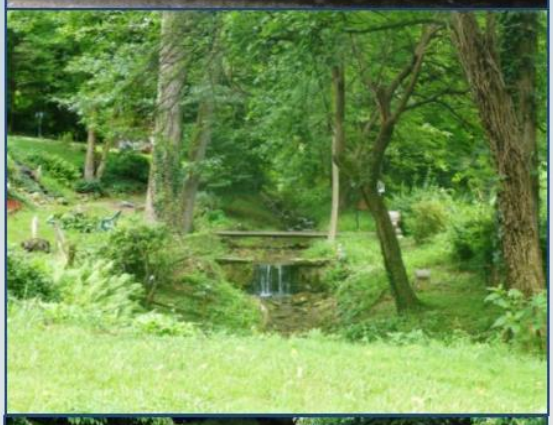


LOWER GUNPOWDER FALLS (URBAN) SMALL WATERSHED ACTION PLAN

Volume I

March 2016

Baltimore County Executive Kevin Kamenetz
and the County Council

Prepared for

Baltimore County Department of
Environmental Protection and Sustainability

Prepared by

VERSAR

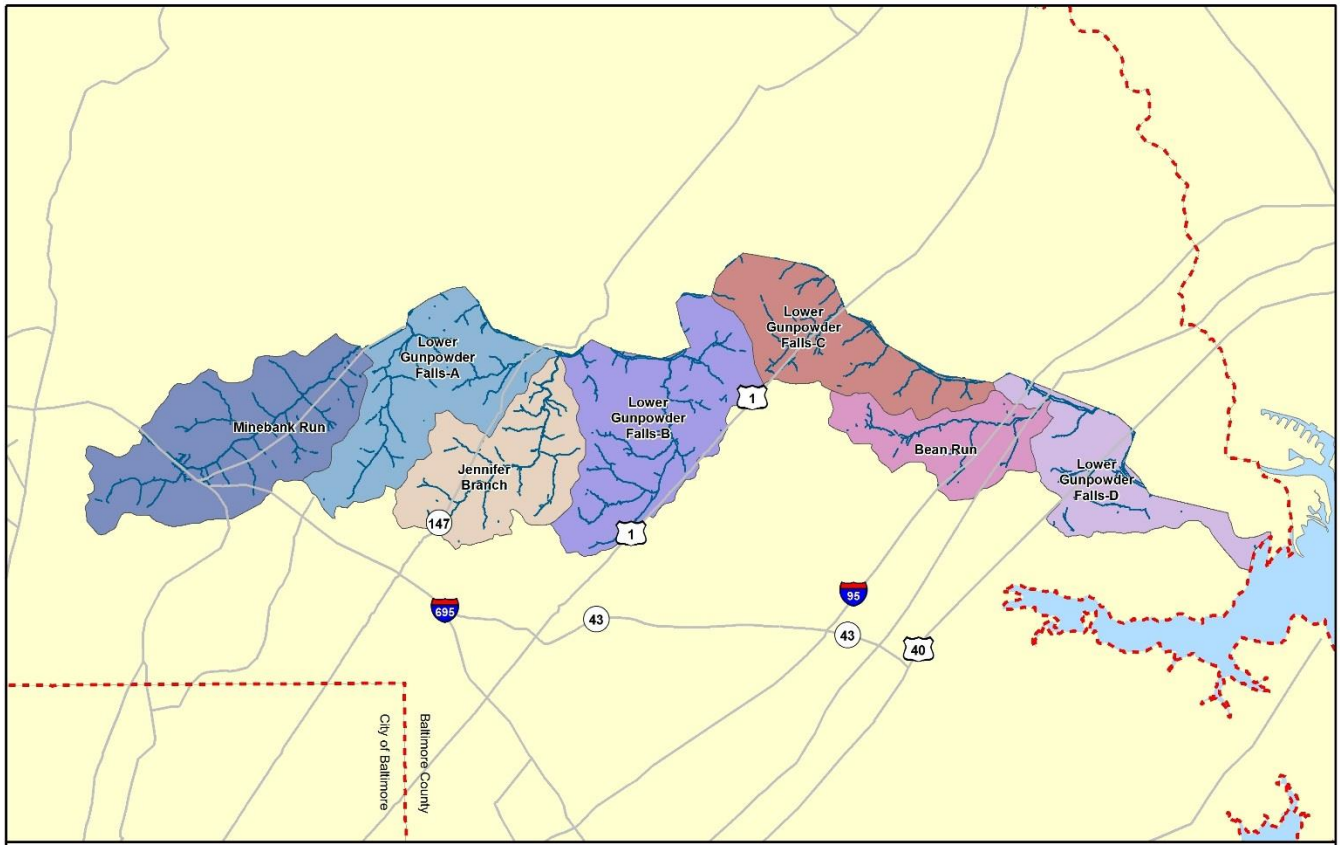
with

Coastal Resources, Inc.

McCormick Taylor

CLEAN GREEN COUNTY

LOWER GUNPOWDER FALLS (URBAN)
SMALL WATERSHED ACTION PLAN



Prepared for

Baltimore County
Department of
Environmental Protection
and Sustainability
111 W. Chesapeake Avenue,
Room 319
Towson, MD 21204

Prepared by

Versar, Inc.
9200 Rumsey Road, Suite 100
Columbia, MD 21045

Coastal Resources Inc.
25 Old Solomons Island Road
Annapolis, MD 21401

McCormick Taylor, Inc.
509 South Exeter Street, 4th Floor
Baltimore, MD 21202

March 2016

Table of Contents

List of Figures

List of Tables

Chapter 1: **INTRODUCTION**

1.1 PURPOSE

The purpose of the Lower Gunpowder Falls (Urban) Small Watershed Action Plan (SWAP) is to provide guidance on the restoration of the Lower Gunpowder Falls (Urban) watershed. This report outlines a series of strategies for watershed restoration, describes management strategies for each of the seven subwatersheds within the Lower Gunpowder Falls (Urban) watershed, and identifies priority projects for implementation. The SWAP includes the identification of potential stormwater management conversion sites and capital projects, as well as citizen-based stream restoration opportunities, operational program implementation, and an implementation schedule. Planning-level cost estimates are provided where feasible and a preliminary schedule for implementation over a ten-year horizon is outlined. Financial and technical partners for plan implementation are suggested for various strategies and projects. The watershed plan is intended to assist Baltimore County and other organizations, such as the Gunpowder Valley Conservancy (GVC), in moving forward with restoration of the Lower Gunpowder Falls (Urban) watershed.

1.2 BACKGROUND

In 2005, Baltimore County initiated a new round of watershed planning, to develop Small Watershed Action Plans (SWAPs). A SWAP identifies strategies for bringing a small watershed into compliance with water quality standards and to meet other watershed management goals. Strategies include a combination of government capital projects, actions in partnership with local watershed associations, educational outreach, and volunteer activities. Effective implementation of watershed restoration strategies will require the coordination of all watershed partners and the participation of many stakeholders.

Baltimore County's SWAP planning process is intended to address the many mandates that the County is charged to meet in each individual watershed. These include the requirements of the County's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit, watershed-specific Total Maximum Daily Loads (TMDLs), and the Chesapeake Bay TMDL. The small watershed action planning process is designed to bring all these individual mandates together at a subwatershed level that will facilitate implementation. The SWAP will inform residents about the intent of each program, examine how to most efficiently meet the goals, and define the roles of the partners.

Over the past year, the Lower Gunpowder Falls (Urban) 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 various watershed partners, was formed to aid in developing the Lower Gunpowder Falls (Urban) SWAP. This included Baltimore County personnel, Maryland Department of Natural Resources (DNR) personnel, members of local watershed organizations, and citizens and leaders from the local community. The Steering Committee met regularly throughout the SWAP development process. Lower Gunpowder Falls (Urban) SWAP Steering Committee members are:

- Baltimore County Department of Environmental Protection and Sustainability (EPS)
  - Wesley Schmidt

  - Steve Stewart

- Baltimore County Department of Planning
  - Bill Skibinski

- Baltimore County Public Schools (BCPS)
  - Joe Davis
  - Chris Blasetti
  - Steven Ruth

- Maryland Department of Natural Resources (DNR)
  - Bob Iman
  - Ken Miller

- Morgan State University, School of Architecture & Planning
  - Jack Leonard

- Gunpowder Valley Conservancy (GVC)
  - Nancy Pentz

- Alliance for the Chesapeake Bay
  - Joanna Freeman

- Hines Estates Homeowners Association
  - Mary Ellen Schultz

- Chatterleigh Association
  - Joseph Solinsky

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

1) ***Community Meeting #1*** (June 16, 2015; 27 attendees): A presentation was given by Baltimore County staff to explain why a SWAP is developed and why watersheds are important to communities and the environment. Representatives of the Versar consultant team then presented a general review of existing conditions, including photographs of watershed features and maps of subwatersheds and land use characteristics. This was followed by a presentation of work to date on the SWAP, including the status of field work, analysis, and reporting. The consultant team then led a visioning exercise for stakeholders to describe what they want the watershed to be ideally. Participants were asked to give feedback on the Draft Vision Statement and fill out a survey card with their priorities for

issues the SWAP should address. The team also presented the project schedule, "next steps", and plans for future stakeholder meetings. There was a question and answer session. Following the presentation, the Versar team provided an interactive electronic map where participants could provide information on improvements in the watershed that should be addressed, either generally or at specific locations. Several community organizations set up tables to provide information on their respective missions.

2) ***Community Meeting #2*** (Wednesday, October 14, 2015; 16 attendees): Baltimore County staff welcomed attendees to the meeting and explained the purpose of the SWAP. The consultant team presented the results of the fieldwork and the characterization report, reviewed restoration options, and solicited input on acceptable options, particularly citizen-based options. Representatives from Master Gardeners provided information about classes and programs the organization sponsors to assist homeowners with making their landscaping and yard-care practices more Bay-friendly, while providing additional stormwater runoff control and wildlife benefits. A representative from Gunpowder Falls State Park provided an overview of the trails, activities, amenities, and volunteer opportunities available through the park. Baltimore County staff then presented on the next steps, including implementation phase of the SWAP during which the recommendations in the plan, such as tree plantings, community trash cleanups, and educational programs, will be undertaken by the County and its SWAP partners.

1.3 ENVIRONMENTAL REQUIREMENTS

This SWAP was developed to satisfy various regulatory drivers. They include:

- Baltimore County's NPDES municipal stormwater permit (MS4) assessment and planning requirements;
- Watershed-specific impairment listings for total suspended solids (TSS), sulfates, chlorides, and other impairments in the Lower Gunpowder Falls (Urban) watershed; and
- TMDL for the Chesapeake Bay for nutrient (nitrogen and phosphorus) and sediment reductions to meet water quality standards.

1.3.1 NPDES MS4 Permits

Baltimore County's NPDES permit (11-DP-3317, MD0068314) requires completion of detailed watershed assessments for all watersheds within the County. Assessments shall:

- Determine current water quality conditions;
- Identify and rank water quality problems;
- Include the results of visual watershed inspections;
- Prioritize all structural and nonstructural water quality improvement projects; and
- Specify pollutant load reduction benchmarks and deadlines that demonstrate progress toward meeting all applicable stormwater wasteload allocations (WLAs).

The County's NPDES permit also requires the County to treat 20 percent of the untreated impervious area during the 5-year permit term. 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 Watershed-Specific Impairments

Section 303(d) of the 1972 Clean Water Act requires states to develop (and periodically update) a list of impaired waters that fail to meet applicable state water quality standards which are defined by their designated uses. States must also establish priority rankings and develop Total Maximum Daily Loads (TMDLs) for waters on the 303(d) list. According to USEPA, a TMDL is a calculation of the maximum amount of a pollutant that a water body can receive in a day 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 Lower Gunpowder Falls (Urban) SWAP area (also known as Baltimore County's SWAP Area N) makes up the southern portions of Maryland's 8-digit watersheds. SWAP Area N consists of the streams and catchments that drain north into the Lower Gunpowder Falls, just above where the Falls meet the tidal Gunpowder River. The Lower Gunpowder Falls has been listed as impaired in the Maryland 303(d) list of impaired waters for the following pollutants of concern: sediment, sulfates, and chloride, as well as for nutrients and sediment as part of the Chesapeake Bay TMDL. Previous listings for heavy metals and phosphorus were removed following Water Quality Assessments (WQAs) in 2003 and 2012, respectively. WQAs are performed by the state to determine if the pollutant of concern is actually impairing the waters. If it is determined that the pollutant of concern is not contributing to water impairment, a WQA report documenting the findings is submitted to USEPA for concurrence.

The mainstem Lower Gunpowder Falls is designated as *Use IV: Recreational Trout Waters;* the tributary non-tidal streams (including Minebank Run, Jennifer Branch, Bean Run and several unnamed streams) in the watershed are designated as *Use I: Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life.* The tidal portion of Lower Gunpowder River is designated as *Use II: Support of Estuarine and Marine Aquatic Life,* according to Maryland water quality standards. Impairment listings reflect the inability to meet water quality standards for these designated uses. Impairment in the tidal receiving waters is related to pollutants coming from the entire watershed; therefore, TMDLs developed for this segment will require watershed pollutant load reductions. Table 1-1 summarizes the status of the various impairment listings for the Lower Gunpowder Falls.

Table 1-1: Lower Gunpowder Falls Water Quality Impairment Listings and Status

Impairment	Applicable Segment	Regulatory Status	Approval Date
Nutrients, TSS	Gunpowder River, including Lower Gunpowder Falls	Impaired; the Chesapeake Bay TMDL, addressing this impairment, was finalized on 12/29/2010.	December 2010
TSS, Sulfates, Chlorides	Lower Gunpowder Falls 1st thru 4th order streams	The Biostressor analysis indicates that sediment, sulfates, and chlorides are major stressors affecting biological integrity in this watershed	2012 Listing
Channelization	Lower Gunpowder Falls 1st thru 4th order streams	The Biostressor analysis indicates that stream channelization due to urban development is a major stressor affecting biological integrity in this watershed.	2012 Listing
Heavy Metals	Lower Gunpowder Falls	WQA – water quality standard is being met	2003
Phosphorus	Lower Gunpowder Falls	WQA – water quality standard is being met	2012

As shown in the table above, the Lower Gunpowder Falls watershed has three impairment listings and two WQAs have been completed. TMDLs or WQAs will be developed at some point in the future for the TSS, Sulfate, and Chloride impairment listings.

1.3.3 Chesapeake Bay TMDL

The Lower Gunpowder Falls drains to the tidal Gunpowder River and then to the Chesapeake Bay, the largest estuary in North America. In 1975, the United States Congress directed the Environmental Protection Agency (EPA) to conduct a comprehensive study of the most important problems affecting the Chesapeake Bay. The findings of this study formed the crux of the first Chesapeake Bay Agreement, signed in 1983 by Maryland, Virginia, Pennsylvania, Washington DC, the Chesapeake Bay Commission and the EPA. Additional scientific information gained from monitoring data and modeling efforts was used to amend that Agreement, resulting in the 2000 Chesapeake Bay Agreement and the interagency efforts that continue today with the development of the Chesapeake Bay TMDL and Watershed Implementation Plans (WIPs).

Scientific studies have shown that three of the biggest problems facing the health of the Chesapeake Bay and its tributaries (the rivers and streams that flow into the Bay) are excess nitrogen, phosphorus, and sediments. The nutrients nitrogen and phosphorus fuel excessive algae growth. These algae, as well as suspended sediments, cloud the water and prevent bay grasses from getting enough light. When healthy, bay grasses provide essential habitat for crabs and fish as well as food for waterfowl. When algae die, they decompose using up essential oxygen. This lack of oxygen kills bottom-dwellers such as clams and sometimes fish. In addition, excess nutrients sometimes favor the growth of harmful algae. Harmful algae can be toxic to aquatic animals and even humans.

EPA established the Chesapeake Bay TMDL, a historic and comprehensive “pollution diet” with rigorous accountability measures to initiate sweeping actions to restore clean water in the Chesapeake Bay and the region’s streams, creeks, and rivers.

Concurrent with the development of the Bay TMDL, EPA charged the Bay watershed states and the District of Columbia with developing Watershed Implementation Plans (WIPs) to provide adequate “reasonable assurance” that the jurisdictions can and will achieve the nutrient and sediment reductions necessary to implement the TMDL within their respective boundaries.

Maryland’s Phase I WIP provided a series of proposed strategies that will collectively meet the 2017 target (70% of the total nutrient and sediment reductions needed to meet final 2020 goals). After more than a year of cooperative work, MDE and the Departments of Natural Resources, Agriculture, and Planning, submitted Maryland’s Final Phase I WIP to EPA in December 2010. Baltimore County’s Phase I plan required reductions equivalent to retrofit of 30% of pre-1985 developed land.

MDE worked with the other Maryland Bay agencies and many partners in local jurisdictions to develop Phase II WIPs with more detailed reduction targets and specific strategies to further ensure that the water quality goals of the Bay TMDL will be met. Baltimore County completed its Phase II WIP in July 2012, which was incorporated into the Maryland Phase II WIP that was finalized in October 2013. Phase II WIP reduction targets for the Baltimore County watershed urban areas are: 32.2% for nitrogen and 47.0% for phosphorus. The Phase II process will continue through 2017.

1.4 U.S. EPA WATERSHED PLANNING "A-I CRITERIA"

This watershed plan is written to meet EPA guidance published in the October 23, 2003 Federal Register. The guidance requires watershed-based plans to restore waters impaired by nonpoint source (NPS) pollution using incremental Section 319 funds to include particular "components of a watershed based plan". Baltimore County will request EPA review and acceptance of this watershed plan based on their A-I Criteria, so that NPS implementation projects consistent with this watershed plan will be eligible for 319(h) Grant funding. The watershed plan components listed in EPA's guidance, which are commonly called the "A-through-I Criteria", are summarized below:

a) Identification of the causes and 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 nonpoint source (NPS) management measures;

c) A description of the NPS management measures that will need to be implemented;

d) An estimate of the amount of technical and financial assistance needed 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;

h) A set of criteria to determine load reductions and track substantial progress towards attaining water quality standards; and

i) A monitoring component to determine whether the watershed plan is being implemented.

This watershed plan meets the A-I criteria. Table 1-2 shows where these criteria are addressed throughout this watershed plan.

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	✓								

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, a great deal of cooperation and coordination has been advancing in recent years as common goals in water quality improvement in local streams and rivers are sought.

1.5.1 Baltimore County

Baltimore County has a watershed restoration program to implement restoration projects, including stream restoration, stormwater conversions and retrofits, reforestation, and shoreline enhancement projects. The Lower Gunpowder Falls Water Quality Management Study was submitted to Maryland Department of the Environment in 1999. The Lower Gunpowder Falls Watershed Assessment (WA; McCormick Taylor 2011) identified Capital Improvement Projects (CIPs) in the Mainstem-Perry Hall Tributary subwatershed, which is part of the Lower Gunpowder Falls-B subwatershed. Based on the recommendations from these watershed studies, as well as other evaluation efforts, several of the highest need stream reaches have already been restored; these restoration projects include areas of Minebank Run (various projects 1996-2014) and Jennifer Branch (2013). A total of 25,000 linear feet of stream channel have been restored. Two stream restoration projects, totaling 6,500 linear feet of stream channel, are planned in the Perry Hall Tributary (Lower Gunpowder Falls-B) subwatershed as a result of recommendations from the 2011 WA. Three other projects were also completed in these subwatersheds in conjunction

with the County's Department of Public Works; these included two conversions and one repair project.

Baltimore County has an extensive monitoring program that assesses the current ambient water quality, evaluates efficiency of various restoration projects in relation to pollutant removal efficiency and biological community improvement, and tracks trends over time. The County also has an Illicit Connection Program that monitors storm drain outfalls, tracks pollution sources, and coordinates remediation.

Baltimore County is under a consent decree 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. Implementation of the consent decree requirements will help reduce bacteria contamination, as well as reduce nitrogen and phosphorus in the streams.

The County operates street sweeping and inlet cleaning programs throughout the county that remove sediment, nitrogen, and phosphorus before they reach the waterways. These programs are tracked and estimates of the pollution removal are calculated (EPS 2014).

