basis for the CBP approved stream restoration credits. The erosion problems observed in the Spring Branch were significant and are typical of many of Maryland's urban streams.

Therefore, MDE will allow the efficiencies approved by the CBP to be used for other stream restoration projects in Maryland.

b. Literature Review: The literature review and the CBP guidance on stream restoration (Appendix E) emphasize that restoration projects should be planned within broader watershed goals. Walsh and Kunapo, 2009, and Booth, 2005 describe the importance of dispersing stormwater controls within a watershed to mimic natural flow attenuation to improve the success of stream restoration. Further, Palmer, 2008, emphasized the importance of focusing on replacing hydrology and other watershed processes when planning restoration projects.

The credit system established by MDE includes the consideration of the research on this topic and recognizes the importance of planning stream restoration with other activities to replace natural hydrology. The information provided in the stream restoration design criteria will support these goals and provide the basis for any credit given.

c. Stream Restoration Design Criteria: CBP accounting principles from Appendix E have been incorporated in the criteria below. It is recognized that there are numerous methods and design strategies that may be utilized for a given stream restoration project. In addition, each project is subject to a regulatory process that requires detailed evaluation and reporting. Therefore, it will be important to consider the level of analysis and the basis for the proposed management strategy when jurisdictions use stream restoration for credit. At a minimum, each jurisdiction should report a summary of the following information as part of NPDES required watershed assessments:

- A stream stability evaluation for restoration projects
- An evaluation of upstream impacts and a description of how these may be addressed
- A description of the watershed and stream restoration strategy
- A description of maintenance and inspection activities or planned monitoring to determine the effectiveness of the project

d. Accounting Recommendation: The three methods described below provide options for applying credit to stream restoration projects. These methods are based on approved CBP efficiencies. As further research is developed, these numbers may be modified.

Method I: Baseline Stream Restoration Credit

TN = 0.02 lb/linear foot/year
TP = 0.0035 lb/linear foot/year
TSS = 2.55 lb/linear foot/year

In recognizing that stream restoration projects provide some benefit, a baseline credit may be applied toward pollutant removal rates and impervious area restored. MDE will not require intensive physical, chemical, and biological monitoring for these projects. However, inspection and maintenance is recommended to ensure that the goals of the project are met.

Impervious acreage treated = 1 acre / 100 linear feet stream restored

The impervious area credit of 1 acre restored for every 100 linear feet of stream restoration is based on the pollutant removal efficiencies for TN, TP, and TSS. MDE has developed a method for determining an equivalent impervious area credit based on the approved CBP numbers. Section VI. of this document will describe how this credit is derived for all practices.

Method II: Stream Restoration using ESD and Structural BMPs

The credit granted in Method I above assumes that BMPs or ESD practices have not been implemented in the uplands. Additional credit will be available when structural BMPs and ESD practices are provided in combination with a stream restoration project. Each BMP will receive credit for pollutant removal (according to that BMP type) and impervious acreage treated for its corresponding drainage area. All BMPs must meet the criteria outlined under Section IV.1. of this document.

ESD disconnection practices provide additional opportunity to receive credit on untreated impervious areas. In order to maximize the area that may be used for disconnections, field surveys may be necessary to confirm runoff drainage patterns. Local jurisdictions should use outreach efforts with private property owners to explore opportunities for using landscaped areas to establish disconnections and small scale ESD practices.

The example below illustrates how these credits are applied in conjunction with stream restoration. The data are based on a stream restoration project on 1,000 linear feet of channel. The total drainage area to the downstream point of the restored stream is 90 acres and the total impervious area is 30 acres.

Table 8. Stream Restoration Credits

BMP Credit	**Contributing Drainage Area (Acres)**	**Impervious Area to BMP (Acres)**
Wet Pond	5.8	3.6
Infiltration	2.2	1.6
Wet Extended Detention	7.4	3.4
Filtration	2.4	1.0
Existing Impervious Surface Disconnections	2.0	2.0
Private Property Disconnects	2.0	2.0
	Upland BMP Sub Total:	13.6
Stream Restoration Credit		
1000 linear feet	90	10.0
	Stream Restoration Sub Total:	10.0
	Grand Total:	23.6

In this example, a certain level of management is provided using upland BMPs (13.6 acres of impervious area treatment). This includes 2 acres of disconnection credit where field observations confirm that runoff from impervious surfaces will sheetflow onto vegetated areas and provide water quality treatment. Another 2 acres of disconnection practices are implemented by working with residential property owners. Because the baseline credit is available, the upland BMPs combined with stream restoration result in a credit for a significant portion of the watershed impervious area. Incorporating these strategies together in small watersheds provides an advantage toward achieving impervious area restoration credit. As a general rule, whether Methods I or II is used, the impervious area credit for stream restoration shall not be greater than the total impervious area within the drainage for that project.

Method III: Local Monitoring for Stream Restoration Credits

A local jurisdiction may choose to provide more detailed monitoring for pre and post-restoration conditions in order to justify greater credit. In these situations, the jurisdiction should work closely with MDE to ensure that the monitoring program will be acceptable. Application of stream restoration credits will be based on individual review and approval and will be determined on a case by case basis. Further application to other projects within a jurisdiction may be considered. However, until more research is done toward stream restoration efficiencies and credits across Maryland, MDE does not recommend applying monitoring data across jurisdictions until the CBP accepts those data.

6. Shoreline Stabilization: These practices apply to the shoreline of the Chesapeake and Atlantic Coastal Bays and tidal rivers. Proper stabilization techniques can reduce shoreline erosion and improve water quality. MDE and Maryland's Chesapeake and Coastal Bays Critical Area Protection Program encourage the use of nonstructural practices or living shorelines. These include tidal marsh creation and beach nourishment. Structural practices include stone revetments, breakwaters, or groins. Further information on the design and construction of these practices can be found in MDE's *Shoreline Erosion Control Guidelines for Waterfront Property Owners* (MDE, 2008).

The Maryland Department of Natural Resources (DNR) provides a website tool, Maryland Shorelines Online (MSO), to determine shoreline erosion rates. Using this computer-driven tool and some field measurements, the cubic feet of soil lost can be estimated for an unprotected shoreline. The nutrient composition of eroding banks along the Bay shoreline is documented in the study, *Eroding Bank Nutrient Verification Study for the Lower Chesapeake Bay* (Ibison et al, 1992).

Table 9. Annual Shoreline Stabilization Credit

Practice Type	TN (lbs/linear ft)	TP (lbs/linear ft)	TSS (lbs/linear ft)
Structural	0.16	0.11	451
Nonstructural	0.16	0.11	451

Baltimore County used the MSO tool and the results from Ibison to estimate the pounds retained for 23 shoreline restoration projects, structural and nonstructural. MDE analyzed these data to establish nutrient and sediment removal rates that would be applicable for use in other jurisdictions, see Table 9. Because there are many factors that effect shoreline erosion and pollutant reduction can vary, a median analysis was used to prevent the influence of data extremes. The pollutant load reduction rates provided by MDE for shoreline stabilization may be used for NPDES stormwater permit accounting.

7. Nutrient Management plans specify the rate, timing, and application of fertilizers to urban turf grass. Soil disturbed during the development process is required to be stabilized with grass seed and mulch according to approved erosion and sediment control plans. Soil tests are required for determining the appropriate amount of fertilizer to be applied to ensure a healthy stand of grass that will prevent further soil erosion. Once a site is stabilized, i.e. > 95%, soil tests can be used as part of a comprehensive nutrient management plan for reducing and or eliminating fertilizer use. On government-owned land, localities may claim this credit when nutrient management policies have been recently established and receipts from the jurisdiction can be used to show a commensurate reduction in the pounds of fertilizer bought.