1.5.2 Gunpowder Valley Conservancy (GVC)

The Gunpowder Valley Conservancy, a non-profit organization, mobilizes people and resources to care for the lands, waters and character of the Gunpowder River watershed. Its emphasis is on land preservation, restoration, stream cleanups and education.

GVC has been working since 1989 to preserve land, improve water quality, and educate people in the Gunpowder River watershed. Their efforts include reforestation, tree maintenance, stream cleanups, trail maintenance, stormwater pollution controls, and public outreach. They partner with National Fish and Wildlife Foundation (NFWF), Baltimore County EPS, Chesapeake Bay Trust, and dozens of community partners and volunteers to perform this work. To date they have preserved 1,500 acres through conservation easements, planted 23,000 trees, cleaned 150 miles of streams, distributed 150 rain barrels, and connected with and influenced thousands of citizens through outreach efforts.

1.6 THE LOWER GUNPOWDER FALLS (URBAN) WATERSHED OVERVIEW

The Lower Gunpowder Falls (Urban) watershed is located almost entirely within the Eastern Piedmont region of Maryland, and lies north and east of the City of Baltimore (Figure 1-1). The far eastern tip of the watershed is located in the Coastal Plain region. Table 1-3 summarizes key watershed characteristics of the Lower Gunpowder Falls (Urban), which flows into the tidal Gunpowder River. The 306,136 acres of the Gunpowder River Watershed (including the tidal portions) are located within Baltimore, Carroll, and Harford Counties in Maryland and York County in Pennsylvania. The tidal portion of the Gunpowder River flows about 6.8 miles from just south of Joppa down to the Chesapeake Bay between Baltimore and Harford Counties.

The Lower Gunpowder Falls (Urban) SWAP area comprises a southern portion of the Gunpowder basin, including the areas Loch Raven, Carney, Parkville, Perry Hall, and White Marsh, and is approximately 10,533 acres (16.5 square miles) or 3.4 percent of the overall Gunpowder River watershed.

This SWAP focuses on the seven subwatersheds of the Lower Gunpowder Falls 8-digit watershed that are located south and drain directly to the mainstem Falls, where land use/land cover is predominantly urban and forest. A detailed review of the natural resources and landscape of the watershed is provided in the Lower Gunpowder Falls (Urban) Watershed Characterization report (Appendix E).

The Lower Gunpowder Falls (Urban) watershed contains seven smaller drainage areas called subwatersheds (Figure 1-2). In addition to characterizing the entire watershed, analyses were conducted on a subwatershed scale to provide detailed information for smaller areas and to focus restoration and preservation efforts. Also, success of restoration efforts can be more easily monitored and measured on this smaller scale.

Table 1-3: Key Characteristics of Lower Gunpowder Falls (Urban) Watershed

Drainage Area	10,533 acres (16.5 sq. mi.)	
Stream Length	66.35 miles	
Subwatersheds	7	
Jurisdictions	Baltimore County	
Population	38,834 (2010 census)	
Land Use/Land Cover	Very Low Density Residential:	3.0%
	Low Density Residential:	13.2%
	Medium Density Residential:	29.7%
	High Density Residential:	8.0%
	Commercial:	4.1%
	Industrial:	1.3%
	Institutional:	3.7%
	Extractive:	0.3%
	Open Urban Land:	0.8%
	Agriculture:	7.1%
	Forest:	26.2%
	Barren Land:	1.5%
	Water/Wetlands:	0.1%
	Transportation	1.1%
Impervious Cover	1,753 acres (16.6% of watershed)	
Soils	A Soils (low runoff potential):	7.5%
	B Soils:	64.1%
	C Soils:	19.4%
	D Soils (high runoff potential):	9.1%
Note: Totals may not add up to 100% due to rounding discrepancies.		

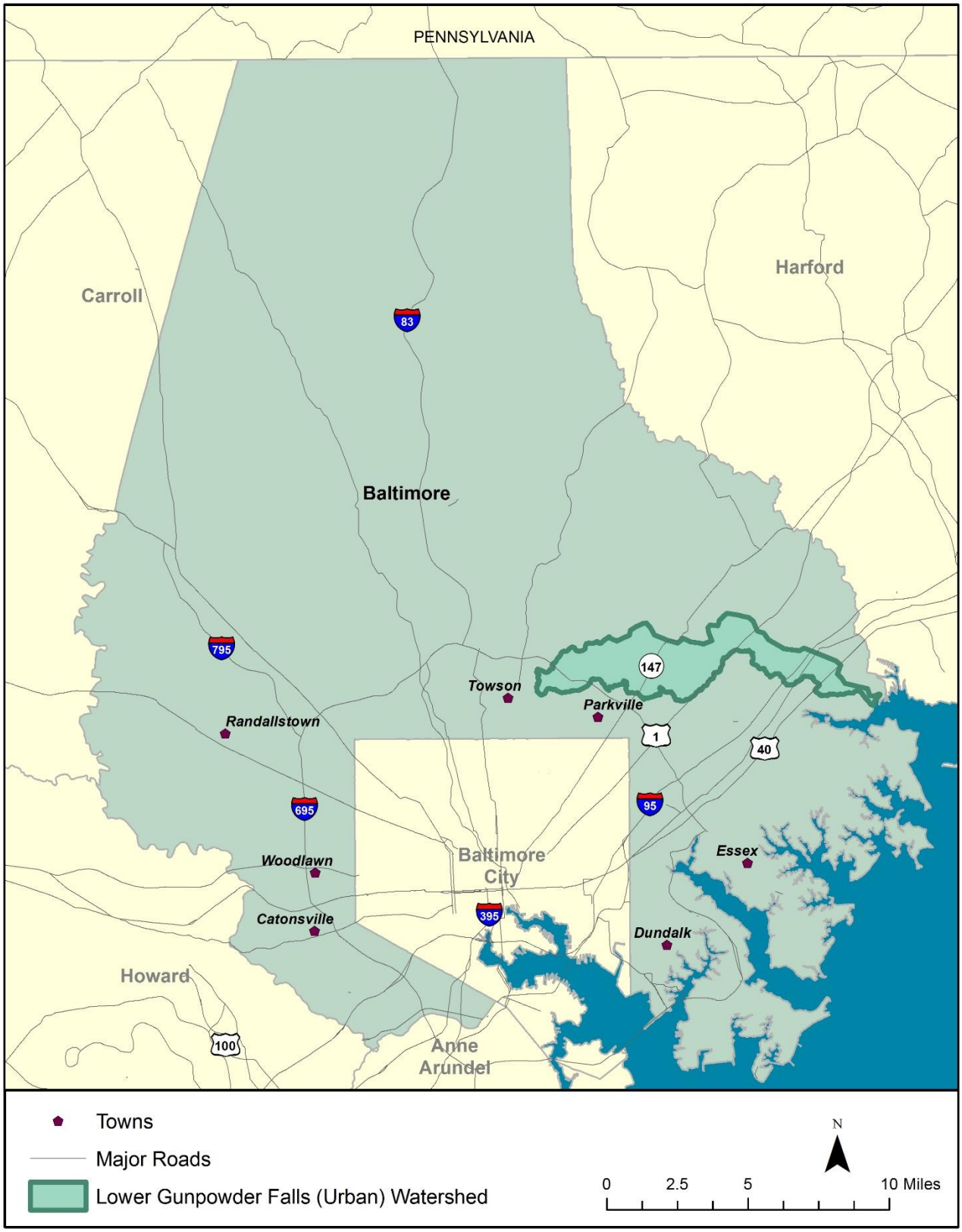


Figure 1-1: Lower Gunpowder Falls (Urban) SWAP Area

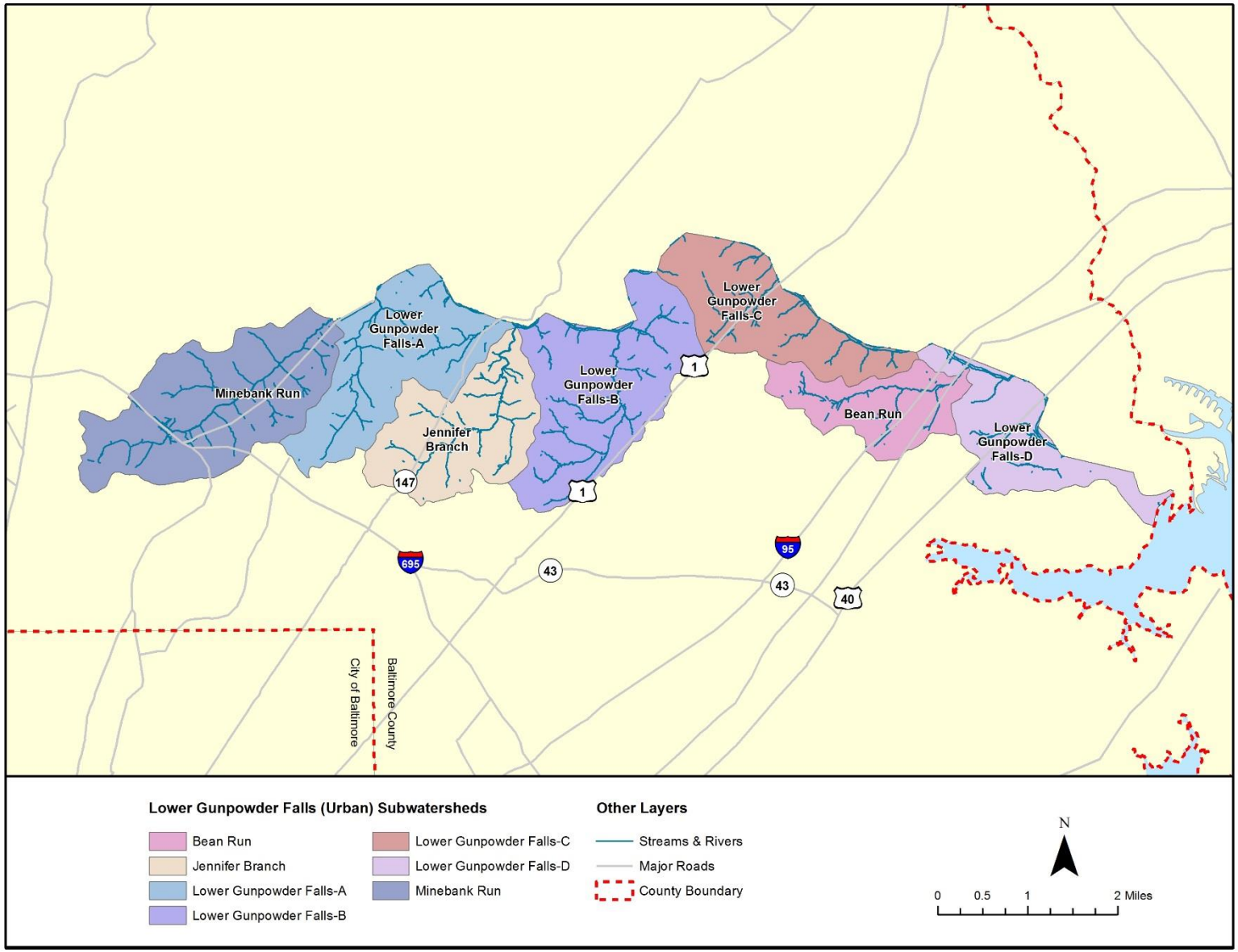


Figure 1-2: Lower Gunpowder Falls (Urban) Subwatersheds

1.7 REPORT ORGANIZATION

The SWAP consists of two volumes. Volume 1 is the Small Watershed Action Plan and is organized into 5 major chapters. Volume 2 includes supporting materials as appendices.

1.7.1 Volume 1: The SWAP

Chapter 1 is a short introduction chapter explaining the background and purpose of the Small Watershed Action Plan (SWAP), the environmental mandates, partner organizations, and an overview of the report and the planning area.

Chapter 2 covers the Vision, Goals, and Objectives for the SWAP agreed upon by the steering committee and members of the local community.

Chapter 3 describes the restoration strategies deemed as feasible by the steering committee and members of the local community. Those strategies are categorized based upon municipal actions and citizen-based actions. Computations for estimating nutrient and sediment reductions from the proposed actions across the entire watershed are included in this section. Identified stream enhancement and restoration projects are also included, along with corresponding estimated loading reductions.

Chapter 4 presents restoration strategies by subwatershed and ranks the subwatersheds based on various evaluation criteria. A map showing the location of proposed restoration strategies, photos, and supporting narrative for the recommendations is included here.

Chapter 5 details how implementation of the SWAP will be evaluated long-term via monitoring and includes a discussion of performance measures.

This volume also includes the following appendices with additional, detailed information used to develop and support this SWAP.

- Appendix A consists of a table of all actions identified for implementation towards meeting goals divided into four categories: Restoration, Outreach and Awareness, Funding, and Reporting. The table includes the action, the performance measure, and schedule for implementation, unit cost, and the responsible party. The goal and objective of each action are described here.

- Appendix B provides information on how the development of the SWAP addresses EPA A-I criteria for watershed planning and serves as a guide to the location within the document where each criterion is addressed.

- Appendix C provides an analysis of the potential cost of implementation of the plan and a list of potential funding sources.

- Appendix D includes a table showing the most current Chesapeake Bay Program Best Management Practice (BMP) pollutant reduction efficiencies.

1.7.2 Volume 2: Characterization Report

This volume includes the following appendices with supporting documentation related to the current conditions of the Lower Gunpowder Falls (Urban) watershed.

- Appendix E contains the Lower Gunpowder Falls Urban) Watershed Characterization report.
- Appendix F contains Upland Survey Data Summaries.
- Appendix G contains supporting calculations for Neighborhood Source Assessment Analyses.
- Appendix H provides copies of current TMDLs and WQAs applicable to the planning area.
- Appendix I contains Access databases, scanned copies of Upland Assessment field datasheets, digital photographs from Upland Assessment field visits, datasheets and other supporting materials from the stream assessment evaluation, and photos from the stream assessment evaluations.

Chapter 2: VISION, GOALS, AND OBJECTIVES

2.1 VISION STATEMENT

The Lower Gunpowder Falls (Urban) Watershed Steering Committee adopted the following vision statement that served as a guide in the development of the SWAP:

> *Our vision for the Urban Lower Gunpowder Falls Watershed is an environmentally-sensitive community with valuable connections made to surrounding natural and recreational areas, in which healthy networks of streams deliver high-quality water to the Gunpowder Falls and Chesapeake Bay*

2.2 LOWER GUNPOWDER FALLS (URBAN) SWAP GOALS & OBJECTIVES

A total of five goals were identified for restoring the Lower Gunpowder Falls (Urban) watershed based on the vision statement and input from the Steering Committee meetings and Community meeting. The goals were developed through discussions with the Lower Gunpowder Falls (Urban) SWAP Steering Committee and refined based on feedback from watershed residents at the first SWAP community meeting. Community stakeholders were given the opportunity to rank the importance of goals developed by the Steering Committee, raise any additional issues that are important to the community, and indicate the type of restoration activities that are of interest to achieve watershed goals. Community participation is important to ensure the implementation and success of the plan.

The following sections present a discussion of each of the five goals for restoring the Lower Gunpowder Falls (Urban) watershed. For each goal, a series of objectives was developed to ensure that the plan will meet each goal. An objective is a measurable statement such as “reduce Total Phosphorus loading in the watershed by 47.0%.” 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 “reforestation of 25 acres of open pervious area” in a given subwatershed. The action strategies developed to achieve these objectives and goals are summarized in Appendix A and discussed further in Chapter 4.

When possible, action strategies are expressed as quantifiable measures (e.g., linear feet of forested buffer planted). However, the numeric 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 provides a table that lists the action strategies proposed for the Lower Gunpowder Falls (Urban) watershed and their applicable goals and objectives.

The general types of restoration strategies proposed for the Lower Gunpowder Falls (Urban) watershed are discussed further in Chapter 3. 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.

2.2.1 Goal 1: Improve and Maintain Water Quality

While there are no local TMDLs for Lower Gunpowder Falls, the entire watershed is subject to the Chesapeake Bay TMDL for nutrients. Watershed implementation plans (WIPs) have been developed by the state of Maryland and Baltimore County in order to provide adequate "reasonable assurance" that the jurisdictions can and will achieve the nutrient reductions necessary to implement the TMDL within their respective boundaries. Meeting these TMDL goals will go a long way toward improving overall water quality in the Lower Gunpowder Falls and achieving the community's vision of a healthy, swimmable river.

Objectives:

1. Reduce annual Total Nitrogen (TN) and Total Phosphorus (TP) loadings from urban land in the Lower Gunpowder Falls (Urban) SWAP area by 32.2% and 47.0% respectively to meet the requirements of the Chesapeake Bay TMDL.
2. Reduce sediment flowing into Lower Gunpowder Falls.
3. Encourage enforcement of Critical Area regulations.
4. Reduce the amount of sewage entering the river.
5. Reduce the impact of impervious surfaces on water quality in Lower Gunpowder Falls (Urban).

2.2.2 Goal 2: Maintain and Improve Aquatic Biodiversity

Healthy ecosystems have a robust and diverse community of plants and animals; aquatic biodiversity is the living proof of the health and vitality of a river system. Physical damage to aquatic habitats has resulted over time from development of land and shorelines, poor land management practices, introduction of exotic invasive species, and obstructions to upstream breeding sites, etc. The objectives for this goal relate to the improvement of degraded river conditions that result in poor conditions for aquatic life.

Objectives:

1. Restore and protect stream to encourage robust aquatic communities.
2. Create riparian buffers and enhance existing buffers to quality forests to filter runoff and provide habitat.
3. Assure that fish caught in the Lower Gunpowder Falls are safe to eat.
4. Use stream monitoring programs and data collected by the County, Maryland Department of Natural Resources, and other agencies and citizen groups to track health of aquatic communities.

2.2.3 Goal 3: Increase Tree Cover and Support Healthy Sustainable Forests

Healthy forests contribute to healthy streams and a healthy Chesapeake Bay. Forests are a multi-functional part of any landscape, as they reduce high stormwater flows that cause erosion in streams, remove nutrients and pollutants from stormwater runoff, and provide shade and food to aquatic animals living in streams and rivers. Protecting existing forests and adding to the forest

cover within the watershed are vital components of any effort to improve water quality and protect stream life.

Objectives:

1. Control exotic invasive species in forested areas.
2. Raise community awareness regarding invasive species identification, control, and removal.
3. Protect and maintain healthy forests.

2.2.4 Goal 4: Improve Community Connection to the Gunpowder Falls and Awareness of Recreational Opportunities along the River

There is no substitute for engaged and involved citizens participating in the protection of their local watersheds. However, the first step to engaging citizens is making them aware of their connections to the Lower Gunpowder Falls and the problems particular to this watershed. In a modern, urbanized landscape, it is easy to become disconnected from the natural environment, since few people have a stream running through their backyard. In addition, the thought of tackling challenges, like those faced by the Chesapeake Bay, can be overwhelming for most people. By raising awareness about the issues facing a nearby stream, citizens are given an opportunity to take action on a local, more manageable scale, where they are more likely to see the positive effects their actions produce, and thus continue their efforts.

There are many ways for people to develop a connection to Lower Gunpowder Falls. People are empowered when they can physically make a difference and improve their community in a way that benefits everyone. Clean-ups and other restoration projects are great opportunities for education. Students, families, and community groups (civic, corporate, religious, etc.) are readily available labor sources. Restoration projects should be recognized as celebrations of our natural heritage. Participation in outdoor recreation allows citizens to develop an appreciation for the beauty and value of the natural resources available to them. When people have hiked along a trail or paddled a stream or river, and seen firsthand the impact of trash and pollution, they may feel greater motivation to participate in clean-ups and become advocates for the health of Lower Gunpowder Falls. However, it is necessary to balance the benefits of outdoor recreation with the toll it can take on the environment. Proper planning and education can minimize these drawbacks and maximize the educational value and enjoyment of the outdoor experience.

Objectives:

1 Improve public access to the river.

2 Facilitate better public awareness of programs and facilities available through Gunpowder Falls State Park.

3. Outreach to commercial, farming, industrial, and residential communities throughout the watershed to encourage and support actions that reduce pollutant loads to the river.

2.2.5 Goal 5: Support Terrestrial Species in the Watershed

By definition, a watershed is composed not only of a water body, but also all of the land draining to that water body. Terrestrial species may not be the first type of fauna that come to mind during

a watershed plan, but they are an integral and valuable part of the watersheds they occupy. By considering terrestrial wildlife and their habitat needs, strong, robust ecosystems are promoted and animals are provided areas to exist within an urbanized landscape. Concern for and protection of terrestrial species in turn provides protection for the watershed they are in and vice versa.

Objectives:

1. Raise awareness about the types of local wildlife, their habitat needs, and what may be done to protect them.
2. Promote outdoor recreational activities that create a connection to wildlife, *e.g.* birdwatching, wildlife photography, etc.
3. Involve citizens in actions that engage them in improving wildlife habitats and the watershed at large, such as trash cleanups, setting up bird houses and bat boxes, and planting wildflowers for butterflies and bees.

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 Lower Gunpowder Falls (Urban) watershed. A complete list of actions proposed for the watershed 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 Lower Gunpowder Falls (Urban) watershed restoration will occur as a partnership between the local government, watershed groups, 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 campaigns. Watershed groups and citizens are able to implement locally-based programs such as tree plantings 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 sources within the Lower Gunpowder Falls (Urban) watershed is discussed in Section 3.4. Section 3.4 also discusses the pollutant removal calculations for proposed BMPs (i.e., key restoration strategies discussed in Sections 3.2 and 3.3) to ensure that TMDL requirements are met in Lower Gunpowder Falls.

3.2 MUNICIPAL STRATEGIES

Baltimore County is working to improve watershed health and water quality by restoring local streams, through capital improvement projects and municipal management activities (e.g., development review, street sweeping, illicit connection programs, etc.). Key municipal strategies proposed for restoring the Lower Gunpowder Falls (Urban) watershed are discussed in the following sections.

3.2.1 Stormwater Management

Increased importance of water quality and water resource protection led to the development of the Maryland Stormwater Design Manual, which provided BMP design standards and environmental incentives (MDE 2000; 2009 revisions). There has been a general shift toward adopting practices that mimic natural hydrologic processes, are low impact, and achieve pre-development conditions. Building upon the approaches in the 2000 Manual, the Maryland Stormwater Act of 2007 (and 2009 revisions to the Manual) takes those principles one step further and requires that Environmental Site Design (ESD) be implemented to the maximum extent

practicable (MEP) via the comprehensive use of non-structural BMPs and/or other better site design techniques that mimic predevelopment hydrology. The intent of ESD 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.

A total of 193 existing stormwater management (SWM) facilities are located within the Lower Gunpowder Falls (Urban) watershed including dry and wet ponds, wetlands, infiltration/filtration practices, extended detention, and proprietary BMPs. Existing SWM facilities treat a total drainage area of approximately 1,888 acres of urban land or 28.6 percent of the total urban land use in the watershed.

3.2.2 Stormwater Management Conversions

Detention ponds are typically designed to address water quantity only (channel protection and/or flood control) and therefore provide almost no pollutant removal. Because they have already been created for water treatment purposes, and because they have established maintenance agreements they are excellent candidates for conversion to a type of facility that provides pollution control benefits in addition to quantity control. Conversion is relatively simple and certainly cheaper than permitting and constructing a new BMP. For example, dry extended detention ponds are designed to capture and retain stormwater runoff from a storm to allow sediment and pollutants to settle out while also being able to simultaneously provide flood control. Baltimore County identified 4 existing stormwater management facilities in the Lower Gunpowder Falls (Urban) watershed as being suitable for conversion.

3.2.3 Stormwater Retrofits

Stormwater management retrofits involve implementing BMPs in existing developed areas where SWM practices do not currently exist in order to help improve water quality. Stormwater retrofits improve water quality by capturing and treating runoff before it reaches receiving water bodies. For example, based on initial field and desktop evaluations, Neighborhood Source Assessments (NSAs) identified seven sites as having sufficient open space for stormwater retrofits to treat runoff from impervious parking lots or alleys. Candidate sites for stormwater retrofits will be drawn from all four upland components surveyed: neighborhoods, hotspots, institutions, and pervious areas.

Impervious surfaces, including roads, parking lots, roofs and other paved surfaces, prevent precipitation from infiltrating into the ground as it would naturally in a forest or meadow in good condition. As a result, impervious surface runoff can result in decreased times of concentration of stormwater to receiving streams (“flashy flows”) leading to erosion, flooding, habitat destruction, and increased pollutant loads to receiving water bodies. Subwatersheds with high proportions of impervious cover are more likely to have degraded stream systems and be significant contributors to water quality problems in a watershed than those that are less developed. Removing impervious cover and converting it to pervious or forested land will help promote infiltration of runoff and reduce pollutant loads.

Unused or unmaintained (broken, crumbling) impervious surfaces with the potential for removal were identified at eight institutional locations. The areas of these impervious surfaces were used to estimate potential pollutant load reductions that would result from impervious cover removal activities.

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.

3.2.4 Stream Restoration

Stream restoration practices are used to enhance the appearance, stability and aquatic function of urban stream corridors. Stream restoration practices can include vegetative bank stabilization, localized grade control and comprehensive repairs, such as full channel redesign and realignment. As part of the SWAP process, a review of previous watershed studies, and the restoration recommendations that resulted from them, was completed for the Lower Gunpowder Falls (Urban) watershed. Stabilizing stream channels improves water quality in many ways including preventing eroded soils, and the pollutants contained in them, from entering the stream and making their way to the Gunpowder River and Chesapeake Bay.

3.2.5 Street Sweeping and Trash Reduction

Street sweeping removes floatable trash, sediment, heavy metals and nutrients associated with sediment particles, petroleum associated with sediment, and organic matter such as leaves and twigs from the curb and gutter system, preventing them from entering storm drains and nearby streams. Decay of a disproportionate amount of organic matter in the stream can take away oxygen needed for supporting aquatic life. Additionally, excessive organic matter can clog streams and storm drains, causing flooding resulting in costly maintenance. There were no neighborhoods during the survey of Lower Gunpowder Falls (Urban) watershed that had significant trash and/or organic matter build-up along curbs, so in this case, none were recommended for additional street sweeping.

While trash is not currently a major issue in the neighborhoods in this watershed, there was a stream area noted by a citizen at the first Community Meeting that had a large quantity of garbage along both banks. Baltimore County's approach to trash and litter reduction is a multi-faceted approach. The County is currently in the planning stages of an effort that will possibly include public service advertising, a trash treaty, celebrity encouragement, clean-ups, and targeted enforcement.

A citizen awareness campaign is part of the overall strategy and focuses on better stewardship regarding trash issues. Advertising includes different media for different audiences. Other elements may include trash can signs, point-of-sale displays and print ads.

A trash treaty encourages citizens not to litter. Volunteers lead the effort by gathering the signatures. In some programs, those that sign up receive a gift such as a reusable grocery bag or recycling & litter bags for cars. Data indicate that if someone signs a treaty they are much more likely to act upon the issue.

Clean-ups, promoted as Quick Pick-It-Ups (e.g. Baltimore County's Clean Green 15 program), include all audiences. Groups may include recreation councils, scout troops, businesses and religious organizations. A model used in Howard County was very successful where specific dates and times are promoted; however, it is clear that any clean-up will be counted towards the goal. Additional clean-ups are encouraged through Project Clean Stream, Stream Watch and the County's Adopt-a Road program.

Enforcement is the stick that every institution hopes is unneeded, but recognizes is necessary. Baltimore County uses local police and staff from its Code Enforcement unit to carry out enforcement when needed. Enforcement actions usually address businesses or apartments with consistent litter problems, overflowing dumpsters, and dumping.

3.2.6 Illicit Connection Detection/Disconnection

An Illicit Discharge Detection and Elimination program has been developed by Baltimore County to find and stop discharges into streams that are harmful to aquatic life and water quality or that are causing erosion/sedimentation problems. The County will continue its 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.

3.2.7 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) by 2020. 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 the Lower Gunpowder Falls (Urban) watershed.

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 the watershed that would not be possible without public participation. Citizen participation is critical to the implementation and long-term maintenance of restoration activities. Key citizen-based strategies proposed for restoring Lower Gunpowder Falls are discussed in the following sections.

3.3.1 Reforestation

Trees help improve water quality by capturing and removing pollutants in runoff including removal of excess nutrients through their roots before the pollutants enter groundwater and streams. Tree leaves and stems also intercept precipitation which helps to reduce the energy of raindrops and prevent any erosion resulting 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 for public property, can help increase the success of planting efforts. Several areas throughout the watershed are targeted for reforestation opportunities and are described below.

3.3.1.1 Riparian Buffer

Stream and shoreline riparian buffers are critical to maintaining healthy streams and rivers. Forested buffer areas along streams and shorelines can improve water quality and prevent flooding since they can filter pollutants, reduce surface runoff, stabilize stream banks, trap

sediment, and provide habitat for various types of terrestrial and aquatic life including fish. Buffer encroachment as a result of development was noted during upland and stream surveys conducted throughout the watershed. Areas on privately-owned land (e.g., residential properties) can be recommended for buffer awareness initiatives to encourage landowners to plant trees and/or create a no-mow area adjacent to streams and shorelines. Open pervious areas identified within the 100-foot stream and shoreline buffer areas via a GIS analysis in the Watershed Characterization Report (Appendix E) are good candidates for tree planting and are targeted for initial buffer reforestation efforts.

3.3.1.2 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 identified in the Pervious Area Assessments (PAAs) should be further investigated for tree planting potential. Publicly-owned lands requiring minimal site preparation (low-hanging fruit) are targeted for initial reforestation efforts.

3.3.1.3 Street and Open Space Tree Plantings

A few opportunities for neighborhood street tree plantings were identified during NSAs. Opportunities for open space tree plantings were also identified at several institutional sites and in some neighborhoods with multi-family housing. Street trees and open space trees provide aesthetic value and air and water quality benefits. They provide shade thereby reducing urban heat-island effect while also providing habitat for wildlife. They also absorb nutrients through their root systems.

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

Downspout disconnection 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 and the Center for Watershed Protection (CWP). Results from these programs can be used to determine successful techniques and strategies for Lower Gunpowder Falls (Urban) watershed.

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 an excellent citizen-based strategy. Yards and lawns typically represent a significant portion of the land cover in an urban subwatershed and therefore, can be a major source of nutrients, pesticides, sediment, and runoff. Fertilization, pesticide use, watering, landscaping, and trash/yard waste disposal all impact subwatershed quality. Urban nutrient management efforts related to lawn maintenance and using

natural “Bayscaping” (defined below) as opposed to manicured monocultures of lawn grass can help reduce nutrient inputs to nearby streams.

3.3.3.1 Lawn Maintenance Education

Lawn maintenance activities often involve over-fertilization, poor pest management, and over-watering resulting in excess pollutant runoff to local streams. Lawns with a dense, uniform grass cover or signs designating chemical lawn care treatment indicate high-maintenance lawn care activities. Neighborhoods identified as having high lawn maintenance issues should be targeted for awareness programs emphasizing responsible fertilizing techniques such as proper application and timing, 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.

3.3.3.2 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 maintenance and therefore less stormwater pollution. Bayscaping is also beneficial to wildlife because it creates pockets of native habitat. 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 AND REMOVAL ANALYSES

This section presents results of the watershed pollutant loading analysis performed to estimate current nutrient loads generated by the various non-point sources within the Lower Gunpowder Falls (Urban) watershed. Also discussed are the pollutant removal calculations for proposed BMPs to ensure the TMDL requirements are met in the Lower Gunpowder Falls (Urban) watershed.

3.4.1 Pollutant Loading Analysis

A pollutant loading analysis was performed to estimate total nitrogen, phosphorus, and sediment loads currently generated by all non-point sources (i.e., runoff from all land uses) present within the Lower Gunpowder Falls (Urban) watershed. Estimates were based on Maryland Department of Planning’s (MDP) 2010 Land Use/Land Cover (LU/LC) GIS layer and pollutant loadings rates developed by CBP for all 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 results from the watershed pollutant loading analysis including areas, nutrient loadings rates, and annual nutrient loads for each nonpoint source/land use type.

Table 3-1: Lower Gunpowder Falls Watershed Nitrogen, Phosphorus, and Sediment Loads Estimated Using 2010 MDP Land Use/Land Cover (see Appendix E for details)

Source	Area (acres)	Nitrogen		Phosphorus		Sediment	
		Rate (lbs/ac)	Load (lbs/yr)	Rate (lbs/ac)	Load (lbs/yr)	Rate (lbs/ac)	Load (lbs/yr)
Urban Impervious	1,640	17.40	28,536	1.51	2,483	1,947	3,193,080
Urban Pervious	4,950	11.50	56,925	0.24	1,163	266	1,316,700
Crop	477	9.30	4,436	0.68	325	683	325,791
Pasture/Orchards/Ag Build.	410	8.50	3,485	0.72	294	238	97,580
Livestock	0	171.60	0	25.09	0	3874	0
Forest	2,891	2.80	8,095	0.04	113	77	222,607
Water	10	10.30	103	0.61	6	0	0
Wetlands	0	10.30	0	0.61	0	0	0
Bare Ground	154	32.30	4,974	5.15	793	10,292	1,584,968
Totals	10,532		106,554		5,177		6,740,726

As discussed in Chapter 1, a TMDL analysis showed stormwater runoff is the primary contributor to nutrient and sediment inputs to the Lower Gunpowder Falls (Urban) watershed. The bulk of the nitrogen, phosphorus, and sediment reductions required to meet the Chesapeake Bay TMDL and water quality standards for the Lower Gunpowder Falls (Urban) watershed will come from control of stormwater runoff. The Chesapeake Bay TMDL analysis determined that a 32% reduction in nitrogen and a 47% reduction in phosphorus loads from urban stormwater discharges are necessary to meet Bay water quality standards. The load reductions needed within the urban portion of the Lower Gunpowder Falls (Urban) watershed to achieve these reductions are summarized in Table 3-2**.**

Table 3-2: Lower Gunpowder Falls (Urban) Watershed Nitrogen, Phosphorus, and Sediment Load Reductions

Source	Area (acres)	TN Load (lbs/yr)	TP Load (lbs/yr)	Sediment Load (lbs/yr)
Urban	6,590	85,462	3,665	4,509,982
Reduction Goal:		27,519	1,723	N/A

3.4.2 Pollutant Removal Analysis

The following sections present a quantitative analysis of pollutant removal capabilities of the proposed BMPs to ensure that the required reduction in nutrient loads from urban runoff in the Lower Gunpowder Falls (Urban) watershed is achieved. Note that many of the removal efficiencies used to estimate pollutant reductions are based on peer-reviewed and CBP-approved nonpoint source BMP tables developed for the Phase 5.3 CBP Watershed Model. These tables are included in Appendix D. Also note that the calculations and estimates presented in the following subsections represent maximum potential pollutant capabilities. A summary of overall pollutant load reduction estimates is presented at the end of this section for two scenarios: a maximum implementation scenario and one based on projected participation for each BMP.

3.4.2.1 Implemented Capital Improvement Projects

Baltimore County has implemented many capital improvement projects in the county's various watersheds including stream restoration, stormwater facility retrofits and conversions, and shoreline enhancements. The County has implemented 11 pond conversions and 8 stream restoration projects (totaling 34,582 linear feet of stream – 11,500 feet of which are currently under design or construction) in the Lower Gunpowder Falls (Urban) watershed. Pollutant loads were estimated by the County based on the contributing drainage area (DA) and the corresponding project type's land use-specific pollutant loading rates. Load reduction is calculated as the product of the pollutant load and removal efficiency. For the BMP retrofits, filtration pollutant removals are 40% for nitrogen, 60% for phosphorus, and 80% for sediment per the values shown in Appendix D under Urban and Mixed Open BMPs, Stormwater Management. For stream restoration projects, nutrient reduction credits are based on the length of stream restored. A summary of existing load reductions is shown in Table 3-3.

Table 3-3: Load Reductions Estimated for BMP Retrofit, Pond Conversion, and Stream Restoration Projects in Lower Gunpowder Falls (Urban) Watershed

Project	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Sediment Reduction (lbs/yr)
Pond Conversions			
279	71.2	8.85	15,932
393	104.6	13.01	23,415
452	27.8	3.45	6,215
453	47.2	5.87	10,562
473	50.5	6.28	11,312
517	58.7	7.30	13,138
525	39.8	4.95	8,913
815	37.8	4.70	8,464
845	117.3	14.58	26,249
846	36.8	4.58	8,246
1764	37.8	4.69	8,450
Totals	629.6	78.3	140,897
Stream Restorations			
Minebank Run I	525.0	476.0	314,160
Minebank Run II	750.0	680.0	448,800
Minebank Run Trib @Waller	36.2	32.8	21,632
Gunpowder Falls @ Cromwell (DPW)	112.5	102.0	67,320
Jennifer Branch	451.8	409.6	270,357
Lower Minebank*	225.0	204.0	134,640
Lower Gunpowder @ Proctor*	150.0	136.0	89,760
Lower Gunpowder @ Seven Courts*	337.5	306.0	201,960
Totals	2,588.0	2,346.4	1,548,629

*Project under design or construction

3.4.2.2 Existing Stormwater Management (SWM)

As described in detail in Section 2.3 of the Watershed Characterization Report (Appendix E), there are 193 existing SWM facilities in the Lower Gunpowder Falls (Urban) watershed including dry ponds, infiltration/filtration practices, extended detention, proprietary BMPs and other types of SWM facilities (i.e., underground detention). The pollutant removal capability of the existing SWM in the watershed is not fully accounted for in the baseline 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 (RE) recommended by CBP for the various types of SWM faculties. The equation used to estimate total nitrogen (TN) load reductions for a particular type of SWM facility is expressed as:

[12.97 (lbs/ac/yr)*DA (acres)]*RE (%)

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

[0.55 (lbs/ac/yr)*DA (acres)]* RE (%)

The equation used to estimate sediment load reductions for a particular type of SWM facility is expressed as:

[684 (lbs/ac/yr)*DA (acres)]* RE (%)

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in the above equations. The pollutant loading rates shown, 12.97lbs TN/ac/yr, 0.55 lbs TP/ac/yr, and 684 lbs sediment/ac/yr, represent the weighted average of impervious and pervious urban rates used in the pollutant loading analysis (Table 3-2) 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 Phase 5.3, as implemented in the Maryland Assessment Scenario Tool (MAST) run from June 2015 for the 2010 Progress scenario. The percent pollutant removal efficiency depends on the type of facility and is based on the values shown in Appendix D 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 is shown in the Table 3-4.

Table 3-4: Existing SWM Load Reductions

SWM Facility Type	#	DA (acres)	Total Nitrogen			Total Phosphorus			Sediment		
			Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
Dry Pond	38	760.3	9,227.2	2-5%	440.0	434.36	5-10%	41.58	498,005	5-10%	47,718
Dry Well	1	0.1	0.9	32%	0.0	0.05	37%	0.02	59	40%	24
Extended Detention	83	755.6	9,230.0	20%	1,846.0	475.31	20%	95.06	549,344	60%	329,606
Extended Detention, other	10	20.4	175.6	19-67%	86.2	8.29	22-78%	4.33	10,052	24-84%	5,545
Infiltration Basin	5	71.2	898.3	38-65%	375.6	45.81	44-75%	22.79	48,278	47-81%	25,969
Infiltration Trench	19	10.1	156.9	45-80%	107.2	11.53	52-85%	8.75	14,508	56-95%	12,247
Level Spreader	2	1.9	12.4	61-66%	7.9	0.57	71-77%	0.42	723	77-83%	578
Oil and Grit Separator	1	0.3	5.0	5%	0.2	0.43	10%	0.04	553	10%	55
Permeable Pavement	1	1.5	17.2	45%	7.7	0.91	52%	0.48	1,092	56%	611
Sand Filter*	32	183.7	2,289.5	20-39%	670.0	115.03	36-62%	54.12	133,759	11-79%	74,347
Shallow Marsh	3	21.3	261.8	29-38%	82.5	12.27	46-60%	6.05	14,121	58-77%	8,862
Swale	2	3.0	39.2	45-60%	20.3	2.34	52-70%	1.43	2,858	56-75%	1,863
Underground Storage	1	1.7	22.9	5%	1.1	1.21	10%	0.12	1,430	10%	143
Wet Pond	6	160.0	1,846.5	6-37%	483.8	77.49	9-59%	32.57	86,738	12-76%	46,657
Totals	193	1,888.0	24,183.5		4,128.7	1,185.61		267.75	1,361,519		554,225

*Eleven of the sand filters noted above (and the 3.0 acres of drainage area they treat) are components of stormwater management conversions; therefore, these sand filters and the drainage areas treated by them are not included in the totals, as this would double count the converted stormwater management facilities.