8. Septic Systems are accounted for in the CBP model as a nonpoint source load allocation (LA). When describing pollutant sectors the CBP often refers to an urban load, which is actually a combination of stormwater WLAs and septic system LAs. Because these two sources are often intertwined, localities can investigate opportunities to improve septic system discharges in urban areas, which may be used for achieving reductions under NPDES stormwater permits.

The CBP estimates that septic systems, per unit, deliver 12 pounds of TN annually to the Bay. Also, the Bay Program estimates that the pollutant removal efficiency for septic system pumping is 5%, or 0.6 pounds of TN annually, and enhanced denitrification units reduce nitrogen by 50%, or 6 pounds annually. MDE estimates that when septic systems are connected to WWTP with enhanced nitrogen removal capability, then the net unit reduction is 9 pounds of TN annually. Load reductions associated with septic system maintenance, enhancements, and conversions can be used by local governments as alternative practices for meeting NPDES stormwater permit requirements.

9. Alternative BMPs for Consideration: The following alternative BMPs have been recommended by Maryland's NPDES municipalities for further examination: education, sub-soiling, trash removal, pet waste management, outfall stabilization, floodplain restoration, river bank stabilization, disconnection of illicit discharges, and bio-reactor carbon filter. These options may be used for fulfilling NPDES stormwater restoration requirements when clear performance criteria are set and monitoring data documenting pollutant removal capability are submitted to MDE for approval. Additionally, routine inspection and maintenance procedures for these practices shall be established to ensure longevity and performance. MDE will work collaboratively with Maryland's NPDES stormwater community and the CBP in order to determine the proper recording of any alternative BMP that appears to work well.

10. New Technology/Innovative Practices: MDE recognizes that new and innovative approaches to stormwater management are being developed on a continuous basis. These practices are currently allowed for redevelopment, infill development, pretreatment, and retrofit projects provided that they are accepted locally. In order to foster further innovative approaches for achieving watershed restoration goals and meeting stormwater requirements for new development projects, MDE offers the following guidelines:

- The use of any BMP must be documented in the jurisdiction's TMDL implementation plan. Documentation must include all relevant data related to the expected pollutant reduction efficiencies of the practice and describe life-cycle maintenance requirements and costs.
- Jurisdictions shall provide independently verified assessment data or propose a monitoring plan to evaluate the effectiveness of the practice.
- MDE will evaluate all monitoring data and approve any credit toward meeting pollutant reduction targets under established TMDL's.
- Jurisdictions shall submit the practice to the Bay Program's Urban Stormwater Workgroup for consideration as an EPA recognized stormwater BMP.

VI. An Equivalent Impervious Acre

While structural BMPs have a clearly defined drainage area and imperviousness, the task of relating an impervious area controlled by alternative stormwater management practices such as street sweeping, reforestation, and stream restoration becomes more difficult. Alternative stormwater management practices however, do provide significant pollutant load reductions and should receive a credit toward NPDES restoration requirements. MDE has developed a method for relating the reduction in pollutant loads from alternative practices into an equivalent impervious acre.

Table 10. Pollutant Loads for Impervious and Forest Cover

Parameter	Impervious (lbs/acre/yr)	Forest (lbs/acre/yr)	Delta (lbs/acre/yr)
TN	10.85	3.16	7.69
TP	2.04	0.13	1.91
TSS (tons)	0.46	0.03	0.43

(MDE derived from CBP Model, Version 5.3.0, 2011)

Fundamental to this approach is knowing the pollutant loads associated with runoff from an acre of impervious land cover and an acre of forest. The CBP estimates that the TN load in runoff from an impervious acre is 10.85 lbs annually while the load from an acre of forest is 3.16 lbs annually. The difference between the two land covers is 7.69 lbs of TN per year. The Delta for TP and TSS loads are shown in Table 10. These differences can be used to set a level of implementation that alternative practices would need to meet to mimic forest conditions.

Table 11. Estimated Pollutant Load Reductions from Mechanical Street Sweeping

Parameter	Implementation Units	Urban Impervious (lbs/acre/yr)	Reduction Efficiency	Pollutant Load Reduction (lbs/acre/yr)
TN	1 acre	10.85	4%	0.43
TP	1 acre	2.04	4%	0.08
TSS (tons)	1 acre	0.46	10%	0.05

(MDE derived from CBP Model, Version 5.3.0, 2011)

Next, using the BMP efficiencies for street sweeping and a unit rate of implementation, a pollutant load reduction in pounds can be determined as shown in Table 11. These are based on enhanced, bi-monthly sweeping. If the Delta between impervious and forest land cover is divided into the pounds reduced as a result of street sweeping, then an equivalent impervious acre factor can be derived. Because Chesapeake Bay's TMDLs are based on TN, TP, and TSS, the equivalent impervious acre analyses for all three pollutants are averaged together to determine a single weighted equivalent impervious acre conversion factor as shown in Table 12.

Table 12. Equivalent Impervious Acre Analyses for Street Sweeping

Parameter	Implementation Units	Treatment Delta (lbs)	BMP Load Reduction (lbs)	Impervious Acre Conversion Factor
TN	1 acre	7.69	0.43	0.06
TP	1 acre	1.91	0.08	0.04
TSS (tons)	1 acre	0.43	0.05	0.12
Average for Nutrients and Sediment:				0.07

Examples are presented in Table 13 using the equivalent impervious acre conversion factor for street sweeping, or 0.07, along with various drainage areas, e.g., 2, 50, and 100 acres, to calculate an equivalent impervious acre. An equivalent impervious acre analysis has been conducted by MDE for each alternative stormwater management practice presented in this document and listed in Table 14, Matrix of Alternative Urban BMPs.

Table 13. An Equivalent Impervious Acre

Implementation Units	Conversion Factor for Street Sweeping	Impervious Acre Equivalent
2 acres	0.07	0.14
50 acres	0.07	3.5
100 acre	0.07	7.0

VII. Alternative Urban BMP Matrix

NPDES stormwater permits require that alternative urban BMPs be recorded on a stormwater restoration database (Appendix C). MDE has expanded the list of acceptable alternative BMPs for reporting and the appropriate abbreviations for coding (Appendix D). All BMPs need to be GIS-mapped as point or polygon shape files and linked to the restoration database.

BMP efficiencies and impervious acre equivalencies in Table 14 are calculated per acre of practice implementation, except where noted otherwise. For example, the pounds reduced and impervious acre equivalency for stream restoration need to be multiplied by the linear feet of the project. Catch basin cleaning needs to be multiplied by the tons of dry material removed. And, septic system pumping or treatment system changes need to be multiplied by the number of units improved.

BMP definitions and design criteria can be found in Maryland's *Manual*, materials that support the CBP's approved BMP efficiencies, and within the body of this guidance document. All BMP efficiencies are derived from the CBP unless otherwise noted, e.g., MDE. Local governments shall use the BMP efficiencies and impervious acre equivalencies in this guidance to show progress toward meeting the NPDES 20% impervious cover restoration requirement, water quality benchmarks, and stormwater WLAs.

Some of the alternative stormwater management practices, including reforestation, shoreline stabilization, and septic system upgrades may be claimed by other agencies in pursuit of the Chesapeake Bay TMDL. To prevent the double counting of BMPs, any practice used for meeting stormwater WLAs and NPDES stormwater permit conditions cannot be claimed by another program or government agency. Because local governments maintain the responsibility for various environmental regulatory programs and are the organizational structure for implementing the Chesapeake Bay Phase II WIP, it will be incumbent upon localities to prevent the double reporting of BMPs.