3.4.2.3 Stormwater Management Conversions

Four dry ponds could be converted to facilities with higher capacity for nutrient removal. 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 (RE) based on BMP efficiencies by CBP for detention and extended detention facilities (http://www .mastonline.org/Documentation.aspx). The equation used to estimate total nitrogen (TN) load reductions for SWM conversion is expressed as:

[12.97 (lbs/ac/yr)*DA (acres)]*RE (%)

The equation used to estimate total phosphorus (TP) load reductions for SWM conversion is expressed as:

[0.55 (lbs/ac/yr)*DA (acres)]* RE (%)

The equation used to estimate sediment load reductions for SWM conversion is expressed as:

[684 (lbs/ac/yr)*DA (acres)]* RE (%)

The pollutant load received from the drainage area contribution to the SWM facility is denoted by the first expression in brackets in the equations above. Similar to existing SWM, the pollutant loading rates, 12.97 lbs TN/ac/yr, 0.55 lbs TP/ac/yr, and 684 lbs sediment/ ac/yr, represent the weighted average of impervious and pervious urban rates in the pollutant loading analysis (Table 3-2) since this represents the likely sources of runoff being treated. The increased in pollutant removal efficiency is represented by the third expression in the equations above. This is the difference between percent pollutant removal efficiencies of the facilities, based on CBP guidance shown in Appendix D under Urban and Mixed Open BMPs, Stormwater Management. A summary of SWM conversion load reduction calculations and results are shown in Table 3-5 and Table 3-6.

Table 3-5: SWM Conversion Load Reductions

Pollutant	Total DA for SWM Conversion (acres)	Max Potential Load Reduction (lbs/yr)
TN	41.9	172
TP	41.9	14
Sediment	41.9	16,459

Table 3-6: SWM Conversion Load Reductions for Individual Ponds

Pond #	Potential for Conversion	Total DA for SWM Conversion (acres)	Nitrogen Load Reduction (lbs/yr)	Phosphorus Load Reduction (lbs/yr)	Sediment Load Reduction (lbs/yr)
524	High	10.5	40.2	2.68	4,035
631	High	4.5	18.8	1.56	2,487
850	High	10.2	75.9	6.03	8,155
1744	High	16.7	37.1	3.73	1,781
Total		41.9	171.9	14.00	16,459

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 identified for retrofit potential during uplands surveys for neighborhoods, institutions, hotspots, and pervious areas. Pollutant reductions for stormwater retrofits are calculated based on the approximated pollutant load received from the impervious drainage area (DA) and removal efficiency (RE) of bioretention and underground structure type BMPs. The equation used to estimate total nitrogen (TN) load reductions for stormwater retrofits is expressed as:

[17.40 (lbs/ac/yr)*DA (acres)]*RE (%)

The equation used to estimate total phosphorus (TP) load reductions for stormwater retrofits is expressed as:

[1.51 (lbs/ac/yr)*DA (acres)]*RE (%)

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

[1,947 (lbs/ac/yr)*DA(acres)]*RE(%)

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in the equation above. The pollutant loading rates shown, 17.40 lbs TN/ac/yr, 1.51 lbs TP/ac/yr, and 1,947 lbs sediment/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 bioretention and infiltration basin, based on CBP guidance shown in Appendix D under Urban and Mixed Open BMPs, Stormwater Management. A summary of stormwater retrofit load reduction calculations and results are shown in Table 3-7.

Table 3-7: Stormwater Retrofit Load Reduction

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	Impervious Area for SW Retrofit (acres)	Load for DA (lbs/yr)	RE (%)	Max Potential Load Reduction (lbs/yr)
Bioretention/Rain Gardens					
TN	17.40	10.5	182	25%	45.46
TP	1.51	10.5	16	45%	7.12
Sediment	1,947	10.5	20,346	55%	11,190
Infiltration Basins					
TN	17.40	1.2	21	85%	17.75
TP	1.51	1.2	2	85%	1.54
Sediment	1,947	1.2	2,336	95%	2,220

3.4.2.5 Impervious Cover Removal

Potential sites for impervious cover removal were identified at several institutions. Pollutant reductions for impervious cover removal are calculated based on a land conversion from impervious to pervious urban. The equation used to estimate total nitrogen (TN) load reductions for stormwater retrofit is expressed as:

[17.40 (lbs/ac/yr) – 11.50 (lbs/ac/yr)]*Impervious Area (acres)

The equation used to estimate total phosphorus (TP) load reductions for stormwater retrofits is expressed as:

[1.51 (lbs/ac/yr) - 0.24 (lbs/ac/yr)]*Impervious Area (acres)

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

[1,947 (lbs/ac/yr) - 266 (lbs/ac/yr)]*Impervious Area (acres)

Impervious cover removal would involve converting impervious surfaces to pervious surfaces. Therefore, the loading rate would be reduced by a factor equal to the difference between impervious and pervious urban loading rates 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 area proposed for impervious cover removal. 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 (acres)	Max Potential Load Reduction (lbs/yr)
TN	17.40	11.50	5.90	0.3	1.8
TP	1.51	0.24	1.28	0.3	0.4
Sediment	1,947	266	1,681	0.3	504

3.4.2.6 Stream Buffer Reforestation

The current vegetative condition of the stream riparian buffer (100 feet on either side of the stream system, total area 1,655 acres) was analyzed in Chapter 2 of the Watershed Characterization Report (Appendix E). Buffer conditions were classified as impervious, open pervious, or forested areas. Open pervious areas are the best areas to initially target for restoration. Approximately 406 acres of open pervious area were identified within the stream buffer zone.

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 D). The equation used to estimate total nitrogen (TN) load reductions for the land use conversion portion of stream buffer reforestation is expressed as:

Land Use Conversion (TN) = [11.5 (lbs/ac/yr) – 2.8 (lbs/ac/yr)]* Open Pervious Area (acres)

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

Land Use Conversion (TP) = [0.24 (lbs/ac/yr) – 0.04 (lbs/ac/yr)]* Open Pervious Area (acres)

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

Land Use Conversion (sediment) = [266 (lbs/ac/yr) –77 (lbs/ac/yr)]* Open Pervious Area (acres)

The first expression in brackets in the equation above represents the difference between pervious urban and forest loading rates used in the watershed pollutant loading analysis. This reduction in loading rate is then multiplied by the available open pervious area for reforestation to determine the loads 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 D, one acre of buffer treats approximately one acre of upland area for nitrogen with an efficiency of 25 percent for urban and mixed open buffers. The total nitrogen (TN) load reduction for the removal efficiency portion of buffer reforestation can be expressed as:

Buffer BMP Removal (TN) = [Open Pervious Area (acres)*10.12 (lbs/ac/yr]*25%

Similarly, one acre of buffer treats approximately one acre of upland area for phosphorus with an efficiency of 50 percent for urban and mixed open buffers. The total phosphorus (TP) load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

Buffer BMP Removal (TP) = [Open Pervious Area (acres)*0.49 (lbs/ac/yr]*50%

Similarly, one acre of buffer treats approximately one acre of upland area for sediment with an efficiency of 50 percent for urban and mixed open buffers. The sediment load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

Buffer BMP Removal (sediment) = [Open Pervious Area (acres)*640 (lbs/ac/yr]*50%

The loading rates shown in the equation above, 10.12 lbs TN/ac/yr, 0.49 TP/ac/yr, and 640 lbs sediment/ac/yr, represent overall watershed loading rates. This is estimated as the total watershed nutrient load (106,554 lbs TN/yr, 5,177 lbs TP/yr, and 6,740,726 lbs sediment/yr) divided by the total area (10,532 acres), which is the area 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

Pollutant	Open Pervious Area (acres)	Land Use Conversion		Buffer BMP Removal			Max Potential Load Reduc-tion (lbs/yr)
		Reduced Loading Rate (lbs/ac/yr)	Land Use Conversion Reduction (lbs/yr)	RE (%)	Overall Watershed Loading Rate (lbs/ac/yr)	Overall Watershed Load (lbs/yr)	
TN	406	8.70	3,532	25%	10.12	4,108	4,559
TP	406	0.20	80	50%	0.49	200	179
Sediment	406	189	76,734	50%	640	259,849	206,659

3.4.2.7 Urban Nutrient Management – Maryland Fertilizer Use Act of 2011

The State of Maryland recently passed the Maryland Fertilizer Use Act of 2011 (the Act) that took effect in October 2013. The Act bans phosphorus and provides a greater percentage of slow release nitrogen in lawn fertilizer. The fertilizer bags have better labeling and lawn care professionals are required to be certified in proper fertilizer application. The Chesapeake Bay Program Urban Nutrient Management Expert Panel Report recommendations include TN reductions of 9 percent for commercial applicators of fertilizer and 4.5 percent for "do-it yourself" fertilizer applicators for the State of Maryland (Schueler and Lane, 2013). A 25% reduction is given to TP for urban nutrient management. In Lower Gunpowder Falls (Urban), this reduction will apply to an estimated 3,014 acres of residential parcels (lawns), and 553 acres of non-residential parcels (pervious area of the golf course, open urban areas, institutional and commercial areas). Pollutant reductions applied for the Act are calculated based on the urban pervious pollutant load multiplied by the acres of managed turf, then the pollutant reduction efficiency. The equation used to estimate total nitrogen (TN) load reductions for commercial applicators, on non-residential parcels is expressed as:

[11.50 (lbs/acre/yr) x managed turf (acres)] x 9%

The equation used to estimate total nitrogen (TN) load reductions for residential applicators, on residential parcels is expressed as:

[11.50 (lbs/acre/yr) x managed turf (acres)] x 4.5%

The equation used to estimate total phosphorus (TP) load reductions for the Act reduction is expressed as:

[0.24 (lbs/acre/yr) x managed turf (acres)] x 25%

The pollutant load received from the urban pervious area that the Act will be applied to is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 11.50 lbs/ac/yr of TN and 0.24 lbs/ac/yr of TP, are the pervious urban rates used in the pollutant

loading analysis. Pollutant removal efficiencies are those reported by the State to be applied from the Act. A summary of fertilizer load reduction calculations and results are shown in Table 3-10.

Table 3-10: Maryland Fertilizer Use Act of 2011 Load Reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Acres of Managed Turf	RE (%)	Max Potential Load Reduction (lbs/yr)
TN (Residential)	11.50	3,014	4.5%	1,560
TN (Non-residential)	11.50	553	9.0%	572
TP	0.24	3,567	25.0%	209

3.4.2.8 Pervious Area Reforestation

Open pervious areas with reforestation potential have been identified in the Lower Gunpowder Falls (Urban) watershed equaling 38 acres. Pollutant reductions for pervious area reforestation are calculated based on land use conversion from pervious urban to forest. The equation used to estimate total nitrogen (TN) load reductions for pervious area reforestation is expressed as:

Land Use Conversion (TN) = [11.50 (lbs/ac/yr) – 2.80 (lbs/ac/yr)]* Open Pervious Area (acres)

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

Land Use Conversion (TP) = [0.24 (lbs/ac/yr) – 0.04 (lbs/ac/yr)]* Open Pervious Area (acres)

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

Land Use Conversion (sediment) = [266 (lbs/ac/yr) – 77(lbs/ac/yr)]* Open Pervious Area (acres)

Pervious area reforestation 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 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. A summary of pervious area reforestation reduction calculations and results are shown in Table 3-11. Note that assessments were performed and plantings recommended at four State Highway Administration (SHA) properties. While the County may encourage plantings at these sites, any pollution reduction benefits would be credited to SHA, as the agency has its own NPDES permit and associated reduction goals. Therefore, acres recommended for planting at these sites were not included in the model.

Table 3-11: Pervious Area Reforestation Load Reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Forest Loading Rate (lbs/ac/yr)	Reduced Loading Rate (lbs/ac/yr)	Open Pervious Area (acres)	Max Potential Load Reduction (lbs/yr)
TN	11.50	2.80	8.70	38	328.0
TP	0.24	0.04	0.20	38	7.39
Sediment	266	77	189	38	7,125

3.4.2.9 Stream Corridor Restoration

Several potential stream restoration sites were identified during the review of two previous studies: the Lower Gunpowder Falls Water Quality Management Study (WQMS) by Parsons Brinkerhoff (1999) and the Lower Gunpowder Falls Watershed Assessment (WA) by McCormick Taylor (2011). The purpose of this review was to identify previously recommended stream restoration projects that were the best opportunities for future restoration efforts. These sites are discussed in Section 3.6 of the Watershed Characterization Report (Appendix E). Pollutant load reduction estimates in pounds per linear foot of stream restoration were developed by Schueler and Stack (2013; 2014 revisions). These were also used to calculate load reductions for proposed stream restoration activities (i.e., restoration lengths (RL)) in the Lower Gunpowder Falls (Urban) watershed. The equation used to estimate total nitrogen (TN) reductions for stream restoration is expressed as:

0.075 (lbs/ft)*RL (ft)

The equation used to estimate total phosphorus (TP) load reductions for stream restoration is expressed as:

0.068 (lbs/ft)*RL (ft)

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

44.88 (lbs/ft)*RL (ft)

Edge-of-Stream 2014 interim approved removal rates per linear foot of qualifying stream restoration were obtained from Table 3 in Schueler and Stack (2013; 2014 revisions).

All of the erosion and channel alteration sites, as well as their severity ratings, are summarized in Table 3-24 in Section 3.6 of the Watershed Characterization Report. For the model, potential stream restoration sites were identified as moderately to severely impaired stream lengths totaling up to 9,516 feet. Lower severity impairments were not included in the model. A summary of stream corridor restoration reduction calculations and results are shown in Table 3-12.

Table 3-12: Stream Corridor Restoration Load Reduction

Pollutant	Reduction in Loading Rate (lbs/ft)	Total Stream Length in Watershed (ft)	Potential Stream Restoration Length (ft)	Max Potential Load Reduction (lbs/yr)
TN	0.075	350,328	9,516	714
TP	0.068	350,328	9,516	647
Sediment	44.88	350,328	9,516	427,078

3.4.2.10 Downspout Disconnection

A total of 32 neighborhoods (out of 89 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 (Appendix E).

Pollutant reductions for downspout disconnection are calculated based on the pollutant load received from the total rooftop drainage area (DA) recommended for disconnection and the removal efficiency (RE) of based on removal efficiency for environmental site design (ESD) to the maximum extent practicable (MEP; MDE 2014). The equation used to estimate total nitrogen (TN) load reductions for downspout disconnection is expressed as:

[17.40 (lbs/ac/yr)*DA (acres)]*RE (%)

The equation used to estimate total phosphorus (TP) load reduction for downspout disconnection is expressed as:

[1.51 (lbs/ac/yr)*DA (acres)]*RE (%)

The equation used to estimate sediment load reduction for downspout disconnection is expressed as:

[1,947 (lbs/ac/yr)*DA (acres)]*RE (%)

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 (17.40 lbs TN/ac/yr, 1.51 lbs TP/ac/yr, and 1,947 lbs sediment/ac/yr) are the impervious urban rates used in the pollutant loading analysis. Pollutant removal efficiencies are those reported for filtration practices, based on CBP guidance shown in Appendix D under Urban and Mixed Open BMPs, Stormwater Management. A summary of downspout disconnection load reduction calculations and results are shown in Table 3-13.

Table 3-13: Downspout Disconnection Load Reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	DA (Rooftop Area Recommended for Downspout Disconnect) (acres)	RE (%)	Max Potential Load Reduction (lbs/yr)
TN	17.40	80.3	50%	699
TP	1.51	80.3	60%	73
Sediment	1,947	80.3	90%	140,710

3.4.2.11 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 institutional sites. For both neighborhood and institutional tree planting opportunities, the number of trees was estimated based on a spacing of one tree per 15 to 20 feet. Pollutant reductions for pervious area reforestation are calculated based on a land use conversion from pervious urban to forest. An approximation of 100 trees per acre is used to calculate the area available for conversion. The equation used to estimate total nitrogen (TN) load reductions for tree plantings is expressed as:

[11.50 (lbs/ac/yr) – 2.80 (lbs/ac/yr)] * [# Trees * (1 acre/100 trees)]

The equation used to estimate total phosphorus (TP) load reductions for tree plantings is expressed as:

[0.24 (lbs/ac/yr) – 0.04 (lbs/ac/yr)] * [# Trees * (1 acre/100 trees)]

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

[266 (lbs/ac/yr) – 77 (lbs/ac/yr)] * [# Trees * (1 acre/100 trees)]

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 rates multiplied by the open pervious 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 3-14 and Table 3-15.

.

.

Table 3-14: 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	Equivalent Forest Area (acres)	Max Potential Load Reduction (lbs/yr)
TN	11.50	2.80	8.70	6,353	64	553
TP	0.24	0.04	0.20	6,353	64	12.45
Sediment	266	77	189	6,353	64	12,007

Table 3-15: 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	Equivalent Forest Area (acres)	Max Potential Load Reduction (lbs/yr)
TN	11.50	2.80	8.70	181	1.81	16
TP	0.24	0.04	0.20	181	1.81	0.35
Sediment	266	77	189	181	1.81	342

3.4.2.12 Street Sweeping

Approximately 208 miles of road were reported to have street sweeping in the Lower Gunpowder Falls watershed. For the purposes of this watershed plan, the overall Lower Gunpowder Falls watershed was divided into two portions. Load reductions for street sweeping were pro-rated for the Lower Gunpowder Falls (Urban) portion of the overall watershed based on the proportion of road miles within that portion of the watershed; 72% of road miles in the overall watershed area were within Lower Gunpowder Falls (Urban). Records from the Department of Public Works (DPW) Street Sweeping Program (EPS 2014) showed that 476.1 lbs TN, 190.4 lbs TP, and 57,127 lbs TSS were removed overall; the allocations to the Lower Gunpowder Falls (Urban) watershed based on 150 miles of street sweeping were 342.8 lbs TN, 137.1 lbs TP, and 41,132 lbs TSS. A summary of street sweeping reduction calculations and results are shown in Table 3-16.

Table 3-16: Street Sweeping Load Reductions

Pollutant	Actual Miles of Street Sweeping	Max Potential Load Reduction (lbs/yr)
TN	150	342.8
TP	150	137.1
Sediment	150	41,132

As noted in Section 4.2 of the Watershed Characterization Report, no neighborhoods were recommended during Neighborhood Source Assessments (NSAs) for street sweeping.

3.4.2.13 Sanitary Sewer Overflows

Sanitary sewer overflows over the past 14 years have been an on-going issue in the Lower Gunpowder Falls (Urban) watershed. These are assumed to be eliminated by 2020 through sewer line upgrades occurring as a result of the consent decree.

A total of 55 sanitary sewer overflow (SSO) events were documented between 2000 and 2013 within Lower Gunpowder Falls (Urban) watershed. An estimated 5,252,163 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, found in Appendix E):

- Total Nitrogen (TN): A conversion factor of 2.5×10^{-4} was used to convert gallons of overflow to pounds of pollutant. This is based on a 30 mg/L TN concentration for raw sewage 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 for raw sewage and a multiplier of 8.3×10^{-6} lb•L/mg•gal.

Based on these conversion factors, approximately 1,313 lbs of total nitrogen and 435.9 lbs of total phosphorus were released over the 14-year period as a result of SSOs. This is equivalent to pollutant reduction capabilities of 93.8 lbs TN/yr (i.e., 1,313.0 lbs TN/14 yrs) and 31.1 lbs TP/yr (i.e., 435.9 lbs TP/14 yrs). Note that TN and TP concentrations shown above are values for waste and wash water combined from CWP's Watershed Treatment Model version 3.1.

3.4.2.14 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 the 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 **3-17**.

Table 3-18 presents a summary of estimated pollutant load reductions for both scenarios – maximum implementation and projected practicable – including how reductions were credited, pollutant removal efficiencies, maximum potential load reductions, units available for restoration, projected participation, and projected load reductions.

The projected, practicable implementation of proposed restoration BMPs, shown in Table 3-18, would fall short of meeting the 32 percent reduction for nitrogen and would meet the 47 percent reduction for phosphorus needed to meet water quality standards for the Lower Gunpowder Falls (Urban) watershed as specified by Chesapeake Bay TMDL for nutrients (Appendix J). There is opportunity to achieve greater reductions if more stormwater retrofit opportunities are identified or 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 and tours

of completed projects). These types of actions are not included in the pollutant removal analysis because reductions efficiencies are not well known and are difficult to estimate.

Table 3-17: Projected Participation Factors

BMP	Projected Participation	Basis of Assumption
Capital Investment – Filtration	100	Existing - pond retrofits already implemented
Existing SWM	100	Existing - BMP already implemented
SWM Conversion	100	Completion of 11 conversions recommended
SW Retrofits (NSA, ISI, PAA, HSI)*	50	General estimate to achieve reduction goal
ISI Impervious Cover Removal	50	General estimate to achieve reduction goal
Reforest Stream Buffer	80	General estimate to achieve reduction goal
Pervious Area Reforestation	75	General estimate to achieve reduction goal
Stream Restoration	100	General estimate to achieve reduction goal
NSA Downspout Disconnection	66	General estimate to achieve reduction goal
NSA Tree Plantings	50	General estimate to achieve reduction goal
ISI Tree Plantings	75	75% of estimated trees located on public lands
Urban Nutrient Management	100	State Mandate
Street Sweeping	100	General estimate to achieve reduction goal
SSO Reduction/Elimination	100	Consent Decree requirements

* NSA (Neighborhood Source Assessment); ISI (Institutional Site Investigation); PAA (Pervious Area Assessment); HSI (Hotspot Investigation)

Table 3-18: Summary of Pollutant Load Reduction Estimates

BMP	How Credited	TN Efficiency	TP Efficiency	Sediment Efficiency	Max Potential TN Load Reduction (lbs/yr)	Max Potential TP Load Reduction (lbs/yr)	Max Potential Sediment Load Reduction (lbs/yr)	Units Available		Projected Participation (%)	Projected TN Load Reduction (lbs/yr)	Projected TP Load Reduction (lbs/yr)	Projected Sediment Load Reduction (lbs/yr)
Existing Retrofits	Efficiency	varies	varies	varies	114	9	5,745	0	acres	100	114	9	5,745
Existing Stream Restoration	lbs per Ln Ft	0.075	0.068	44.88	2,588	2,346	1,548,629	34,506	ft	100	2,588	2,346	1,548,629
Existing SWM	Efficiency	varies	varies	varies	4,129	268	554,225	1,888	acres	100	4,129	268	554,225
SWM Conversion	Efficiency	varies	varies	varies	172	14	16,459	42	acres	100	172	14	16,459
New SW Retrofits (NSA, ISI, PAA, HIS)	Efficiency	varies	varies	varies	63.2	8.7	13,410	11.65	acres	50	31.6	4.33	6,705
ISI Impervious Cover Removal	LU Conversion	N/A	N/A	N/A	1.77	0.38	504	0.30	acres	50	0.89	0.19	252
Reforest Stream Buffer	LU Conversion + Efficiency	25%	50%	50%	4,559	179	206,659	406	acres	80	3,647	143	165,327
Urban Nutrient Management	Efficiency	varies	varies	N/A	2132	210	N/A	3,567	acres	100	2,132	210	N/A
Pervious Area Reforestation	LU Conversion	N/A	N/A	N/A	328	7	7,125	38	acres	75	246	5.54	5,344
New Stream Restoration	lbs per Ln Ft	0.075	0.068	44.88	714	647	427,078	9,516	ft	100	714	647	427,078
NSA Downspout Disconnection	Efficiency	50%	60%	90%	699	73	140,710	80	acres	66	461	48	92,868
NSA Tree Plantings	LU Conversion	N/A	N/A	N/A	553	12	12,007	64	acres	50	276	6	6,004
ISI Tree Plantings	LU Conversion	N/A	N/A	N/A	16	0.35	342	1.81	acres	75	12	0.27	257
Street Sweeping	Direct Removal	N/A	N/A	N/A	343	137	41,132	150	miles	100	343	137	41,132
SSO Reduction/Elimination	Direct Removal	N/A	N/A	N/A	94	31	N/A	855,770	gallons	100	94	31	N/A
				Total	16,504	3,943	2,974,025				14,960	3,870	2,870,024
				Total Existing Urban Load (lbs/yr)	85,461	3,646	4,509,780				85,461	3,646	4,509,780
				Reduction Achieved	19.3%	108.1%	65.9%				17.5%	106.1%	63.6%

Chapter 4: SUBWATERSHED MANAGEMENT STRATEGIES

4.1 INTRODUCTION

This chapter describes the criteria and methodology used to rank the seven subwatersheds within the Lower Gunpowder Falls (Urban) watershed (Figure 4-1). The subwatershed ranking provides a tool for targeting restoration actions by location/waterbody. 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 Watershed Characterization Report, included as Appendix E.

4.2 SUBWATERSHED PRIORITIZATION

A ranking methodology was developed to prioritize subwatersheds in terms of restoration need and potential. Subwatersheds are represented by an overall prioritization score on a scale of 44, based on a set of 11 criteria each worth a maximum of four points. Lower scores denote the least significant impacts to water quality and a total score of 48 corresponds to the greatest water quality improvement potential. The total prioritization score for a subwatershed comprises the following ranking criteria:

- Phosphorus Loads,
- Nitrogen Loads,
- Impervious Surfaces,
- Neighborhood Restoration Opportunity/Pollution Source Indexes,
- Neighborhood Downspout Disconnection,
- Institutional Site Investigations,
- Pervious Area Assessments,
- Stormwater Pond Conversions,
- Illicit Discharge Data,
- Stream Buffer Improvement, and
- Stream Restoration Potential.

In general, subwatersheds were grouped 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, and 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 narrow or clustered, or cases where zero values were assigned to subwatersheds that had no recommended action for a particular criterion.

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.

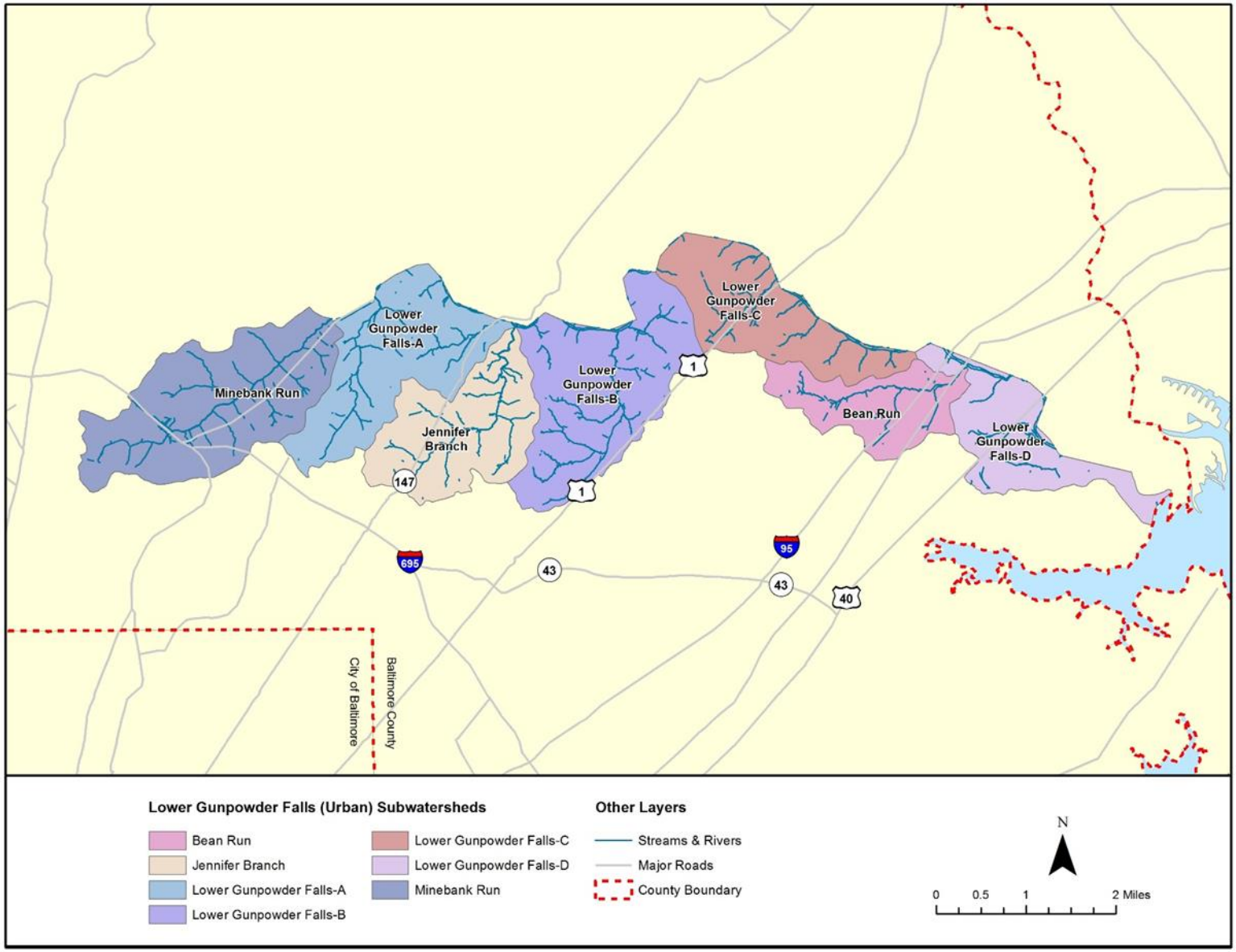


Figure 4-1: Lower Gunpowder Falls (Urban) Subwatersheds

4.2.1 Phosphorus and Nitrogen Loads

One of the objectives that will improve and maintain water quality in the Lower Gunpowder Falls (Urban) watershed streams and help meet the Chesapeake Bay TMDLs is to reduce annual average total phosphorus and nitrogen loads. Annual pollutant loads (lbs/year) for total nitrogen and total phosphorus were calculated for each subwatershed based on loading rates established by MDE and the Chesapeake Bay Program (CBP) for various land use types and subwatershed land use distributions. The pollutant loading analysis for Lower Gunpowder Falls (Urban) watershed is explained in further detail in Section 3.3 of the Watershed Characterization Report (Appendix E).

For each subwatershed, annual nitrogen and phosphorus loads were divided by the subwatershed's area. This represents pollutant loading rates (lbs/acre/year) and allows a direct comparison among the seven subwatersheds since they vary in size. Subwatersheds with higher pollutant loading rates are higher priorities for restoration within the Lower Gunpowder Falls (Urban) watershed. Therefore, higher pollutant loading rates are assigned high scores to denote greater water quality impacts and restoration needs.

Subwatershed nitrogen loading rates ranged from 7.0 to 9.8 lbs/acre/year. The following point system was used to assign nitrogen load scores to the seven subwatersheds based on the range and distribution of subwatershed nitrogen loading rates:

- > 9.6 lbs/acres/year = 4 pts;
- 9.5 – 9.6 lbs/acre/year = 3 pts;
- 9.2 – 9.4 lbs/acre/year = 2 pts;
- < 9.2 lbs/acre/year = 1 pt.

Subwatershed phosphorus loading rates ranged from 0.24 – 0.75 lbs/acre/year. The following point system was used to assign phosphorus load scores to the seven subwatersheds based on the range and distribution of subwatershed phosphorus loading rates:

- ≥ 0.50 lbs/acres/year = 4 pts;
- 0.40 – 0.49 lbs/acre/year = 3 pts;
- 0.31 – 0.39 lbs/acre/year = 2 pts;
- ≤ 0.30 lbs/acre/year = 1 pt.

Nitrogen and phosphorus 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
Bean Run	9.4	2	0.39	2
Jennifer Branch	9.6	3	0.34	2
Lower Gunpowder Falls-A	8.5	1	0.35	2
Lower Gunpowder Falls-B	9.8	4	0.37	2
Lower Gunpowder Falls-C	7.0	1	0.24	1
Lower Gunpowder Falls-D	9.5	3	0.75	4
Minebank Run	9.2	2	0.38	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 destruction 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 (Appendix E), 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 this indicator allows a direct comparison between the seven subwatersheds. Subwatersheds with higher percentages of impervious cover are higher priorities for restoration and were assigned high scores to denote greater water quality impacts and restoration needs.

Impervious surfaces cover about 16.6% of the overall Lower Gunpowder Falls (Urban) watershed. Subwatershed impervious values range from approximately 8% to 21%. The following point system was used to assign percent impervious scores to the seven subwatersheds based on CWP's Impervious Cover model (see Chapter 2.3.3 of Appendix E) and subwatershed impervious surface percentages:

- > 25% = 4 pts;
- 16 – 25% = 3 pts;
- 11 – 15% = 2 pts;
- < 11% = 1 pt.

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

Table 4-2: Percent Impervious Cover Scores

Subwatershed	% Impervious	% Impervious Score
Bean Run	18	3
Jennifer Branch	18	3
Lower Gunpowder Falls-A	17	3
Lower Gunpowder Falls-B	21	3
Lower Gunpowder Falls-C	8	1
Lower Gunpowder Falls-D	10	1
Minebank Run	19	3

4.2.3 Neighborhood Pollution Source/Restoration Opportunity Indices

As described in the Watershed Characterization Report, neighborhood pollution severity and restoration potential were rated during neighborhood source assessments (NSA). The severity of potential 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). None of the 89 neighborhoods assessed received a PSI rating of severe. Six were rated as high for both PSI and ROI, and 11 neighborhoods were rated as a high PSI with a moderate ROI. Neighborhoods with high PSI and high ROI ratings represent the best areas to initially target for restoration. Neighborhoods that had PSI ratings of low were discarded from this ranking.

Subwatersheds with the most neighborhoods rated as high for both pollution severity and restoration potential received the highest score (4 points). Subwatersheds with a single neighborhood rated as high for both pollution severity and restoration received the second highest score (3 points). Subwatersheds with no neighborhoods rated as high for both PSI and ROI but with five or more neighborhoods rated as high for pollution severity and moderate for restoration potential, or moderate for pollution severity and high for restoration potential, were assigned the third highest score or moderate for (2 points). All other subwatersheds were assigned the lowest score (1 point).

The following point system summarizes PSI/ROI rating scores to the seven subwatersheds:

- High/High; $\geq$2 NSAs = 4 pts;
- High/High; 1 NSA = 3 pts;
- High/Moderate or Moderate/High; >5 NSAs = 2 pts;
- All other ratings = 1 pt.

The number of NSAs associated with various PSI/ROI ratings and corresponding PSI/ROI scores are summarized by subwatershed in Table 4-3.

Table 4-3: NSA PSI/ROI Scores

Subwatershed	# of NSAs by PSI/ROI Rating			
	High/ High	High/ Moderate	Moderate/ High	NSA PSI/ROI Score
Bean Run	0	3	0	1
Jennifer Branch	0	1	6	2
Lower Gunpowder Falls-A	2	0	1	4
Lower Gunpowder Falls-B	1	3	2	3
Lower Gunpowder Falls-C	0	3	0	1
Lower Gunpowder Falls-D	1	0	0	3
Minebank Run	2	1	1	4

4.2.4 Neighborhood Downspout Disconnection

Connected downspouts discharge rooftop runoff either directly to the storm drain system or to impervious surfaces. In either case, 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 and reduces pollutant loads to streams during storm events.

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 that would be 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 seven subwatersheds. Subwatersheds with the highest percentages of impervious rooftop acres and greatest acres of rooftop addressed through downspout disconnection denote the greatest restoration potential and therefore, received the highest scores. Rooftop areas addressed through downspout disconnection range from approximately 0% to 32%, by subwatershed.

The following point system was used to assign downspout disconnection scores to the seven subwatersheds based on the distribution and range of percentages of subwatershed rooftop area addressed:

- $\geq$ 20% and ≥ 15 acres = 4 pts;
- $\geq$ 35% and 5 - 15 acres = 3 pts;
- $\geq$ 10% = 2 pts;
- <10% = 1 pt.

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

Table 4-4: NSA Downspout Disconnection Scores

Subwatershed	Rooftop Acres Addressed	% of Total NSA Rooftop Acres Addressed	NSA Downspout Disconnection Score
Bean Run	17.1	32	4
Jennifer Branch	8.3	14	2
Lower Gunpowder Falls-A	14.1	31	3
Lower Gunpowder Falls-B	31.0	24	4
Lower Gunpowder Falls-C	7.0	23	3
Lower Gunpowder Falls-D	0.0	0	1
Minebank Run	2.9	5	1
Total	80.3	21	

4.2.5 Institutional Site Index

Institutions offer unique opportunities for watershed restoration. Typically, institutional properties encompass considerable portions of land that contain various natural resources. In addition, they offer the opportunity to engage a wide range of citizens in restoration activities. This raises community awareness while also providing water quality improvement benefits in the watershed. A total of 17 community-based facilities were surveyed during Institutional Site Investigations (ISIs) including faith-based facilities, public schools, and municipal facilities (e.g., swim clubs).

The focus of an ISI is to identify potential restoration opportunities, particularly those with opportunities both for community education and 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, prioritization for this criterion was based on the number of institutions and ownership (public versus private), according to the following point system:

- At least 2 public ISIs = 4 pts;
- 1 public ISI = 3 pts;
- Only private ISIs = 2 pts;
- No ISIs = 1 pt.

The total numbers of institutions, including ownership and corresponding institutional site index scores, are summarized by subwatershed in Table 4-5.

Table 4-5: ISI Scores

Subwatershed	# of Public ISIs	# of Private ISIs	Total # of ISIs	ISI Score
Bean Run	0	0	0	1
Jennifer Branch	6	0	6	4
Lower Gunpowder Falls-A	1	2	3	3
Lower Gunpowder Falls-B	3	1	4	4
Lower Gunpowder Falls-C	0	1	1	2
Lower Gunpowder Falls-D	0	0	0	1
Minebank Run	0	3	3	2
Total	10	7	17	

4.2.6 Pervious Area Reforestation

The most likely candidates for successful pervious area reforestation efforts are those on public lands with minimal site preparation required. Public sites are eligible for tree planting through DNR's "Tree-Mendous Maryland" program and are good opportunities for volunteer or community projects. Privately-owned lands are often planned for future development or expansion of an existing facility. In addition, larger open parcels have greater potential for reforestation and water quality benefits than smaller areas.

Subwatershed prioritization related to pervious area reforestation was based on the total acres of reforestation recommended during PAAs. Recommended acreage for reforestation all fell within three of the seven subwatersheds. Scoring for this criterion is as follows:

- $\geq$ 10 acres = 4 pts;
- 0 acres = 1 pts.

Pervious reforestation acreages and corresponding scores are summarized by subwatershed in Table 4-6.

Table 4-6: Pervious Area Reforestation Scores

Subwatershed	Acres Recommended for Reforestation	Pervious Area Reforestation Score
Bean Run	0.0	1
Jennifer Branch	11.9	4
Lower Gunpowder Falls-A	0.0	1
Lower Gunpowder Falls-B	12.0	4
Lower Gunpowder Falls-C	0.0	1
Lower Gunpowder Falls-D	0.0	1
Minebank Run	13.8	4
Total	37.7	

4.2.7 Stormwater Pond Conversions

Existing dry detention ponds within the Lower Gunpowder Falls (Urban) watershed 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, such as a dry extended detention facility, that provides water quality benefits in addition to quantity control. Dry extended detention ponds are designed to capture and retain stormwater runoff from a storm for a minimum duration, in order to allow sediment and pollutants to settle out while also providing flood control. Of the 45 dry ponds in the watershed, 4 were found to have potential for conversion to an extended detention facility with sand filters.