Table 14. Matrix of Alternative Urban BMPs

BMP Practice	Efficiency Per Acre			Impervious Acre Equivalent
	TN	TP	TSS	
Mechanical Street Sweeping	4%	4%	10%	0.07
Regenerative/Vacuum Street Sweeping	5%	6%	25%	0.13
Nutrient Management	17%	22%	0%	0.09
Grass/Meadow Buffers	30%	40%	55%	0.27
Forest Buffers	45%	40%	55%	0.34
Impervious Urban to Pervious (MDE)	13%	72%	84%	0.62
Impervious Urban to Forest (MDE)	71%	94%	93%	1.00
Planting Trees on Pervious Urban (MDE)	66%	77%	57%	0.38
Planting Trees on Impervious Urban (MDE)	71%	94%	93%	1.00
Reforestation on Pervious Urban (MDE)	66%	77%	57%	0.38
Reforestation on Impervious Urban (MDE)	71%	94%	93%	1.00
BMP Practice	**Pounds Reduced per Ton of Collected Dry Material**			**Impervious Acre Equivalent**
	TN	**TP**	**TSS**	
Catch Basin Cleaning	1.5	0.6	600	0.40
Storm Drain Vacuuming	1.5	0.6	600	0.40
Mechanical Street Sweeping	1.5	0.6	600	0.40
Regenerative/Vacuum Street Sweeping	1.5	0.6	600	0.40
BMP Practice	**Pounds Reduced per Linear Foot**			**Impervious Acre Equivalent**
	TN	**TP**	**TSS**	
Stream Restoration	0.02	0.035	2.55	0.01
Shoreline Stabilization (MDE)	0.16	0.11	451	0.04*
BMP Practice	**Pounds Reduced per Unit**			**Impervious Acre Equivalent**
	TN	**TP**	**TSS**	
Septic Pumping	0.6	0	0	0.03
Septic Denitrification	6.0	0	0	0.26
Septic Connections to WWTP (MDE)	9.0	0	0	0.39
Alternative BMPs for Consideration				
Education				
Sub-Soiling				
Trash Removal				
Pet Waste Management				
Outfall Stabilization				
Floodplain Restoration				
River Bank Stabilization				
Bio-Reactor Carbon Filter				
Disconnection of Illicit Discharges				

* Only nutrient values were used to derive impervious acre equivalent

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Appendix A -- Stormwater Model Weblinks

Stormwater management computer models can aid local jurisdictions in establishing baseline pollutant loads, planning restoration work, and showing progress toward meeting waste load allocations (WLAs). Maryland's Assessment and Scenario Tool (MAST) developed for the Chesapeake Bay Program (CBP) and the Hydrological Simulation Program -- Fortran (HSPF), the Stormwater Management Model (SWMM), and spreadsheet versions like the Watershed Treatment Model (WTM) are acceptable for use by Maryland's NPDES localities. MAST is the only model that relates directly to the CBP model and where pollutant removal credits may be assured under the Bay's TMDL. Other models and results can be compared to the Bay model on a proportional basis for NPDES accounting purposes.

1. Maryland Assessment and Scenario Tool

http://www.mde.state.md.us/programs/Water/TMDL/TMDLImplementation/Documents/Webinars/April/WIP_Webinar_2011-04-13_MAST.pdf

2. Hydrological Simulation Program -- Fortran:

http://water.usgs.gov/software/HSPF/

3. Stormwater Management Model

http://www.epa.gov/ednnrmrl/models/swmm/index.htm

4. Watershed Treatment Model

http://www.stormwatercenter.net/monitoring%20and%20assessment/WTM_Users_Notes.htm

Appendix B -- Maryland's Urban BMP Database

Column Name	Data Type	Length	Description
YEAR	NUMBER	4	Annual report year
STRU_ID	TEXT	4	Unique structure ID
PERMIT_NO	TEXT	10	Unique permit number
STRU_NAME	TEXT	60	Structure name
ADDRESS	TEXT	50	Structure address
CITY	TEXT	15	Structure address
STATE	TEXT	2	Structure address
ZIP	NUMBER	10	Structure address
MD_NORTH	NUMBER	8	Maryland grid coordinate (NAD 83 meters) Northing
MD_EAST	NUMBER	8	Maryland grid coordinate (NAD 83 meters) Easting
ADC_MAP	TEXT	5	ADC map book coordinate (optional if BMP has MD Northing\Easting)
WATERSHED_CODE	NUMBER	20	Maryland 12-digit hydrologic unit code
STRU_TYPE	TEXT	10	Identify structure or BMP type[3]
RESTORATION	TEXT	3	Is this a stormwater restoration practice? Answer Yes or No
LAND_USE	NUMBER	3	Predominant land use[2]
DRAIN_AREA	NUMBER	8	Structure drainage area (acres)[1]
IMP_DRAIN	NUMBER	8	Structure impervious drainage area (acres)
TOT_DRAIN	NUMBER	8	Total site area (acres)
RCN	NUMBER	5	Runoff curve number (weighted)
ON_OFF_SITE	TEXT	3	On or offsite structure
APPR_DATE	DATE/TIME	8	Permit approval date
BUILT_DATE	DATE/TIME	8	Construction completion date
INSP_DATE	DATE/TIME	8	Record most recent inspection date
GEN_COMNT	TEXT	60	General comments (e.g., redundant controls)
LAST_CHANGE	DATE/TIME	8	Date last change made to this record

[1] GIS shapefile required
[2] Use Maryland Office of Planning land use codes
[3] Use urban BMP type code

Appendix C -- Maryland's NPDES Stormwater Restoration Database

Column Name	Data Type	Length	Description
YEAR	TEXT	4	Annual report year
STRU_ID	TEXT	10	Unique structure ID
STRU_NAME	TEXT	60	Structure name
STRU_TYPE	TEXT	10	Identify structure or BMP type[3]
DESCRIPTION	TEXT	60	Brief description of the project
LAND_USE	TEXT	3	Predominant land use[2]
DRAIN_AREA	NUMBER	8	Structure drainage area (acres)[1]
IMP_AREA	NUMBER	8	Imperviousness in drainage area (acres)[1]
MD_NORTH	NUMBER	9	Maryland grid coordinate (NAD 83 meters) Northing
MD_EAST	NUMBER	9	Maryland grid coordinate (NAD 83 meters) Easting
WATERSHED_CODE	TEXT	20	Maryland 12-digit hydrologic unit code
PROJ_STAT	TEXT	2	Enter P for Proposed, UC for Under Construction, and C for Complete
APPR_DATE	DATE/TIME	8	Permit approval date
BUILT_DATE	DATE/TIME	8	Construction completion date
INSP_DATE	DATE/TIME	8	Maintenance inspection date
GEN_COMNT	TEXT	60	General comments (e.g., experimental BMP)
LAST_CHANGE	DATE/TIME	8	Date last change made to this record

[1] GIS shapefile required
[2] Use Maryland Office of Planning land use codes.
[3] Use urban BMP type code.