The following point system was used to assign stormwater conversion scores to the seven subwatersheds based on conversion potential of ponds within the subwatershed:

- ≥1 pond selected for conversion = 4 pts;
- No ponds selected for conversion = 1 pt;
- No ponds in subwatershed = 0 pts.

The number of dry ponds and their conversion potential, along with corresponding scores are summarized by subwatershed in Table 4-7.

Table 4-7: Stormwater Pond Conversion Scores

Subwatershed	# of Dry Ponds in Subwatershed	# of Dry Ponds Selected for Conversion	Stormwater Pond Conversion Score
Bean Run	0	0	0
Jennifer Branch	11	1	4
Lower Gunpowder Falls-A	8	0	1
Lower Gunpowder Falls-B	21	3	4
Lower Gunpowder Falls-C	0	0	0
Lower Gunpowder Falls-D	0	0	0
Minebank Run	5	0	1
Total	45	4	

4.2.8 Illicit Discharge Data

Baltimore County tracks illicit discharges through a program of routine outfall screening. Illicit discharges refer to any inputs to the storm sewer system that are not stormwater, or otherwise permitted (illicit discharges may also include leaky or incorrectly connected pipes). The County has an outfall prioritization system based on data from the outfall screening. Under this system, major outfalls are assigned one of the following priority ratings: none, low, high, or critical. Critical outfalls are those with major problems that require immediate correction and/or close monitoring, or outfalls with recurring problems. These are sampled the most frequently (four 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 (Appendix E).

There are 46 major outfalls in the Lower Gunpowder Falls (Urban) watershed. Subwatersheds with the most illicit discharge data and highest prioritization ratings represent the best areas to target for restoration initially. The following point system was used to rank illicit discharge connection data scores in the seven subwatersheds based on the number of major outfalls and their prioritization rankings:

- ≥2 outfalls ranked Critical = 4 pts;
- ≥1 outfalls ranked Critical = 3 pts;
- ≥1 outfalls ranked High = 2 pts;
- No ranked outfalls = 1 pt;
- No outfalls = 0 pts.

The number of major outfalls associated with various County outfall prioritization ratings and corresponding illicit discharge data scores are summarized by subwatershed in Table 4-8.

Table 4-8: Illicit Discharge Data Scores

Subwatershed	County Outfall Prioritization Rankings				Illicit Discharge Data Score
	Critical	High	Low	None	
Bean Run	0	0	0	0	0
Jennifer Branch	3	2	7	1	4
Lower Gunpowder Falls-A	1	7	2	1	3
Lower Gunpowder Falls-B	0	5	0	5	2
Lower Gunpowder Falls-C	0	1	0	0	2
Lower Gunpowder Falls-D	0	0	0	2	1
Minebank Run	3	6	0	0	4
Total	7	21	9	9	

4.2.9 Stream Buffer Improvements

Forested buffers along streams play a crucial role in improving water quality and flood mitigation. They can reduce surface runoff and pollutant loads, stabilize stream banks, trap sediment, and provide habitat for various types of terrestrial and aquatic life, including fish. Maintaining healthy streams and forest buffers is important for reducing nutrient and sediment loadings to the Gunpowder Falls and the Chesapeake Bay. When forested stream buffers are cleared and

developed, their beneficial functions are lost and stream health declines. Riparian buffer zones can be re-established or preserved as a BMP, reducing land use impacts by intercepting and controlling pollutants entering a water body.

In the Watershed Characterization Report, the vegetative condition of a 100-foot buffer zone on either side of the stream system was analyzed. Three conditions 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 conditions. Open pervious areas (e.g., mowed lawns) represent the greatest potential for stream buffer reforestation. 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 ranges from 17% to 29% of the buffer zone. The following point system was used to assign stream buffer improvement scores to the seven subwatersheds based on the distribution and range of open pervious buffer area percentages:

- >26% = 4 pts;
- 25-26% = 3 pts;
- 20-25% = 2 pts;
- <20% = 1 pt.

Percentages of open pervious stream buffer areas and corresponding scores are summarized by subwatershed in Table 4-9.

Table 4-9: Stream Buffer Improvement Scores

Subwatershed	% Open Pervious Stream Buffer Area	Stream Buffer Improvement Score
Bean Run	26	3
Jennifer Branch	17	1
Lower Gunpowder Falls-A	22	2
Lower Gunpowder Falls-B	26	3
Lower Gunpowder Falls-C	29	4
Lower Gunpowder Falls-D	26	3
Minebank Run	26	3

4.2.10 Stream Restoration Potential

In Section 3.6 of the Watershed Characterization Report (Appendix E), two past studies were reviewed: the Lower Gunpowder Falls Water Quality Management Study (WQMS) by Parsons Brinkerhoff (1999) and the Lower Gunpowder Falls Watershed Assessment (WA) by McCormick Taylor (2011). The purpose of this review was to identify previously recommended stream restoration projects that were the best opportunities for future restoration efforts. The stabilization of streambanks and other channel restoration measures can provide numerous benefits, including nutrient and sediment load reductions and improved habitat health for aquatic biota.

The length of stream restoration recommended ranged from 383 feet to over 4,000 feet. Extensive stream restoration projects have already been undertaken in Jennifer Branch and Minebank Run subwatersheds; there were also no opportunities identified in Lower Gunpowder Falls-D

subwatershed. The following point system was used to assign stream restoration potential scores to the seven subwatersheds based on the distribution and range of length of recommended stream restoration:

- ≥3,000 feet = 4 pts;
- 1,000 – 2,999 feet = 3 pts;
- 500 – 999 feet = 2 pts;
- ≤ 500 feet = 1 pt;
- No restoration recommended in subwatershed = 0 pts.

The lengths of streams exhibiting erosion or alterations, which may have potential for restoration, are summarized by subwatershed in Table 4-10 along with corresponding scores.

Table 4-10: Stream Restoration Potential Scores

Subwatershed	Linear Feet of Stream Restoration Recommended	Stream Restoration Potential Score
Bean Run	383	1
Jennifer Branch	0	0
Lower Gunpowder Falls-A	897	2
Lower Gunpowder Falls-B	4,705	4
Lower Gunpowder Falls-C	1,539	3
Lower Gunpowder Falls-D	0	0
Minebank Run	0	0
Total	7,524	

4.2.11 Subwatershed Prioritization Summary

The Lower Gunpowder Falls (Urban) watershed comprises seven subwatersheds that are ranked according to the total restoration prioritization score (i.e., the sum of prioritization criterion scores). Subwatershed restoration ranking results are summarized in Table 4-11 including individual criterion scores, total scores, and rankings by subwatershed.

Table 4-11: Subwatershed Ranking Results

Subwatershed	Nitrogen Load	Phosphorus Load	% Impervious Cover	NSA PSI/ROI	NSA Downspout Disconnection	ISI Site Index	Pervious Area Reforestation	Stormwater Conversion	Illicit Discharge Data	Stream Buffer Improvement	Stream Restoration Potential	TOTAL SCORE	SUBWATERSHED RANK
Bean Run	2	2	3	1	4	1	1	0	0	3	1	18	6
Jennifer Branch	3	2	3	2	2	4	4	4	4	1	0	29	2
Lower Gunpowder Falls-A	1	2	3	4	3	3	1	1	3	2	2	25	4
Lower Gunpowder Falls-B	4	2	3	3	4	4	4	4	2	3	4	37	1
Lower Gunpowder Falls-C	1	1	1	1	3	2	1	0	2	4	3	19	5
Lower Gunpowder Falls-D	3	4	1	3	1	1	1	0	1	3	0	18	6
Minebank Run	2	2	3	4	1	2	4	1	4	3	0	26	3

Subwatersheds were placed into one of four restoration priority categories based on ranking results: very high, high, medium, and low. These results are summarized in Table 4-12 and illustrated in Figure 4-2**.**

Subwatersheds with a total prioritization score greater than 30 received a priority rating of Very High (Lower Gunpowder Falls-B). A rating of High was assigned to the next logical grouping of subwatersheds, with total prioritization scores of 25-30 (Jennifer Branch, Lower Gunpowder Falls-A, and Minebank Run). None of the subwatersheds received a total score of 20-24, and so none the subwatersheds received a rating of Medium. Subwatersheds with total prioritization scores of less than 20 were assigned a priority rating of Low. Restoration actions will have to occur throughout the entire Lower Gunpowder Falls (Urban) watershed in order to meet environmental goals and requirements. However, subwatershed prioritization provides a tool/framework for focusing initial restoration efforts.

Table 4-12: Subwatershed Restoration Prioritization

Rank	Subwatershed	Total Score	Prioritization Category
1	Lower Gunpowder Falls-B	37	Very High
2	Jennifer Branch	29	High
3	Minebank Run	26	High
4	Lower Gunpowder Falls-A	25	High
5	Lower Gunpowder Falls-C	19	Low
6	Bean Run	18	Low
6	Lower Gunpowder Falls-D	18	Low

As noted in the goals for the SWAP laid out in Chapter 2, in addition to improving the quality of Lower Gunpowder Falls (Urban) and the impaired sections of the watershed it is also important

to protect those areas that are in good condition. Degradation of streams and subwatersheds that are in relatively good condition already will only make attaining the goals set for the Lower Gunpowder Falls (Urban) watershed that much harder. For this reason, the subwatersheds were also ranked in order of protection priorities (Table 4-13). Identifying these subwatersheds is simply a matter of reversing the subwatershed restoration prioritization. For example, a watershed with a lesser amount of impervious surface and fewer areas of inadequate stream buffer would receive fewer points, indicating less impairment and degradation. These subwatersheds would be ideal targets for protective measures such as pursuing conservation easements and enforcing stricter riparian buffer regulations.

Table 4-13: Subwatershed Protection Prioritization

Rank	Subwatershed	Total Score	Prioritization Category
1	Bean Run	18	Very High
1	Lower Gunpowder Falls-D	18	Very High
3	Lower Gunpowder Falls-C	19	Very High
4	Lower Gunpowder Falls-A	25	Medium
5	Minebank Run	26	Medium
6	Jennifer Branch	29	Medium
7	Lower Gunpowder Falls-B	37	Low

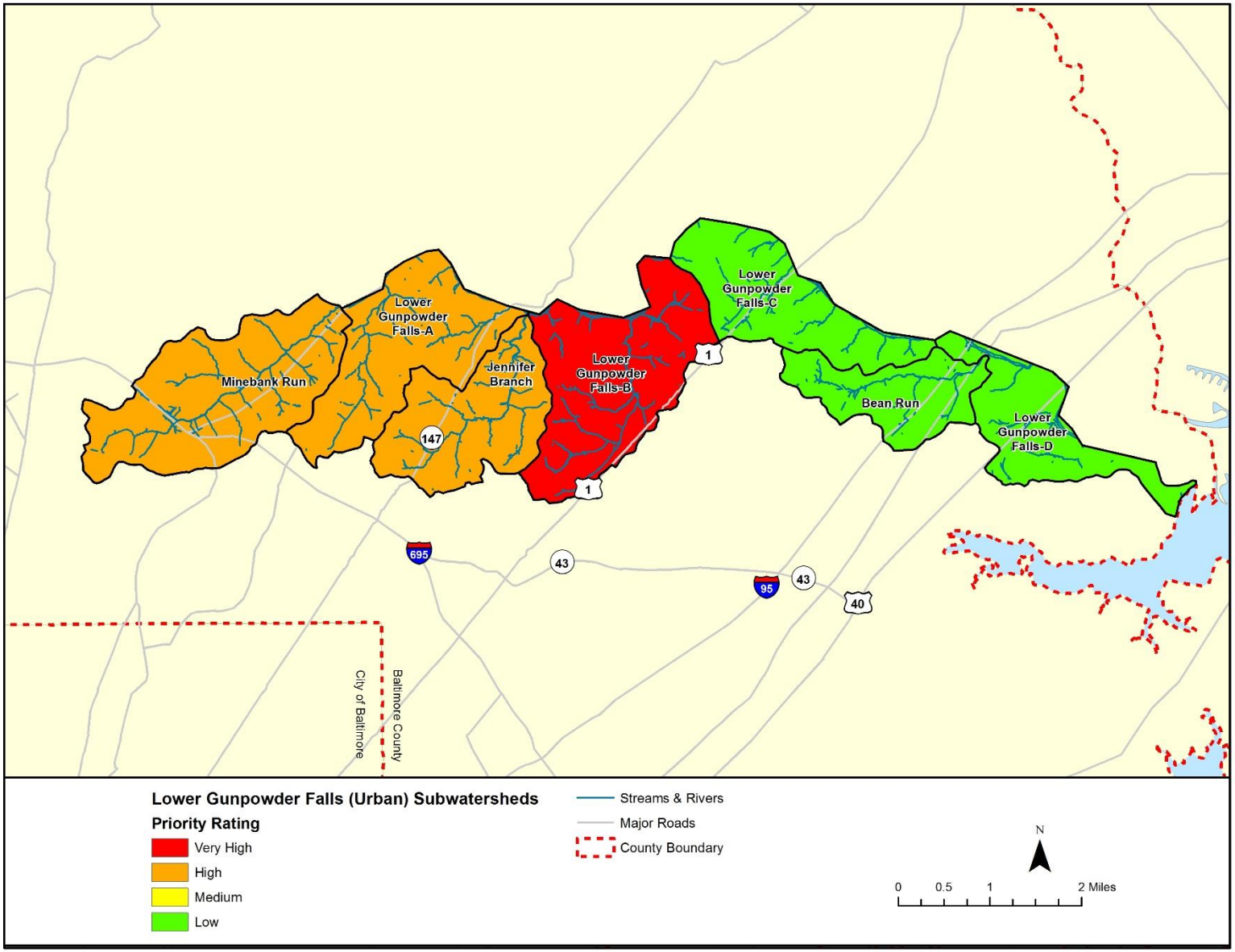


Figure 4-2: Lower Gunpowder Falls (Urban) Subwatershed Restoration Prioritization

4.3 SUBWATERSHED RESTORATION STRATEGIES

Restoration strategies for each subwatershed are presented in the following subsections. Subwatersheds are presented in order of their "Subwatershed Code," a number assigned to the watershed by Baltimore County. 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 stormwater management (SWM) facilities. Assessment results for neighborhoods, hotspots, institutions, pervious areas, potential stream restoration sites, illicit discharges, and stormwater conversions are also summarized for each subwatershed. Details on these assessment techniques can be found in Chapter 4 of the Watershed Characterization Report (Appendix E). Finally, a subwatershed management strategy including recommended citizen and municipal actions is presented at the end of each subsection.

Note that because there are numerous operations in the Lower Gunpowder Falls (Urban) watershed that might qualify as stormwater hotspots, not all could be individually evaluated during the uplands survey. Hotspot Site Investigations (HSIs) were focused on 23 sites identified through desktop GIS analysis and through crew leaders' best professional judgment. This sample assessment is intended to represent common types of hotspot operations located throughout the watershed and help develop an overall strategy to encompass all hotspot operations occurring in the watershed.

Likewise, there are a large number of institutions (i.e. community-based facilities) in the Lower Gunpowder Falls (Urban) watershed; however, only 17 of those were surveyed in order to determine which retrofit and restoration strategies are best-suited to the Lower Gunpowder Falls (Urban) SWAP area. In order to be as representative as possible, a range of institutions were surveyed, including faith-based facilities, public schools, and municipal facilities (e.g., swim clubs).

On a similar note, there are various open pervious areas throughout the watershed with reforestation potential. Seventeen pervious area assessments (PAAs) were conducted, all of which are large open parcels, and most with minimal site preparation required for reforestation. Fifteen of these PAAs were judged to represent the best available opportunities for reforestation, although there are likely many more opportunities throughout the watershed.

4.3.1 Minebank Run (Subwatershed Code 100)

Minebank Run is located northwest of Towson, is in the western portion of Lower Gunpowder Falls (Urban) watershed, and is the largest of the seven subwatersheds in the SWAP area. This subwatershed has the largest area of impervious surface, along with Lower Gunpowder Falls-B (>400 acres). Land use is primarily split up between low density residential, medium density residential, and forest. Table 4-14 summarizes key subwatershed characteristics of Minebank Run.

Table 4-14: Key Subwatershed Characteristics – Minebank Run

Drainage Area	2,136.0 acres (3.34 sq. mi.)	
Stream Length	12.7 miles	
Population	8,395 (2010 Census) 3.9 people/acre	
Land Use/Land Cover	Very Low Density Residential:	3.2%
	Low Density Residential:	18.9%
	Medium Density Residential:	21.2%
	High Density Residential:	4.1%
	Commercial:	6.9%
	Industrial:	3.4%
	Institutional:	6.2%
	Extractive:	0.0%
	Open Urban Land:	1.9%
	Agriculture:	11.3%
	Forest:	20.6%
	Barren Land:	0.0%
	Water/Wetlands:	0.0%
	Transportation:	2.3%
Impervious Cover	19% of subwatershed	
Soils	A Soils (low runoff potential):	2.5%
	B Soils:	70.8%
	C Soils:	12.5%
	D Soils (high runoff potential):	14.2%
SWM Facilities	38% of urban land use treated	
Restoration Priority Rating	High	

Neighborhoods

A total of 10 distinct neighborhoods were identified and assessed within Minebank Run during the uplands assessment of the Lower Gunpowder Falls (Urban) watershed. Recommendations for addressing stormwater volume and pollutants within this subwatershed include rain barrels, rain gardens, storm drain marking, Bayscaping, stream buffer improvements, and a parking lot retrofit. A summary of neighborhood recommended actions is presented in Table 4-15.

Table 4-15: NSA Recommendations – Minebank Run

Site ID	Lot Size (acres)*	RECOMMENDED ACTIONS												Notes
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Pet Waste	Trash Management	Buffer Improvement	Parking Lot/Alley Retrofit	Street Sweeping	# of Street Trees	# of Open Space Trees	
NSA_N_80	1/2	20	✓	✓	✓	✓						0	300	Tree planting area looks like private property - this area was also noted in NSA_N_78.
NSA_N_81		80	✓		✓					✓		0	400	Kathsway Ct. has positive drainage and access to inlets and greenspace. Inlets in grass could have pretreatment.
NSA_N_82	<1/4	10	✓		✓							0	0	
NSA_N_83	1/2	5	✓	✓	✓	✓						0	0	Roadway rubble/sediment./
NSA_N_84	<1/4	10	✓		✓							0	0	
NSA_N_85	1/2	5	✓	✓		✓			✓			0	0	Open lawn areas provide tree planting opportunities.
NSA_N_86	1/2	5	✓	✓		✓			✓			0	0	Lots mostly grass, providing good opportunity for tree planting. Mowing along buffer from Cowpens Ave. to Brook Meadow Dr.
NSA_N_87	1/2	10				✓				✓		0	0	Grass swales at entrance and at dead end road, by grazing field.
NSA_N_88	1/4	15	✓	✓	✓				✓			0	0	
NSA_N_89	1/4	15	✓									0	0	Grass swale between E. Joppa Rd. (uphill side) and stream (adjacent to Goucher Blvd.); could vegetate or install a new BMP.

*Lot sizes are only available for single family homes – blanks indicated apartments or condominiums.

All of the neighborhoods assessed within Minebank Run had opportunities for improvement. Storm drain marking, rain barrels, and Bayscaping were widely recommended. Storm drain marking is popular because this relatively easy and inexpensive action can have a great effect by reminding residents not to dump potentially dangerous materials into the storm drain. It can also be easily paired with other education efforts, for example, with education regarding the effects of pet waste on water quality, in neighborhoods where both were recommended. Rain barrels serve as temporary storage of roof runoff, decreasing the volume of stormwater running off site. Two excellent tree planting opportunities (300-400 trees) were found in two of the neighborhoods in the subwatershed (Figure 4-3). Projects on this scale may encourage widespread community engagement and are ideal opportunities for children and families to participate and become involved with their watershed in a concrete way. In addition, actions as simple as adjusting mowing practices and tree plantings along stream channels and drainage ditches may help to slow down high stream flows that cause bank erosion and intercept nutrients and toxins before they enter the aquatic ecosystem (Figure 4-4).

Figure 4-3: Opportunities for Open Space Trees in NSA_N_80 (left) and NSA_N_81 (right)

Figure 4-4: Stream Buffer Improvement Opportunity Where Excessive Mowing Occurs in NSA_N_86

Hotspots

There were seven facilities assessed in the Minebank Run subwatershed during the uplands assessment of the Lower Gunpowder Falls (Urban) watershed. Two of these were severe hotspots and two were confirmed as hotspots. Table 4-16 summarizes Minebank Run potential pollution sources from facilities visited. Crews noted certain conditions during the field investigations that they felt merited immediate notification of Baltimore County for further investigation and/or follow-up action. Table 4-9 in Section 4.3 of the Watershed Characterization Report (Appendix E) summarizes the field crew reports, as well as subsequent actions taken by the County.

Table 4-16: Hotspot Summary – Minebank Run

Site ID	HSI Status (# filled circles)	Description	POTENTIAL POLLUTION SOURCES						Notes
			Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf / Landscaping	Stormwater	
HSI_N_101	Confirmed (12)	Commercial - Strip mall		✓					Salt pile needs better containment so it does not spill past roof. Businesses throughout the area need to clean up dumpster areas and pick up windblown trash.
HSI_N_102	Severe (16)	Commercial - Shopping center	✓						Very filthy site. Storage, washing, and maintenance of school buses in back. Significant outdoor storage of chemicals and materials. Deicing material spilling out of trailer into back parking lot.
HSI_N_103	Confirmed (4)	Commercial - Seafood restaurant			✓				Improve waste oil storage.
HSI_N_128	Severe (17)	Commercial - Equipment rental							Several uncommon fueling tanks present. Lots of uncommon equipment stored outdoors. Whole site drains to one catch basin in back. Portable generator/construction lighting was leaking coolant. Make sure spill control plan is up to date.
HSI_N_129	Not a hotspot (4)	Commercial - Car rental							No active car washing seen, only car vacuuming and window cleaning. Site has a sand filter device in rear.
HSI_N_131	Potential (7)	Commercial - Restaurant							Stains leading from dumpster to storm drain, but otherwise clean. Excessive impervious surface behind adjacent facility, but might be planned for new, mixed-use development.
HSI_N_132	Potential (7)	Commercial - Diner							Stain from dumpster area to catch basin in front. Spoke with cook, seemed aware of proper practices for handling grease and other waste.

The first severe hotspot was a shopping center, with a variety of businesses (HSI_N_102). There were many issues, including uncovered salt and de-icing chemicals (Figure 4-5), vehicle washing and maintenance with no washwater containment, and cleaning material sitting out with no cover or secondary containment. The other severe hotspot (HSI_N_128) was an equipment rental facility. There was coolant leaking from a piece of equipment, as well as outdoor fueling operations (Figure 4-6). The first confirmed hotspot site was strip mall with a wide variety of businesses (HSI_N_101), where trash was strewn across the site and salt was spilling beyond the roof that covered it. The other second confirmed hotspot was a seafood restaurant

(HSI_N_102). Overall, the site was reasonably well-maintained, however there were issues noted with their waste oil containment (Figure 4-7).

Figure 4-5: Trailer with De-icing Material Spilling Out

Figure 4-6: Uncovered Fueling Station

Figure 4-7: Grease Dumpster with the Lid Left Open

Institutions

In the Minebank Run subwatershed, field staff performed ISIs at two public schools and one privately-owned church. A summary of restoration opportunities that were identified at the sites is presented in Table 4-17.

Table 4-17: ISI Recommendations – Minebank Run

Site ID	Name	Public/ Private	RECOMMENDED ACTIONS							Notes
			Storm Drain Marking	# Trees for Planting	Downspout Disconnection	Stormwater Retrofit	Impervious Cover Removal	Buffer Improvement	Trash Management	
ISI_N_101	Cromwell Valley Elementary School	Public		N/A		✓	✓		✓	Impervious asphalt apron around building; bare soil area at southeast corner of building.
ISI_N_104	Loch Raven High School	Public	✓	N/A		✓		✓	✓	
ISI_N_105	Maryland Presbyterian Church	Private		3		✓				Upper lot has curb cut to armored channel; proactive approach to environmental stewardship.
N/A = Not Applicable. Tree planting at public schools is being coordinated under a separate effort.										

As was noted at several public schools in the Lower Gunpowder watershed, investigators identified excess impervious cover, in the form of an asphalt or concrete apron, around approximately half of the Cromwell Valley Elementary School (ISI_N_101) building (Figure 4-8). The removal of excess impervious cover will promote greater infiltration of rainfall and reduce runoff to the storm sewer system. A demonstration of the linking of impervious surfaces with local streams through the storm drain system can be provided through a storm drain stenciling activity at Loch Raven High School (ISI_N_104; Figure 4-8).

Figure 4-8: Impervious Surface Removal Opportunity at ISI_N_101 (left) and Storm Drain Stenciling Opportunity at ISI-N_104 (right)

Other educational opportunities in watershed stewardship include installing stormwater retrofits at both Cromwell Valley Elementary School and Loch Raven High School. Both schools' grounds provide ample space to treat parking areas and reduce impact to local streams. At Loch Raven High School, upgrades to stormwater treatment are already underway, but additional retrofits can be situated prominently near student parking to illustrate measures to reduce runoff pollution and quantity to one of two first order streams that cross the school property (Figure 4-9).

Figure 4-9: Bioretention Opportunities at the Edge of Tennis Court at ISI_N_101 (left) and near Student Parking at ISI_N_104 (right)

Additionally, the buffer along both first order streams can be improved and thereby provide additional treatment as well as a reduction in lawn care expenses near the stream (Figure 4-10). Furthermore, water quality improvements will be realized by conversion of one of the stream beds from a concrete to a natural channel, which students may witness first-hand (Figure 4-10).

Figure 4-10: Stream Buffer Improvement Opportunities at ISI_N_104

Investigators identified waste management concerns at both schools: at least one dumpster at each facility was found to be open. At Cromwell Valley Elementary School, an open dumpster was found adjacent to a storm drain inlet, which is a readily available conduit for transporting dumpster leachate to the storm drain system (Figure 4-11). At Loch Raven High School, investigators noted an open dumpster with legacy staining, which may indicate a chronic problem with migration of leached material out of the dumpster and onto impervious surfaces. For both conditions, management methods can be improved through implementation of training programs and updating of standard procedures for handling and properly storing waste so as to reduce the likelihood of pollutants entering the storm drain system. Relocating dumpsters away from impervious surfaces and storm drain inlets will further lessen the chances for pollutant transport.

Figure 4-11: Waste Management Improvement Opportunities at ISI_N_101 (left) and ISI_N_104 (right)

At Maryland Presbyterian Church (ISI_N_105), investigators noted that the congregation had implemented several watershed-friendly practices, such as the use of rain barrels, composting, and location of exterior activity areas on mulched surfaces rather than on additional impervious areas. Investigators identified modest tree planting opportunities (since most of the lot was already well-planted) and stormwater treatment retrofits for parking areas (Figure 4-12). The additional trees will enhance the existing, extensive canopy and provide additional stormwater infiltration, interception, and treatment. The installation of bioretention near parking areas will provide further concrete evidence of the congregation's commitment to reducing their impervious footprint within the watershed.

Figure 4-12: Bioretention (left) and Tree Planting (right) Opportunities at ISI_N_105

Pervious Areas

Pervious area restoration has the potential to convert areas of turf, often with high nutrient inputs, to forest, which can instead absorb and filter nutrients. Two pervious areas were assessed for restoration potential in Minebank Run. These sites included a portion of Cromwell Valley Park and Airway Circle Apartments Open Space. The Cromwell Valley Park site is located immediately north of Cromwell Bridge Road, and is maintained by Baltimore County. It is a fairly large park, and is currently covered by a diverse mixture of semi-fallow fields, planted woodlands (primarily conifers), riparian deciduous woodlands, and turf. Reforestation at the site would require verification that it would not interfere with the current use of the site and tree planting could be a potential community project. The Airway Circle Apt. Open Space site is located off of Airway Circle and Treeway Court, adjacent to I-695, and is owned and maintained by Baltimore County. It was deemed a generally poor site for tree planting because of the steep slopes, as well as the proximity of existing buildings, roads, and other development features.

A summary is provided in Table 4-18.

Table 4-18: PAA Summaries – Minebank Run

Site ID	Location	Description	Acres	Ownership
PAA_N_101	Cromwell Valley Park	Park	Parcel - 49.89 Recommended planting - 13.79	Public
PAA_N_103	Airway Circle Apartments Open Space	HOA Open Space	Parcel - 16.01 Recommended planting - 0.00	Private

Stream Restoration Recommendations

There were no stream restoration projects recommended for Minebank Run. However, approximately 20,500 linear feet of stream have been restored in this subwatershed since 1996.

Illicit Discharges

Minebank Run subwatershed contains nine major outfalls, three of which rated priority 1, and the other six of which are rated priority 2. Priority 1 outfalls have major problems that require immediate correction and/or close monitoring, or outfalls with recurring problems. These outfalls are sampled four times each year. Priority 2 outfalls have minor to moderate problems that have the potential to become severe and are sampled once a year. These outfalls are sampled on a 10-year cycle. Baltimore County will continue its Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

Stormwater Pond Conversions

Minebank Run subwatershed contains five stormwater management dry ponds. Baltimore County EPS did not select any of these dry ponds as a priority for conversion.

Subwatershed Management Strategy

Figure 4-13 provides a visual summary of restoration opportunities in the subwatershed.

<u>Engaging Citizens & Watershed Groups</u>

1. Conduct appropriate downspout rain barrel installation measures in neighborhoods according to Table 4-15.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-15.
3. Raise awareness among citizens about the benefits and importance of Bayscaping for the recommended neighborhoods in Table 4-15.
4. Raise awareness among property owners about improving stream buffer management at locations indicated in Table 4-15.
5. Encourage communities to plant open space trees. Table 4-15 shows potential neighborhoods for planting as many as 700 open space trees.
6. Raise awareness among staff and members of institutional sites about the importance of proper trash management and outdoor material storage techniques at sites listed in Table 4-17.

7. Engage institutional sites listed in Table 4-17 in other recommended restoration actions including improved stream buffer management and tree planting.
8. Work with Cromwell Valley Park to explore tree planting opportunities in the park, as described in Table 4-18.

Municipal Actions

1. Follow-up regarding conditions at the severe and confirmed hotspots and continue to monitor conditions at potential hotspots indicated in Table 4-16.
2. Work with the institution owners to pursue retrofit and impervious cover removal opportunities at public institutions noted in Table 4-17.
3. Continue to monitor illicit discharges.
4. Address issues at outfalls with major problems. Conduct follow-up investigations at those outfalls with problems that have the potential to become severe as described above and in the Watershed Characterization Report.
5. Investigate feasibility of retrofits for NSA_N_81 and NSA_N_87 noted in Table 4-15

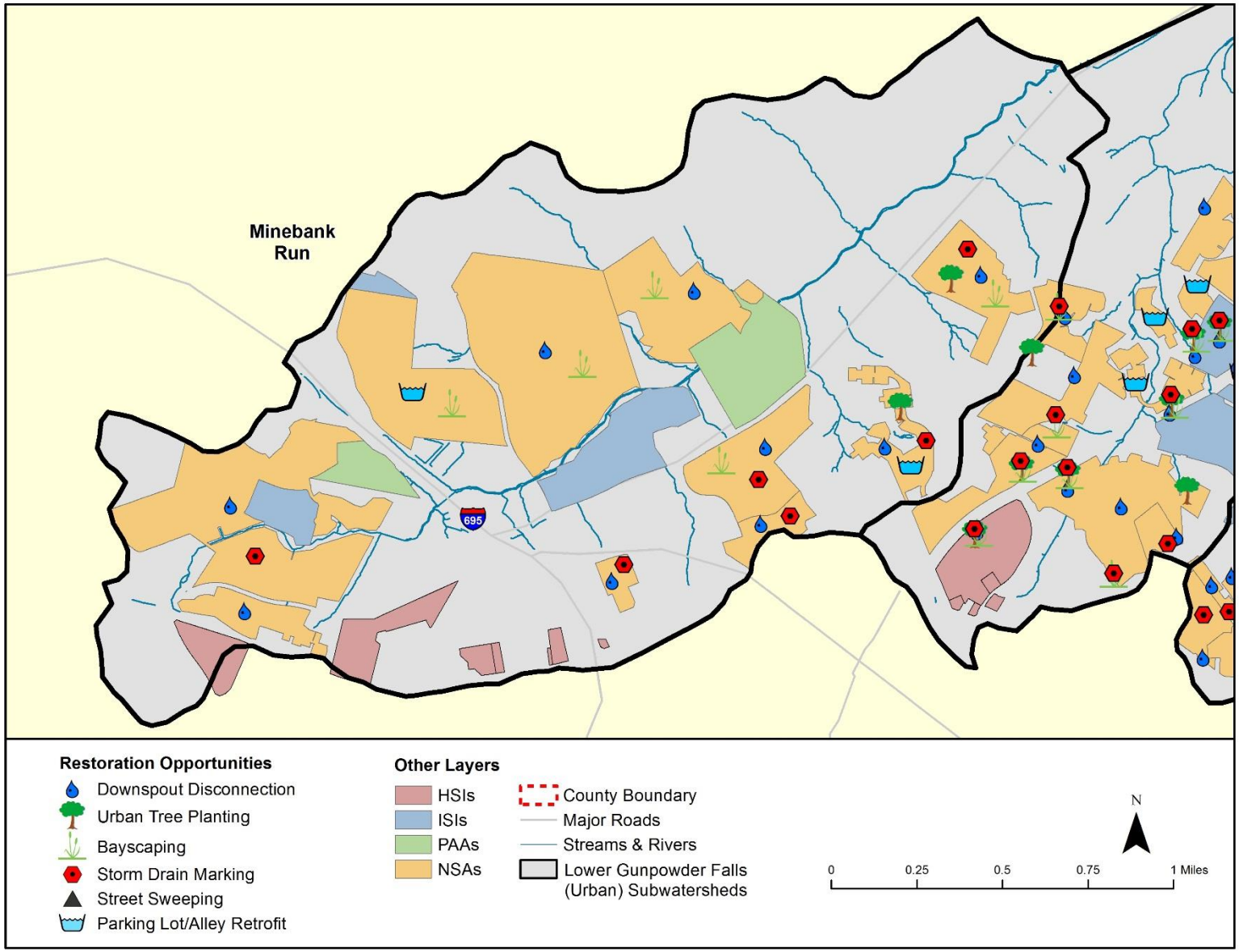


Figure 4-13: Restoration Opportunities in Minebank Run

4.3.2 Lower Gunpowder Falls-A (Subwatershed Code 200)

Lower Gunpowder Falls-A is the third largest subwatershed in the Lower Gunpowder Falls (Urban) watershed, and is located in the western portion of the watershed. It encompasses the western half of Carney and a section of Gunpowder Falls State Park runs along its northern border. Land use in this subwatershed is primarily urban, though it also has the highest percentage of agricultural land (two-thirds of which is pasture) of any of the subwatersheds. Table 4-19 summarizes key subwatershed characteristics of Lower Gunpowder Falls-A.

Table 4-19: Key Subwatershed Characteristics – Lower Gunpowder Falls-A

Drainage Area	1,636.5 acres (2.56 sq. mi.)	
Stream Length	10.4 miles	
Population	4,143 (2010 Census) 2.5 people/acre	
Land Use/Land Cover	Very Low Density Residential:	2.3%
	Low Density Residential:	6.5%
	Medium Density Residential:	22.9%
	High Density Residential:	12.6%
	Commercial:	5.9%
	Industrial:	0.0%
	Institutional:	9.1%
	Extractive:	0.0%
	Open Urban Land:	0.8%
	Agriculture:	12.1%
	Forest:	27.8%
	Barren Land:	0.0%
	Water/Wetlands:	0.0%
	Transportation:	0.0%
Impervious Cover	17% of subwatershed	
Soils	A Soils (low runoff potential):	0.0%
	B Soils:	75.5%
	C Soils:	15.9%
	D Soils (high runoff potential):	8.6%
SWM Facilities	23% of urban land use treated	
Restoration Priority Rating	High	

Neighborhoods

A total of 11 distinct neighborhoods were identified and assessed within Lower Gunpowder Falls-A during the uplands assessment of the Lower Gunpowder Falls (Urban) watershed. Recommendations for addressing stormwater volume and pollutants within this subwatershed include rain barrels, rain gardens, storm drain marking, education regarding cleaning up pet waste, Bayscaping, and stream buffer improvements. A summary of neighborhood recommended actions is presented in Table 4-20.

Table 4-20: NSA Recommendations – Lower Gunpowder Falls-A

Site ID	Lot Size (acres)*	RECOMMENDED ACTIONS											Notes
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Pet Waste	Trash Management	Buffer Improvement	Parking Lot/Alley Retrofit	Street Sweeping	# of Street Trees	# of Open Space Trees	
NSA_N_59	1/2	10	✓	✓	✓	✓						0	0	
NSA_N_70	1/8	20	✓		✓							0	0	
NSA_N_71	1/4	15	✓		✓	✓			✓			0	50	Some curbs and gutters are new but others are in disrepair and are a source of sediment.
NSA_N_72		90	✓	✓	✓	✓						7	200	Crews were replacing underground pipes from downspout to curb.
NSA_N_73	1/2	10	✓	✓	✓	✓			✓			0	80	Several storm drains had sediment in and around them - likely from the edge of road that was actively degrading.
NSA_N_74		85	✓		✓	✓				✓		0	150	Pavement removal at end of Perring Rd. Open areas provide opportunities for tree planting or rain gardens.
NSA_N_75	1/4	5	✓		✓	✓						0	0	
NSA_N_76	1/4	5	✓		✓	✓						0	0	
NSA_N_77		90	✓		✓	✓						0	100	Open areas, may be able to plant trees.
NSA_N_78	1/4	5	✓		✓	✓						0	300	Large open space across Satyr Hill Rd. - may be private.
NSA_N_79		5	✓		✓	✓						0	100	

*Lot sizes are only available for single family homes – blanks indicated apartments or condominiums.

Each of the neighborhoods assessed within Lower Gunpowder Falls-A had at least some opportunities for improvement. Storm drain marking, rain barrels, and Bayscaping were widely recommended. Storm drain marking is popular because this relatively easy and inexpensive action can have a great effect by reminding residents not to dump potentially dangerous materials into the storm drain. It can also be easily paired with other education efforts, for example, with education regarding the effects of pet waste on water quality or the benefits of Bayscaping and using native plants for landscaping. Rain barrels serve as temporary storage of roof runoff, decreasing the volume of stormwater running off site. Tree planting opportunities were also spread throughout the subwatershed with five neighborhoods recommended for the planting of at least 100 trees each (Figure 4-14). Projects on this scale may encourage widespread community engagement and are ideal opportunities for children and families to participate and become involved with their watershed in a concrete way. In addition, actions as simple as adjusting

mowing practices and tree plantings along stream channels and drainage ditches may help to slow down high stream flows that cause bank erosion and intercept nutrients and toxins before they enter the aquatic ecosystem. Other conditions in the neighborhood, such as a riparian stream buffer where there is open space for tree planting, provide excellent opportunities for education and engaging the community directly with their watershed (Figure 4-15).

Figure 4-14: Opportunities for Open Space Trees in NSA_N_72 (left) and NSA_N_78 (right)

Figure 4-15: Stream Buffer with Opportunity for Planting Additional Trees in NSA_N_73

Hotspots

There were a total of five facilities assessed in the Lower Gunpowder Falls-A subwatershed during the uplands assessment of the Lower Gunpowder Falls (Urban) watershed. No confirmed hotspots were found to be confirmed hotspots, though four of the five were found to be potential hotspots.

Table **4-21** summarizes the potential pollution sources from facilities visited. Additional details about the hotspots visited are available in Section 4.3 of the Watershed Characterization Report (Appendix E).