Appendix D -- Maryland's NPDES Urban BMP Index of Practices

BMP Practice	**Code**
CBP Structural BMPs	
Dry Detention Ponds	DP
Hydrodynamic Structures	OGS
Dry Extended Detention Ponds	ED
Wet Ponds and Wetlands	WP
Infiltration Practices	IP
Filtering Practices	FP
Vegetated Open Channels	VOC
Erosion and Sediment Control	E&S
Stormwater Management by Era	
Development Between 1985 - 2002	ERA1
Urban BMP Retrofit	ERA2
Development Between 2002 and 2010	ERA3
Development After 2010	ERA4
ESD to the MEP from the *Manual*	
Green Roofs	ESD
Permeable Pavements	ESD
Reinforced Turf	ESD
Disconnection of Rooftop Runoff	ESD
Disconnection of Non-Rooftop Runoff	ESD
Sheetflow to Conservation Areas	ESD
Rainwater Harvesting	ESD
Submerged Gravel Wetlands	ESD
Landscape Infiltration	ESD
Infiltration Berms	ESD
Dry Wells	ESD
Micro-Bioretention	ESD
Rain Gardens	ESD
Grass, Wet, or Bio-Swale	ESD
Enhanced Filters	ESD
Additional Structural BMP Guidance	
Redevelopment	RED
Existing Roadway Disconnect	ERD
Regenerative Stormwater Conveyance	RSC

Appendix D -- Maryland's NPDES Urban BMP Index of Practices

Alternative Practice Type	**Code**
Mechanical Street Sweeping	MSS
Regenerative/Vacuum Street Sweeping	VSS
Nutrient Management	NM
Grass/Meadow Buffers	GMB
Forest Buffers	FB
Impervious Urban to Pervious	IMPP
Impervious Urban to Forest	IMPF
Planting Trees on Pervious Urban	PTPU
Planting Trees on Impervious Urban	PTIU
Reforestation on Pervious Urban	RPU
Reforestation on Impervious Urban	RIU
Catch Basin Cleaning	CBC
Storm Drain Vacuuming	SDV
Stream Restoration	STRE
Shoreline Stabilization	SHST
Septic Pumping	SEPP
Septic Denitrification	SEPD
Septic Connections to WWTP	SEPC
Alternative BMPs for Consideration	
Education	EDU
Sub-Soiling	SUB
Trash Removal	TRA
Pet Waste Management	PET
Outfall Stabilization	OUTS
Floodplain Restoration	FPRES
River Bank Stabilization	RBS
Bio-Reactor Carbon Filter	BRCF
Disconnection of Illicit Discharges	DID

Appendix E -- CBP Stream Restoration Guidance

Stream Restoration in Urban Areas
Crediting Jurisdictions for Pollutant Load Reductions

The Chesapeake Bay Program will credit jurisdictions for reducing pollutant loads to the Bay and its tidal rivers, resulting from stream restoration in urban areas (including suburban areas). This document provides guidance to the jurisdictions regarding the stream restoration actions in urban areas that will be credited in the watershed model.

Stream Restoration in Urban Areas

Land cover changes in the contributing watersheds disrupt the existing natural balance between the water flow regime and sediment flux, destabilize stream channels, and increase the loadings of pollutants to downstream areas. The objectives, opportunities, and measures for stream restoration may differ in urban and rural areas. The objectives for stream restoration in urban areas include, but are not limited to, reducing stream channel erosion, promoting physical channel stability, reducing the transport of pollutants downstream, and working towards a stable habitat with a self-sustaining, diverse aquatic community. Stream restoration activities should result in a stable stream channel that experiences no net aggradation or degradation over time.

In addition to these in-stream restoration activities, addressing upland sources of stream impacts (for example, reducing watershed runoff and associated pollutant loads, or encouraging groundwater recharge) is critical to ensuring the success of stream restoration projects in urban areas. Projects should be planned in the context of a comprehensive watershed assessment or inventory, where upland sources of the problem are considered in the project design. Smaller stream restoration projects on isolated stretches of a stream can be counted as long as upland sources of impacts are considered in some way. To ensure the success of a stream restoration project in an urban area, the project must have adequate watershed controls of upstream sources of urban runoff or be designed to accommodate the current and future urban runoff volume and velocity from upstream sources.

Just like with other best management practices in the Chesapeake Bay watershed, it is important to track and monitor the effectiveness of stream restoration projects in urban areas. All projects should either have a monitoring component or regular inspection and maintenance program to ensure ongoing stability of the urban stream.

What Types of Projects are Credited as Stream Restoration in Urban Areas?

Pollutant load reductions associated with stream restoration projects in urban areas can be credited in the Chesapeake Bay Watershed model if they meet the following criteria:

- Projects must meet multiple objectives of stream restoration in urban areas.
- Project must be set within the context of a watershed assessment that considers the effect of upland sources to the viability of the stream restoration project.
- Project must have a monitoring component and/or regular inspections to demonstrate ongoing stability of the urban stream.

The Chesapeake Bay watershed jurisdictions will annually report the number of urban stream miles restored in each Chesapeake Bay Watershed Model county segment to the Chesapeake Bay Program Office.

Pollutant Load Reductions Associated with Stream Restoration in Urban Areas

In addition to localized benefits, stream restoration in urban areas can result in reductions of pollutant loads entering the Bay and its tidal rivers. There is only one known study that quantifies the pollutant load reductions associated with stream restoration in an urban area. Although data are lacking, the Chesapeake Bay Program decided it was important to account for load reductions resulting from stream restoration. The Chesapeake Bay Program will refine these efficiencies as additional data become available. Reductions in pollutant loads entering the Bay and its tidal rivers from stream restoration in urban areas will be calculated based on the following pollutant removal efficiencies (Baltimore County, Maryland, Spring Branch Stream Study, 2002):

- TN = 0.02 lb/linear foot/year
- TP = 0.0035 lb/linear foot/year
- TSS = 2.55 lb/linear foot/year

APPENDIX D:

Middle Gwynns Falls SWAP Uplands Assessment Map

MIDDLE GWYNNS FALLS SWAP UPLANDS ASSESSMENT

Middle Gwynns Falls

Small Watershed Action Plan

Addendum A:

Sediment and Bacteria TMDLs Analysis and Actions

A.1 Introduction

Based on U.S. EPA – Region 3 review of the *Middle Gwynns Falls – Small Watershed Action Plan* a number of deficiencies were found in meeting the EPA a through i planning criteria. These deficiencies included:

- Addressing the sediment TMDL, and
- Addressing the bacteria TMDL

This addendum to the *Middle Gwynns Falls – Small Watershed Action Plan* has been prepared to address the stream based sediment TMDL that was discussed (*Middle Gwynns Falls – Watershed Characterization* – Section 3.2), but not addressed in the original document. Likewise the bacteria TMDL was discussed (*Middle Gwynns Falls – Watershed Characterization* – Section 3.2.2), but not addressed.

Baltimore County is in the process of developing TMDL Implementation Plans for each EPA approved TMDL in Baltimore County. These TMDL Implementation Plans will have a public participation component, and a public comment period, prior to submittal to Maryland Department of the Environment at the end of December 2014 to meet a component of our recently issued NPDES – MS4 Permit (11-DP-3317, MD0068314). The Small Watershed Action Plans that have been completed will be used to assist in identifying the implementation actions to be included in the TMDL Implementation Plan. Conversely, the TMDL Implementation Plans will be used to inform the SWAPs and possible result in a modification of the actions within the SWAP to assure the TMDL end points are met.

While the SWAP process is specifically designed to incorporate citizens in the plan preparation through the Steering Committee and the Stakeholder meetings; future SWAPs will be posted for a 30 day comment period prior to being finalized to ensure that citizens have the opportunity to express opinions and thoughts on each document. Based on the comments the plans may be modified, in any event a comment response document will be prepared, explaining why or why not the document was modified based on each comment.

A.2 Sediment TMDL

The sediment TMDL for Gwynns Falls is based on impairment of the aquatic community identified through the Maryland Biological Stream Survey monitoring. Subsequent evaluation using the methods detailed in the *Maryland Biological Stressor Identification Analysis Process* (MDE, 2009) indicated that the impairment of the aquatic community was due to a number of causes, including the following factors summarized in *Watershed Report for Biological Impairment of the Gwynns Falls Watershed in Baltimore City and Baltimore County, Maryland Biological Stressor Identification Analysis Results and Interpretation* (MDE, 2009) (See Appendix J in volume 2 of the *Middle Gwynns Falls Small Watershed Action Plan* for full report):

- Inorganic pollutants (chlorides and conductivity) were found in 76% of the Gwynns Falls stream miles with very poor or poor biological conditions. Degradation of the aquatic community due to these factors is related to prolonged exposure. The current lack of state monitoring data for inorganic pollutants limits the ability of the state to more precisely determine the specific cause(s) of the impairment.

- The analysis also indicated that the aquatic community impairments are likely related to flow/sediment related stressors. The document states: "Specifically, altered hydrology and increased runoff from urban impervious surfaces have resulted in channel erosion and subsequent elevated suspended sediment transport through the watershed, which are in turn the probable causes of impacts to biological communities."
- The analysis also identified ammonia as a possible stressor resulting in degraded aquatic communities. The high ammonia was found a two of the twelve sites used in the analysis. It was concluded that more intensive analysis of the available data was needed to determine if there is ammonia toxicity impairment in the Gwynns Falls watershed.

The Gwynns Falls watershed was originally listed as sediment impaired in 1996. The Biological Stressor Identification Analysis confirmed the original listing. The sediment TMDL was developed to address the degradation of the aquatic community. Meeting the sediment TMDL reduction requirements may not result in improvement of the aquatic community to fair or good conditions due to the existence of additional impairing factors (inorganic pollutants and possibly ammonia) for which TMDLs have yet to be developed. However, improvement of aquatic habitat and reduction of sediment is necessary component to any aquatic community improvement.

A.2.1 Gwynns Falls Sediment TMDL

The *Total Maximum Daily Load of Sediment in the Gwynns Falls Watershed, Baltimore County and Baltimore City* (MDE, 2009) document can be found in Volume 2, Appendix H of the *Gwynns Falls Small Watershed Action Plan*. A brief summary is provided in this section.

The framework for developing the TMDL was based on the Chesapeake Bay Program (CBP) Phase 5 Watershed Model. Based on the date of the publication, MDE did not use the final Phase 5 Watershed Model run from July 2011 for derivation of the land use loading rates. MDE used the edge-of-stream (EOS) loading rates in calculation of the baseline load for the TMDL. In the Watershed Model, the EOS loads represent not only the erosion from land, but also all of the intervening processes; hill slope/stream corridor deposition; and stream channel transport, erosion and deposition. This is due to the stream channel layer used in the CBP watershed model being representative of larger streams, typically fourth order. Thus the steam channel processes in the lower order streams are not taken specifically into account. The EOS represents not only the sediment load derived from upland erosion, but also the sediment contribution from low order streams. To remedy this situation, MDE developed a methodology to determine the percentage of the sediment load due to stream channel erosion. Based on the assumption that as impervious surfaces increase, upland sources decrease, flow increases, and change in sediment load is results from increased stream bank erosion, a model was developed. The following equation was used to estimate the percentage of sediment due to stream channel erosion:

$$\%E = \frac{I * L_I}{I * L_I + (1 - I)L_P}$$

where:

%E = percent erosional sediment resultant from stream channel erosion
I = percent impervious
L_I = Impervious urban land use EOF load
L_P = Pervious urban land use EOF load

This model was verified through two different methods used in modeling sediment in the Anacostia River Basin; an HSPF model with a Penn State developed stream channel erosion equation, and sediment rating curve model using data from USGS gage stations to estimate annual loads before and after increased development.

To determine the sediment threshold, a reference watershed approach was used. The basis for this approach is that sediment loads determined for reference watersheds that support aquatic life should serve as the basis for determining allowable sediment loads in sediment impaired watersheds.

The watershed was divided into two segments based on the location of two long-term Department of Natural Resources monitoring sites (see Table A-1).

Table A-1: DNR Core/Trend Sites in Gwynns Falls

Site Number	Latitude	Longitude	Current Water Quality Status	Trend Since 1970s
GWY0015	39.3140	-76.7280	Poor	No Change
GWY0115	39.3620	-76.7620	Fair/Good	Slight Improvement

Site GWY0015 is located in Baltimore City near the base of the Gwynns Falls watershed in Carroll Park. Site GWY0115 is located in Baltimore County on the mainstem of Gwynns Falls at Liberty Road. The Middle Gwynns Falls Planning area contains portions of both segments.

The resulting TMDL and associated reductions are displayed in Table A-2.

Table A-2: Baseline Loads, TMDL Load Reductions, and Percent Reductions for the Gwynns Falls Sediment TMDL

	Baseline Load (lbs/year)	TMDL (lbs/year)	Pounds Reduction	Reduction (%)
Segment 1	16,949,400	12,962,600	3,986,800	23.5
Segment 2	27,147,200	15,029,800	12,117,400	44.6
Total	**44,096,600**	**27,992,400**	**16,104,200**	**36.5**

While the Gwynns Falls Sediment TMDL did not break out the loads based on upland versus stream channel sources, based on the equation above, the document indicated that the entire Gwynns Falls with a 33% impervious cover would result in ~77% of the sediment load coming from stream channel erosion.

A.2.2 Sediment TMDL in Relation to the Middle Gwynns Falls Planning Area

To calculate the sediment load in the planning area, the Maryland Department of Planning (MDP) 2010 land use GIS coverage was used in conjunction with the land use per acre loading rates as determined by the October 2011 Maryland Assessment Scenario Tool (MAST) update. The MDP 2010 land use is based on 2007 aerial imagery and therefore represents the land use as of 2007. The impervious surface coverage was determined through the Baltimore County 2008 planimetric data for roads and buildings. Table A-3 presents per acre sediment loading by land use classification and Table A-4 presents the results of the sediment calculations by subwatershed, along with the average per acre loading and the percentage of sediment attributable to stream channel erosion.

Table A-3: Land Use Sediment Loading Rates

Land Use	Lbs Sediment/Acre/Year
Impervious Urban	2,056.95
Pervious Urban	280.43
Cropland	1,422.32
Pasture	307.45
Forest	82.17

Table A-4: Subwatershed Land Use and Sediment Loading Results

Land Use	Gwynns Falls	Scotts Level Branch	Powder Mill Run	Dead Run	Maiden Choice Run	Total Middle Gwynns Falls
Impervious Urban	1,435	684	239	1,632	305	4,295
Pervious Urban	3,601	1,649	568	2,208	592	8,618
Cropland	4	1	0	0	0	5
Pasture	28	0	0	0	0	28
Forest	1,096	320	151	337	31	1,935
Total	**6,164**	**2,654**	**958**	**4,177**	**928**	**14,881**
Sediment Loads						
Impervious Urban	2,951,723	1,406,954	491,611	3,356,942	627,370	8,834,600
Pervious Urban	1,009,828	462,429	159,284	619,189	166,015	2,416,745
Cropland	5,689	1,422	0	0	0	7,111
Pasture	8,609	0	0	0	0	8,609
Forest	90,058	26,294	12,408	27,691	2,547	158,998
Total	**4,065,907**	**1,897,099**	**663,303**	**4,003,822**	**795,932**	**11,426,063**
Average #s/Acre	**660**	**715**	**692**	**959**	**858**	**768**
% Sediment From Stream Erosion	**69%**	**72%**	**71%**	**82%**	**78%**	**75%**

The target load reductions will vary depending on whether the subwatershed is in the segment 1 or segment 2 TMDL area or is split between the two. Table A-5 indicates the load reductions by subwatershed taking location into account.

Table A-5: Subwatershed Sediment Load Reductions

Subwatershed	Segment	Baseline Sediment Load	Target % Reduction	TMDL Load	Target Pounds Reduction
Gwynns Falls	1 & 2	4,065,907	36.5%	2,581,851	1,484,056
Scotts Level Branch	1	1,897,099	23.5%	1,452,281	445,818
Powder Mill Run	2	663,303	44.6%	367,197	295,833
Dead Run	2	4,003,822	44.6%	2,218,117	1,785,705
Maiden Choice Run	2	795,932	44.6%	450,036	345,896
Total Target Reduction		**11,426,063**	**38.1%**	**7,069,482**	**4,357,308**

A.2.3 Sediment Reduction Strategy

The reduction strategy to meet the Sediment TMDL target load reduction of 4,357,308 pounds is presented in Table A-6. This table is an adaptation of Table 3-24 of the Middle Gwynns Falls SWAP.

Table A-6: Implementation Actions and Expected TSS Reductions for the Middle Gwynns Falls

BMP	How Credited	TSS Efficiency	Units Available		Projected Participation	Projected 2025 TSS Load Reduction
Completed Measures						
Stream Restoration	NPDES Efficiency	Varies	7,775	feet	100%	2,007,250
Existing SWM	Efficiency	Varies	3,087	acres	100%	773,401
Proposed Measures						
SSO Reduction/Elimination	Direct Removal	N/A	223,390	gallons	100%	5,888
SWM Conversions	Efficiency	50%	335	acres	100%	145,837
SW Retrofits (NSA, ISI)	Efficiency	90%	30	acres	50%	27,686
NSA Stormwater Retrofit	Efficiency	90%	17	acres	50%	16,161
ISI Stormwater Retrofit	Efficiency	90%	12	acres	50%	11,526
ISI Impervious Cover Removal	LU Conversion	N/A	4	acres	75%	4,934
NSA Downspout Disconnection	Efficiency	90%	206	acres	43%	163,852
Reforest Stream Buffer	LU Conversion + Efficiency	50%	384	acres	33%	25,234
NSA Tree Plantings	LU Conversion	N/A	67	acres	43%	5,709
ISI Tree Plantings	LU Conversion	N/A	72	acres	65%	9,253
Street Sweeping	Efficiency	25%	76	miles	100%	142,348
WQMP Stream Restoration Projects	Lbs per Ln Ft	310	19,930	feet	85%	5,251,555
Stream Restoration	Lbs per Ln Ft	310	64,863	feet	50%	10,053,784
WQMP Wetland Creation Projects	Efficiency	60%	63	acres	100%	32,813
WQMP BMP Creation Projects	Efficiency	60%	357	acres	60%	112,106
Redevelopment of Urban Areas	Efficiency	60%	1,339	acres	67%	469,025
MS4 Retrofits	Efficiency	65%	12,913	acres	34%	2,486,296
Total TSS Reduction						**18,964,007**

As is evident from the total amount of expected reduction there is an apparent discrepancy between calculated load and the expected reductions due to implementation of the various actions. The expected load in the TMDL document stated that "the land use framework used to develop this TMDL was originally developed for the Chesapeake Bay Program Phase 5 (CBP P5) watershed model". Maryland Department of the Environment developed the model and the document in 2009 with the document being submitted to EPA September 28, 2009 with an EPA approval date of March 10, 2010. The data used to calculate the sediment loading for the Middle Gwynns Falls SWAP was based on the Chesapeake Bay Program Phase 5.2.3 watershed model which was run in July, 2011. During the interim of 2009 and July 2010, a number of changes in the watershed model were incorporated to improve the model. However, the loading rates used in the development of the Sediment TMDL for Gwynns Falls and the sediment loading rates used for the development of the Middle Gwynns Falls SWAP the result in discrepancy between the calculations of the baseline loads.

The Chesapeake Bay Program intends to conduct a mid-point assessment in 2017 of the progress made in meeting the Chesapeake Bay TMDL. As part of this assessment Phase 6 of the Watershed Model will be developed, calibrated and used to assess progress. Part of the development of the Phase 6 model is to reassess the land uses in the model and sediment loading related to the various land uses. Because the scale of the stream layer used in the model does not include most first and second order, and some third order streams, an urban riparian corridor land use is being considered. Inclusion of this land use could account for sediment contributed by stream channel erosion in urban settings, and provide a better mass balance that will allow a better assessment of progress in meeting the sediment TMDL in Gwynns Falls.

A second potential issue relates to load reductions calculated for the various restoration actions. For BMPs that treat runoff from the various land uses the more recent loading rates from CBP Watershed Model 5.2.3 were used to calculate both the load to the practice and then the reduction efficiency was applied. See: http://www.chesapeakebay.net/documents/Final_CBP_Approved_Expert_Panel_Report_on_Stormwater_Retrofits--_long.pdf for methods.

For practices, such as, stream restoration, the reduction is based on pounds removed due to prevented stream bank erosion and deposition on the reconnected floodplain. Stream restoration accounts for ~64% of the sediment reduction in the proposed actions. An interim planning level reduction rate was used for the calculation of the reduction expected. These rates will vary from project to project depending on the rate of stream channel erosion and degree of floodplain reconnection. The methods of calculations are detailed in the document titled "Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects" (Berg, et.al. 2013). The document is located on the web at: http://www.chesapeakebay.net/documents/Final_CBP_Approved_Expert_Panel_Report_on_Stream_Restoration_revised102813_LONG.pdf The recommendations for credit for stream restoration underwent a trial period and based on the trial period, the document is in the process of being revised. When the document is available, the revised credit rates will be used.

Based on the above, three programmatic actions are proposed:

- Continue to work with the Chesapeake Bay Program on land uses and/or stream networks for inclusion in the Chesapeake Bay Watershed Model to better model sediment at the local level.
- Continue to work with the Chesapeake Bay Program – Urban Stormwater Workgroup to improve assessment of various types of restoration projects for crediting purposes; including the crediting of stream restoration for sediment reduction.
- Develop better in-house calculation of sediment reduction for the various stream restoration projects to use in-lieu of the default values used in planning.

The sediment TMDL is based on impacts to the aquatic community. To assess progress in meeting the sediment reductions necessary to meet the TMDL, several monitoring programs will continue to be implemented.

- The Trend Monitoring Program collects grab samples on a fixed interval basis. Total Suspended Solids are part of the suite of constituents analyzed. There are two trend sites located within the Middle Gwynns Falls planning area. The data from this program will be used to assess changes in TSS pollutant load over time.

- The Scotts Level Branch monitoring program, includes storm event and baseflow chemical monitoring, including TSS; stream geomorphologic monitoring; and biological monitoring. There are two permanent storm event monitoring sites within Scotts Level Branch, 10 baseflow sites, and 20 geomorphological monitoring sites, and 10 biological monitoring sites. In addition, each restoration project within Scotts Level Branch is monitored to determine effectiveness, including sediment load reductions and biological community response. This is part of a paired watershed design study to determine the ability to detect changes on a small subwatershed scale that result from restoration activities within the subwatershed.
- The Probabilistic Biological Monitoring Program is conducted throughout the county with random sites selected in the Gwynns Falls watershed in odd years. These data allow an assessment of the trends in the aquatic biological community over time.

For greater detail on each of these monitoring programs, see Section 10 of the latest NPDES – MS4 Annual Report posted on the web page - http://www.baltimorecountymd.gov/Agencies/environment/npdes/

A.3 Bacteria TMDL

Volume 2, Appendix G of the Middle Gwynns Falls SWAP presents the *Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Gwynns Falls Basin in Baltimore City and Baltimore County, Maryland* (MDE 2006) submitted by Maryland Department of the Environment to EPA – Region 3 for review and approval on September 9, 2006 and approved by EPA – Region 3 December 4, 2007. This TMDL is based on nonattainment of designated use of primary contact recreation. The Gwynns Falls watershed was listed on the state 303(d) list as impaired for bacteria (fecal coliform) in 2002. A brief summary of the Bacteria TMDL is presented in Volume 2, Appendix E – Characterization Report, Section 3.2.2. This summary is expand on below, along with actions that are anticipated in reducing bacteria sufficiently to meet the bacteria load reduction for the Gwynns Falls TMDL.

A.3.1 Gwynns Falls Bacteria TMDL

The Gwynns Falls Bacteria TMDL was developed on the basis of one long-term Core monitoring site, and one year of bacteria monitoring at four sites distributed longitudinally along the Gwynns Falls mainstem. Monitoring for *Escherichia coli* (*E.* col) was conducted twice monthly from October 2002 through October 2003 at the four sites, in addition a monthly sample for the Bacteria Source Tracking (BST) analysis was collected. The water quality standard that was the basis for the TMDL load reduction analysis was an *E. coli* standard of a Geometric Mean of 126 MPN/100ml; where MPN stands for Most Probable Number, which is the estimate of the number of bacteria based on the number of *E. coli* bacterial colonies that develop as a result of testing the water quality sample. This is the standard for recreational waters - human contact based on minimizing human illness due to water contact.

The bacteria monitoring for *E. coli* established a baseline load using a flow duration approach where the data was stratified based on the high low and low flow conditions. Based on an analysis of the flow duration curves from gaged sites, it was determined that flows above the 25th

percentile represented high flows and below the 25th percentile represented mid/low flows. The results of the bimonthly sampling are presented in table A-7 based on an annual geometric mean and in Table A-8 for a seasonal geometric mean. The seasonal period is from May 1st through September 30th and represents the period during which recreational contact is most likely to occur.

Table A-7: Annual Steady State Geometric Mean by Monitoring Station (MPN/100 ml)

Station	Flow Stratum	Samples (#)	*E. Coli* Minimum Concentration	*E. coli* Maximum Concentration	Annual Steady State Geometric Mean	Annual Weighted Geometric Mean
GWN0015	**High**	7	15,530	86,600	40,086	32,470
	Low	19	5,800	77,000	30,267	
GWN0026	**High**	6	280	38,700	3,633	753
	Low	17	60	4,350	446	
GWN0115	**High**	7	320	16,700	1,009	321
	Low	19	20	5,790	219	
GWN0160	**High**	6	110	23,800	1,611	508
	Low	17	60	2,050	345	

Table A-8: Seasonal Steady State Geometric Mean by Monitoring Station (MPN/100 ml)

Station	Flow Stratum	Samples (#)	*E. Coli* Minimum Concentration	*E. coli* Maximum Concentration	Seasonal Steady State Geometric Mean	Seasonal Weighted Geometric Mean
GWN0015	**High**	3	43,500	86,600	65,529	40,716
	Low	9	5,800	77,000	35,290	
GWN0026	**High**	3	280	38,700	1,498	528
	Low	9	60	2,600	373	
GWN0115	**High**	3	620	16,700	1,954	842
	Low	9	310	5,790	636	
GWN0160	**High**	3	820	23,800	3,102	1,062
	Low	9	360	2,050	743	

Note that for each station the seasonal weighted geometric mean is greater than the annual weighted geometric mean. This is due to the greater die off of bacteria during colder temperatures than in warm temperatures; it does not indicate a reduction in the sources of bacteria during colder months.

One requirement for the development of a TMDL is to identify sources and partition the load among sources. Maryland Department of the Environment used a Bacteria Source Tracking (BST) method to fulfill this requirement. The rationale behind BST is that different types of organisms have differential responses to antibiotics based on their exposure to antibiotics. Four groups were identified; human, domestic pet, livestock, and wildlife. The methodology is to collect scat from various sources and measure the antibiotic resistance to create a library a reference. Water quality samples are then collected and the antibiotic resistance of the cultured samples is then compared to the library to determine the percent of the sample attributable to the four sources (see Appendix G, for more detail on the methodology). Table A-9 presents the results of the BST analysis on an annual basis for each station based on high flow, low flow and a weighted average, while Table A-10 presents the same data for the seasonal period.

Table A-9: Distribution of Fecal Bacteria Source Loads in the Gwynns Falls Watershed for an Average Annual Period

Station	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
GWN0015	**High Flow**	10	73	0	4	13
	Low Flow	21	66	0	2	11

	Weighted	18	68	0	2	12
GWN0026	**High Flow**	14	66	0	12	8
	Low Flow	27	47	0	10	16
	Weighted	24	52	0	10	14
GWN0115	**High Flow**	11	48	0	16	25
	Low Flow	14	44	0	31	11
	Weighted	14	45	0	27	14
GWN0160	**High Flow**	10	65	0	15	10
	Low Flow	8	59	0	21	12
	Weighted	8	60	0	20	12

Table A-10: Distribution of Fecal Bacteria Source Loads in the Gwynns Falls Watershed for the Seasonal Period (May 1st – September 30th)

Station	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
GWN0015	**High Flow**	10	61	0	4	25
	Low Flow	17	65	0	2	16
	Weighted	16	63	0	3	18
GWN0026	**High Flow**	3	55	0	26	16
	Low Flow	23	43	0	16	18
	Weighted	18	45	0	19	18
GWN0115	**High Flow**	2	48	0	14	39
	Low Flow	9	53	0	27	11
	Weighted	7	51	0	24	18
GWN0160	**High Flow**	12	54	0	22	12
	Low Flow	7	60	0	22	11
	Weighted	8	58	0	22	12

For each station human sources of bacteria account for the highest percentage of the load, domestic pet is somewhat variable by station, livestock sources in this highly urban watershed are not indicated as a source, and wildlife and unknowns account for an appreciable percentage of the bacteria.

Using the concentration factor (MPN/100 ml) and the flow MDE was able to calculate the baseline load at each station as billion *E. coli* MPN/100ml/day (for additional details see Appendix G, section 4.3, starting on page 30). The results are presented in Table A-11.

Table A-11: Baseline Load Calculation

	Station	GWN 0160	GWN0115	GWN0026	GWN0015
High Flow	Daily Average Flow (cfs)	74.9	52.3	96.7	15.5
	E. coli concentration (MPN/100ml)	1,611.3	302.3	8,109.8	740,277.0
Low Flow	Daily Average Flow (cfs)	14.0	9.8	18.1	2.9
	E. coli concentration (MPN/100ml)	345.4	65.2	1,271.1	156,243.6
Baseline Load (billion *E. coli* MPN/100ml/day		**2,539.6**	**314.8**	**17,990.7**	**90,620.3**

In order to meet the water quality standard of a geometric mean of 126 MPN/100ml for *E. coli* the percent reduction for each of the four source categories was calculated. The results are presented in Table A-12.

Table A-12: Required Reductions of Fecal Bacteria to Meet Water Quality Standards

Station	Time Period	Hydrologic Condition	Domestic Pet %	Human %	Livestock %	Wildlife %
GWN0160	Annual	Wet	98%	98%	0%	33%
		Dry	28%	98%	0%	0%
	Seasonal	Wet	98%	98%	0%	76%
		Dry	98%	98%	0%	47%
	Maximum Source Reduction		**98%**	**98%**	**0%**	**76%**
GWN0115	Annual	Wet	0%	32%	0%	0%
		Dry	0%	0%	0%	0%
	Seasonal	Wet	96%	98%	0%	2%
		Dry	0%	82%	0%	0%
	Maximum Source Reduction		**96%**	**98%**	**0%**	**2%**
GWN0026	Annual	Wet	98%	98%	0%	85%
		Dry	98%	98%	0%	45%
	Seasonal	Wet	98%	98%	0%	78%
		Dry	98%	98%	0%	45%
	Maximum Source Reduction		**98%**	**98%**	**0%**	**85%**
GWN0015	Annual	Wet	99.998%	99.9996%	0%	99.096%
		Dry	99.997%	99.9991%	0%	97.037%
	Seasonal	Wet	99.999%	99.9998%	0%	99.562%
		Dry	99.998%	99.9996%	0%	98.890%
	Maximum Source Reduction		**99.999%**	**99.9998%**	**0%**	**99.562%**

There is only one station located within the Middle Gwynns Falls Small Watershed Action Plan area and that is GWN0115. This station is on the mainstem of Gwynns Falls and is upstream of the Dead Run and Powdermill Run subwatersheds. Station GWN0160 is upstream and provides bacteria to the planning area, while GWN0026 and GWN0015 are located in the Baltimore City portion of the watershed downstream of the planning area. For this particular SWAP the bacteria reduction objective is the meet water quality standards at station GWN0115 and all of the subwatersheds within the planning area.

A.3.2 Middle Gwynns Falls Bacteria Reduction Strategy

The bacteria reduction strategy for the Middle Gwynns Falls includes the following components:

- Source reduction
  - Wastewater
  - Domestic Pet
  - Wildlife
- Monitoring
  - Bacteria Trend Monitoring
  - Subwatershed Bacteria Survey
  - Bacteria Source Tracking
  - Illicit Discharge Detection and Elimination
- Treatment Options

The source reduction strategy and the monitoring will occur concurrently, while the treatment options will be considered if the source reduction is insufficient to meet the bacteria load reduction targets.

A.3.2.1 Wastewater Source Reduction

Baltimore County entered into a consent decree (http://resources.baltimorecountymd.gov/Documents/Public_Works/consentdecreefinal.pdf) with the U.S Environmental Protection Agency and the Maryland Department of the Environment to address sanitary sewer overflows, September 21, 2005. The consent decree laid out a schedule of activities that are needed to address sanitary sewer overflows. The schedule is due for completion in 2020. The consent decree covers all of Baltimore County served by sanitary sewer, including the Middle Gwynns Falls. The Middle Gwynns Falls planning area has ~316 miles of force main and gravity sewer and potentially 381 on-site disposal systems (septic systems). It is anticipated that compliance with the consent decree requirements will eliminate the human source of bacteria. The specific implementation action is:

- Implement the requirements of the Baltimore County Consent Decree according to the schedule detailed in the decree, complete all requirements end date specified in the consent decree in 2020.

The Characterization Report for the Middle Gwynns Falls indicated that there are potentially 381 on-site disposal systems within the planning area. This information is based on the data base used to assess charges that result from the Bay Restoration Fund requirements. We have found that in some cases the database is not completely accurate in designating whether the household or commercial/industrial property is actually hooked up to the sanitary sewer or actually is served by an on-site disposal system. We are in the process of verifying the accuracy of the information in the database by conducting field inspections. In some cases the site is actually served by an on-site disposal system, in which case it is determined if the system is functioning properly. The specific implementation action is:

- Continue the process of inspecting sites indicated by the BRF database as being on an on-site disposal system when located within a sewer subshed. Make corrections to the database as necessary and determine the functioning of the on-site disposal system if the site is served by such a system.

A.3.2.2 Domestic Pet Source Reduction

While the TMDL analysis indicates that the domestic pet source for station GWN0115 only requires a reduction for one of the four conditions, seasonal wet weather source, it is likely that domestic pets provides a year round source, but due to cold temperatures during the winter months, the bacteria die off. This source will be addressed by developing a comprehensive pet waste education program. We currently have a door hanger program, where if pet waste is found to be a problem in a certain neighborhood, we will put out door hangers to alert the neighborhood residents to the problem; but we currently do not have a follow-up program to assess behavioral changes.

By the end of 2015 we will develop a comprehensive pet was program and begin a pilot test to determine effectiveness. The pilot will be conducted in 2016. Using what was learned regarding effectiveness of the comprehensive pet waste program, the program will be modified in 2017 and implemented throughout the county.

A.3.2.3 Wildlife Source Reduction

The designation of wildlife as a source is not specific enough to provide a mechanism for targeting programs to reduce bacteria sources from wildlife. The county will work with MDE to see if it is possible to make a finer distinction of the wildlife sources. If, for example, it is found that a major wildlife bacteria contribution has rats as the source, then better targeting of rat control programs can be effective in reducing this source. On the other hand, if song birds are found to be a major source of bacteria, then alternative methods for treatment will be need to be identified.

A.3.2.4 Bacteria Trend Monitoring

Baltimore County has been conducting bacteria trend monitoring since June 2010. This program was initiated to specifically assess progress in meeting bacteria TMDL reductions and standards. Only on site (GWY0115) is located within the Middle Gwynns Falls planning area. While this site is below the Scotts Level Branch subwatershed and in the Middle Gwynns Falls subwatershed; it is above the confluences of Powdermill Run, Dead Run, and Maidens Chouce Run; and therefore results at this station do not reflect the condition bacteria conditions within these subwatersheds. Section 10.3.1.5, Table 10-16 (http://www.baltimorecountymd.gov/Agencies/environment/npdes/) of the 2013 Annual NPDES – MS4 Permit Report indicates that from the time period of 7/1/12 – 6/30/13 only one sample exceeded the *E. coli* standard of 126 MPN/100ml and the geometric mean of 12 samples was 109. This would seem to indicate that we have achieved the bacteria TMDL reduction for the site within this planning area, but the analysis has not stratified the data into the four conditions of annual, seasonal, wet, dry. That data is available and will be included in future analyses.

The next downstream monitoring site (GWY0026), which is below the confluence of the three subwatersheds indicated above, is also reported. This site had only 3 of twelve samples exceed the 126 MPN/100ml standard and had a geometric mean for twelve samples of 195 MNP/100ml. This exceeds the standard, but is a considerable improvement over the initial 17,990.7 MPN/100ml that was determined to be the baseline load in the TMDL.

A.3.2.5 Bacteria Subwatershed Monitoring

Since the monitoring sites used to develop the Gwynns Falls bacteria TMDL all fall along the mainstem, we lack sufficient data to determine if the each individual subwatershed is meeting the bacterial standard. To address this deficiency, the county will conduct a one-year assessment of the subwatersheds within the Middle Gwynns Falls planning area. Results from this on-year assessment will be used to target efforts for bacteria reductions, if needed. All of these subwatersheds are part of the Consent Decree and will undergoing sanitary sewer remediation between now and 2020.

A.3.2.6 Bacteria Source Tracking

Baltimore County is in the process of developing a Bacteria Source Tracking Program to further refine locations of high bacteria and narrow the area that needs to be assessed for bacteria sources. This should not be confused with the State BST Program used to develop the bacteria TMDLs. This program is currently in its pilot stages, where successive samples are taken in an upstream direction and the results used to refine the reaches of stream where the bacteria seem to be entering. The program has been used to locate and lead to the remediation of a sanitary sewer leak in the Powdermill Run subwatershed.

A.3.2.7 Illicit Discharge Detection and Elimination Program

This program, mandated by the NPDES – MS4 Permit, assesses water quality at storm drain outfalls. Some of the illicit discharges detected and eliminated include sanitary sewer cross connections, wash water discharges, on-site disposal system failures and groundwater connections that are contaminated by sanitary sewer leaks. This program will continue and address bacterial contamination by correction and elimination of the source.

A.3.2.8 Treatment Options

Treatment options will be explored, if by 2020 the bacteria water quality standards have not been met. For bacteria, the options are those that either infiltrate water or detain water for a long enough period of time for ultraviolet light to kill off the bacteria. Increasing additional options are appearing in the market, such as, ferrate technology, which can be used for the reduction of bacteria concentrations, although at a relatively high cost. By 2020 Baltimore County will explore and select a suite of treatment options based on the effectiveness of bacterial removal and a cost/benefit analysis.

A.4 Summary

A series of programmatic, implementation, and monitoring actions have been laid out in the above sections of this Addendum. Adherence to fulfilling those actions is expected to result in meeting both sediment and bacteria TMDL reductions for the Middle Gwynns Falls. Baltimore County and the Middle Gwynns Falls Implementation Committee will continue to assess progress in meeting the TMDLs as restoration goes forward and use an adaptive management approach to refine the actions going forward.