Table 4-21: Hotspot Summary – Lower Gunpowder Falls-A

Site ID	HSI Status (# filled circles)	Description	POTENTIAL POLLUTION SOURCES						Notes
			Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf / Landscaping	Stormwater	
HSI_N_223	Potential (9)	Commercial - Large shopping center							Grease dumpsters close to inlets.
HSI_N_224	Not a hotspot (4)	Commercial - Fast food restaurant							Open dumpster with signs of leakage. Parking lot needs to be repaired.
HSI_N_225	Potential (6)	Commercial - Fast food restaurant							Clean site. 55-gallon grease drums under roof. Dumpster has some leakage but is not directly connected to storm drain system.
HSI_N_226	Potential (6)	Commercial - Italian restaurant							Some grease making its way into storm drain. Back parking lot needs to be repaved.
HSI_N_233	Potential (8)	Commercial - Restaurant							Very poor practices, documented by heavy 100-foot long grease stain from grease dumpster into catch basin. Mop buckets obviously being dumped outside of back doors, as evidenced by stains. Back of facility has significant garbage caught in shrubs and brush.

While none of the locations visited required immediate response by the County, many of them exhibited poor practices that would benefit from follow up, outreach and increased education regarding waste management practices and facility hygiene. In one instance, a restaurant has a grease dumpster close to a storm drain inlet (HSI_N_223), where any leakage from that dumpster would enter directly into the storm drain system (Figure 4-16). At another location (HSI_N_233), stains on the pavement indicated that washwater was being dumped out the back door of the facility, from where it would run across a parking lot and into the storm drain system (Figure 4-17). Another facility (HSI_N_226) had trash and debris behind the building and along the edges of the property and would benefit from a general cleanup effort (Figure 4-18).

Figure 4-16: Grease Dumpster near Storm Drain Inlet

Figure 4-17: Washwater Being Dumped out the Door of Facility

Figure 4-18: Trash and Debris Collecting Behind Building

Institutions

Ample restoration opportunities present themselves at institutions investigated in Lower Gunpowder Falls-A subwatershed. Three institutions were assessed in the subwatershed, consisting of two public schools and one private swim club. A summary of the sites visited and their restoration opportunities is presented in Table 4-22.

.

Table 4-22: ISI Recommendations – Lower Gunpowder Falls-A

Site ID	Name	Public/ Private	RECOMMENDED ACTIONS							Notes
			Storm Drain Marking	# Trees for Planting	Downspout Disconnection	Stormwater Retrofit	Impervious Cover Removal	Buffer Improvement	Trash Management	
ISI_N_207	Pine Ridge Swim Club	Private	✓	0		✓				
ISI_N_208	Pine Grove Middle School	Public	✓	N/A		✓	✓	✓		Excess sidewalks and a few paved areas next to sidewalks. Faded storm drain marking. Frisbee golf course on first order stream. Outfall perched.
ISI_N_209	Pine Grove Elementary School	Public	✓	N/A		✓	✓	✓	✓	Impervious apron around school. Ephemeral channel to be restored.
N/A = Not Applicable. Tree planting at public schools is being coordinated under a separate effort.										

Limited restoration opportunities were identified at Pine Ridge Swim Club due to the facility's closure during the off-season. Inspectors could not access the property, but evaluated the site instead from outside of the perimeter fence. Inspectors tentatively identified an end-of-pipe bioretention opportunity (Figure 4-19), which would treat several upland areas of the swim club property, including a portion of the access road.

Figure 4-19: Stormwater Retrofit Opportunity at ISI_N_207 (between sign and antenna)

Investigators noted several worthwhile restoration opportunities at both Pine Grove Middle School (ISI_N_208) and Pine Grove Elementary School (ISI_N_209), chiefly stream restoration and buffer enhancement. Such channel improvement measures will increase stormwater filtration prior to reaching surface streams, reduce heating of the runoff, reduce the energy and consequential erosive power of the runoff, and overall cumulatively improve downstream water quality. Of all of the institutions investigated in Lower Gunpowder Watershed, as a whole, the most urgent stream impact issue was identified at Pine Grove Middle School. At the southwest portion of the school property, a first order stream was found in a wooded area. Trees are plentiful in the buffer zone, but natural growth of grass, shrubs, seedlings, and other small plants that are vital for a healthy stream buffer system are missing because of mowing (in some cases adjacent to the channel) to accommodate a Frisbee golf course along the entire channel and along the receiving channel (Figure 4-20). Additionally, portions of the stream are channelized in concrete, but the concrete has eroded in places, which has allowed erosion and transport of excess sediment to a downstream yard inlet. The yard inlet is completely blocked by sediment deposition and consequently stream flow during heavy rain is bypassing the inlet and is eroding a new overland channel toward the receiving stream (Figure 4-21). A channel restoration is recommended for the first order stream, including removing concrete (which will reduce erosive energy and water temperature), relocating the Frisbee golf course, removing the storm drain infrastructure, and allowing the buffer to grow naturally. Maintenance staff should also consider reducing compaction of turf up-gradient of the stream through restricted use of grassy areas for parking and allowing a natural meadow to develop to help slow down storm runoff. Portions of the restoration monitoring can be taken on by students to assess the effectiveness of the restoration

over time as a comprehensive real-world learning experience. The buffer adjacent to the receiving stream should also be allowed to thrive naturally without the presence of the golf course. Buffer enhancement will also improve the local habitat.

Figure 4-20: Buffer Enhancement (left) and Stream Daylighting (right) Opportunities at ISI_N_208

Figure 4-21: Channel Restoration (left) and Outfall Stabilization (right) Opportunities at ISI_N_208

At Pine Grove Elementary School, investigators identified a restoration opportunity at an ephemeral channel at the southwest portion of the school grounds. Presently, the channel is lined in concrete, which is breaking up at a nick point that is migrating upstream (Figure 4-22). Restoration of this channel, and improvement of the adjacent buffer, will reduce the effects of erosion in the channel and the transport of pollution carried by stormwater runoff. Tree planting has been implemented on the northeast side of the channel, but additional plantings and growth would create a more effective buffer.

Storm drain marking, as an environmental education activity, was identified at both schools. At Pine Grove Middle School, storm drain stenciling already exists, however the markings are faded (Figure 4-22).

Figure 4-22: Ephemeral Channel Restoration Opportunity at ISI_N_209 (left) and Storm Drain Stenciling Opportunity at ISI_N_208 (right)

Investigators identified excess impervious cover at both schools. At Pine Grove Middle School, sidewalks were found well in excess of what is probably required along the western edge of the building (Figure 4-23). At Pine Grove Elementary School, several areas of excess impervious cover were found around the periphery of the school as well as adjacent to a parking lot (Figure 4-23). Removal of these impervious cover areas will increase infiltration of rainfall, improve stormwater runoff management, and enhance root growth of nearby trees.

Figure 4-23: Impervious Cover Removal Opportunities at ISI_N_208 (left) and ISI_N_209 (right)

Both schools provide several opportunities for installing stormwater treatment retrofits. At Pine Grove Middle School, for example, runoff from the entire northeast faculty parking lot, which is aged and breaking up, can be treated by installing a subterranean sand filter and storage chambers underneath it Figure 4-24). Such a facility will reduce pollutant concentrations, such as metals, in stormwater runoff and also reduce peak flows and possible impact to the receiving stream channel. At Pine Grove Elementary School, the entire northern bus loop and faculty parking area can be treated by strategic placement of bioretention areas in available green space. These example stormwater treatment measures will reduce pollutant concentrations leaving the school properties as well as provide, for students, valuable insight into effective stormwater runoff treatment technologies that are available.

Figure 4-24: Stormwater Retrofit Opportunities at ISI_N_208 (left) and ISI_N_209 (right)

Pervious Areas

Pervious area restoration has the potential to convert areas of turf, often with high nutrient inputs, to forest, which can absorb and filter rather than contribute nutrients. One pervious area was assessed for restoration potential in Lower Gunpowder Falls-A. The Gunpowder Falls State Park site is located near the eastern terminus of Old Harford Road, adjacent to the Hickey School. This parcel of the State Park was previously managed by mowing, but has been left fallow for 10 to 15 years; there is no turf cover here. The site presents a very good opportunity for natural regeneration (no tree planting is necessary), in conjunction with a program of an aggressive program of invasive plant species management. Reforestation of this site, however, would require verification that it would not interfere with its current uses and future planning.

A summary of information for this site is provided in Table 4-23.

Table 4-23: PAA Summaries – Lower Gunpowder Falls-A

Site ID	Location	Description	Acres	Ownership
PAA_N_210	Gunpowder State Park	Park	Parcel - 125.96 Recommended planting - 0.00	Public

Stream Restoration Recommendations

In Section 3.6 of the Watershed Characterization Report (Appendix E), two past studies were reviewed: the Lower Gunpowder Falls Water Quality Management Study (WQMS) by Parsons Brinkerhoff (1999) and the Lower Gunpowder Falls Watershed Assessment (WA) by McCormick Taylor (2011). The purpose of this review was to identify previously recommended stream restoration projects that were the best opportunities for future restoration efforts. 897 linear feet of stream in Lower Gunpowder Falls-A were recommended for restoration.

Illicit Discharges

Lower Gunpowder Falls-A subwatershed contains 11 major outfalls, one of which is rated priority 0, one of which are rated priority 1, seven of which are rated priority 2, and the other two of which

are rated priority 3. Priority 0 outfalls are outfalls with insufficient data to determine a priority rating. This may be due to inaccessibility or if there has been only a single screening. Priority 1 outfalls have major problems that require immediate correction and/or close monitoring, or outfalls with recurring problems. These outfalls are sampled four times each year. Priority 2 outfalls have minor to moderate problems that have the potential to become severe and are sampled once a year. Priority 3 outfalls with minor or no problems that do not require close monitoring. These outfalls are sampled on a 10-year cycle. Baltimore County will continue its Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

Stormwater Conversions

Lower Gunpowder Falls-A subwatershed contains eight stormwater management dry ponds. Baltimore County EPS did not select any of these dry ponds as a priority for conversion.

Subwatershed Management Strategy

Figure 4-25 provides a visual summary of restoration opportunities in the subwatershed.

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout rain barrel installation measures in neighborhoods according to Table 4-20.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-20.
3. Raise awareness among citizens about the benefits and importance of Bayscaping for the recommended neighborhoods in Table 4-20.
4. Raise awareness among property owners about improving stream buffer management at locations indicated in Table 4-20.
5. Encourage communities to plant open space trees. Table 4-20 shows potential neighborhoods for planting as many as 980 open space trees.
6. Raise awareness among staff and members of institutional sites about the importance of proper trash management and outdoor material storage techniques at sites listed in Table 4-22.
7. Engage institutional sites listed in Table 4-22 in other recommended restoration actions including storm drain marking, and stream buffer improvement.
8. Investigate the pervious area described in Table 4-23 and consider a plan for allowing natural forest regeneration at site.

Municipal Actions

1.
2. Table 4-21. Engage with property owners and provide education on waste management and proper facility hygiene practices.
3. Work with the institution owners to pursue retrofit and impervious cover removal opportunities at public institutions noted in Table 4-22.
4. Continue to monitor illicit discharges.

5. Address issues at outfalls with major problems. Conduct follow-up investigations of outfalls with insufficient data for priority rating and those with minor to moderate problems that have the potential to become severe as described above and in the Watershed Characterization Report.
6. Consider stream restoration options for the 897 feet of stream identified in this study.

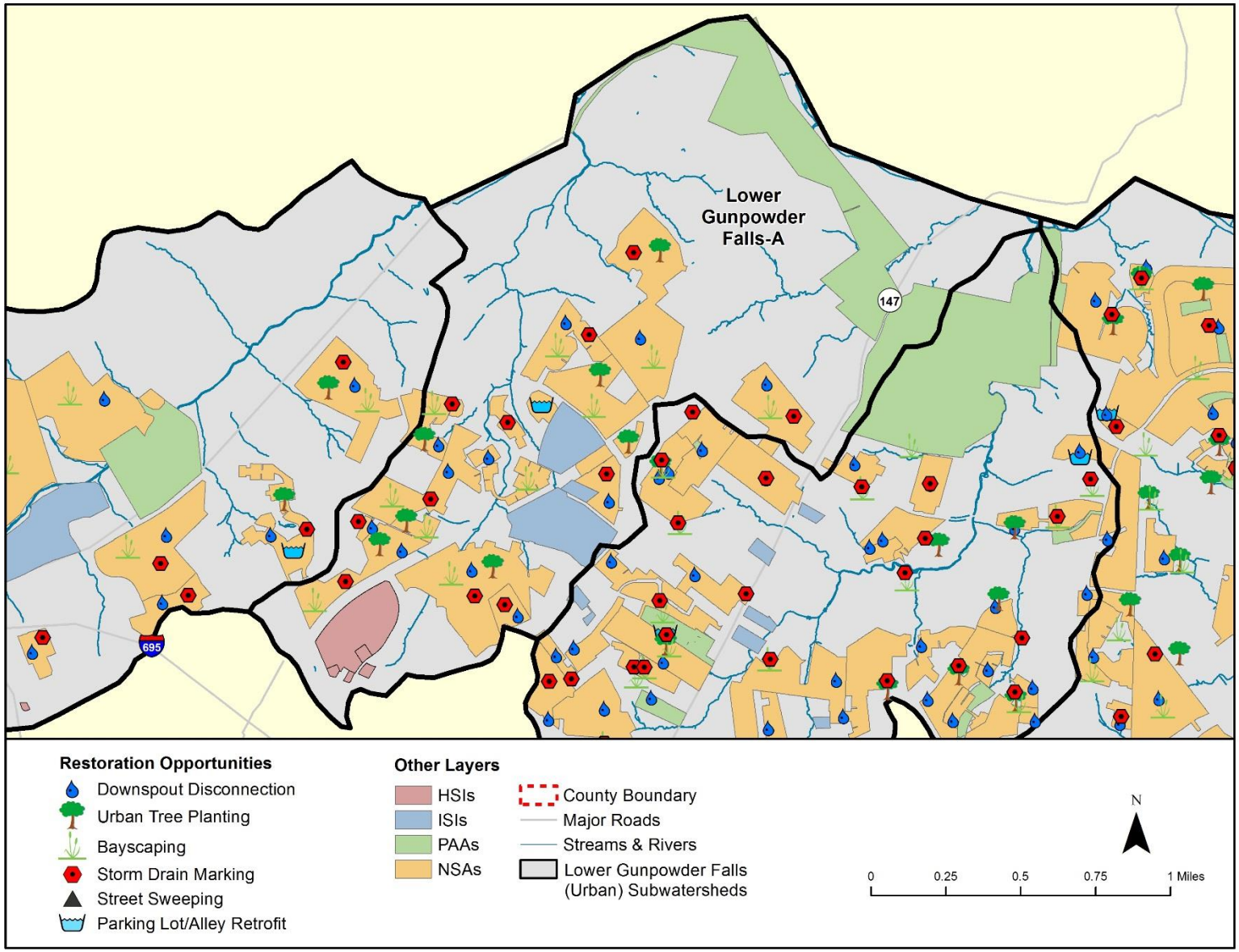


Figure 4-25: Restoration Opportunities in Lower Gunpowder Falls-A

4-40

4.3.3 Jennifer Branch (Subwatershed Code 300)

Jennifer Branch is the fourth largest subwatershed in Lower Gunpowder Falls (Urban) watershed, and is in the central portion of the watershed. It encompasses the eastern half of Carney and portions of Gunpowder Falls State Park lie within its northern border. Land use within the subwatershed is primarily urban; Jennifer Branch has the highest percentage of medium density residential land use (54%) of any of the subwatersheds; while it does not have the largest population, it does have the highest population density (5.6 people per acre). Table 4-24 summarizes key subwatershed characteristics of Jennifer Branch.

Table 4-24: Key Subwatershed Characteristics – Jennifer Branch

Drainage Area	1,412.4 acres (2.21 sq. mi.)	
Stream Length	9.7 miles	
Population	7,846 (2010 Census) 5.6 people/acre	
Land Use/Land Cover	Very Low Density Residential:	1.6%
	Low Density Residential:	4.5%
	Medium Density Residential:	54.2%
	High Density Residential:	9.8%
	Commercial:	2.7%
	Industrial:	1.6%
	Institutional:	2.3%
	Extractive:	0.0%
	Open Urban Land:	1.7%
	Agriculture:	1.9%
	Forest:	19.3%
	Barren Land:	0.0%
	Water/Wetlands:	0.0%
	Transportation:	0.4%
Impervious Cover	18% of subwatershed	
Soils	A Soils (low runoff potential):	4.1%
	B Soils:	71.5%
	C Soils:	22.1%
	D Soils (high runoff potential):	2.3%
SWM Facilities	23% of urban land use treated	
Restoration Priority Rating	High	

Neighborhoods

A total of 20 distinct neighborhoods were identified and assessed within Jennifer Branch during the uplands assessment of the Lower Gunpowder Falls (Urban) watershed. Recommendations for neighborhoods in this subwatershed included actions to reduce stormwater volume and pollutants including downspout disconnection, use of rain barrels, installation of rain gardens, Bayscaping, storm drain marking, stream buffer improvements, a parking lot retrofit, pet waste management, and tree planting. A summary of neighborhood recommended actions is presented in the Table 4-25.

Table 4-25: NSA Recommendations – Jennifer Branch

Site ID	Lot Size (acres)*	RECOMMENDED ACTIONS												Notes
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Pet Waste	Trash Management	Buffer Improvement	Parking Lot/Alley Retrofit	Street Sweeping	# of Street Trees	# of Open Space Trees	
NSA_N_39	1/4	7	✓	✓	✓	✓	✓			✓		0	0	Inlet infrastructure is older; some inlets are degrading. Lots of grass, large front yards (rain gardens possible in front or back yards in many cases). Inlet at end of Fondluc Rd. could have some pavement removed and BMP installed.
NSA_N_50		40	✓		✓	✓			✓			0	150	Roads and parking lots in poor condition with sediment and rubble. Potential tree planting areas already selected through PAAs.
NSA_N_51	<1/4	20	✓						✓			0	0	Storm drains on and near Scott's Harem Dr. have been stenciled, but other inlets in neighborhood lack markings.
NSA_N_52	<1/4	8	✓		✓							0	80	Potential tree planting area is across the street from the neighborhood.
NSA_N_53	1/4	15	✓		✓	✓			✓			0	0	Stream buffer is herbaceous only and could be reforested.
NSA_N_54	<1/4	35	✓		✓							0	0	Edges of roads breaking up because no curb/gutter; becoming a sediment source.
NSA_N_55	1/4	5	✓	✓	✓	✓			✓			0	100	Large areas of maintained grass under powerlines has potential for Bayscaping/landscaping. Plant trees in meadow along stream (narrow forested buffer exists); private land.
NSA_N_56		40	✓		✓	✓			✓			0	0	Stream located on south side of Nearshoot Ln. has been restored and has recent plantings in the buffer.
NSA_N_57	1/2	20	✓	✓	✓	✓						0	0	Many lots have planted trees. Small area in cul-de-sac is landscaped.
NSA_N_58	<1/4	10	✓	✓	✓							0	150	
NSA_N_60	<1/4	15	✓		✓							0	0	Some inlets had grass clippings or sediment (from roadway breaking up) in gutters, but not a significant source of sediment or nutrients.
NSA_N_61	<1/4	15	✓		✓							0	0	
NSA_N_62	1/2	5	✓	✓	✓	✓			✓			0	0	
NSA_N_63	<1/4	5	✓		✓							0	0	
NSA_N_64		60	✓		✓	✓			✓			0	0	
NSA_N_65		50	✓		✓	✓			✓	✓		0	100	Areas between buildings are mostly forested, with some exceptions.

Site ID	Lot Size (acres)*	RECOMMENDED ACTIONS												Notes
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Pet Waste	Trash Management	Buffer Improvement	Parking Lot/Alley Retrofit	Street Sweeping	# of Street Trees	# of Open Space Trees	
NSA_N_66		50	✓		✓	✓						0	0	Homes lack potential for downspout redirection due lack of pervious surface between structures and roadways.
NSA_N_67	<1/4	20	✓		✓							0	0	
NSA_N_68	1/4	10	✓		✓	✓			✓			0	0	Edges of roadways are degrading.
NSA_N_69	<1/4	5	✓		✓							0	0	

*Lot sizes are only available for single family homes – blanks indicated apartments or condominiums.

All of the neighborhoods assessed within Jennifer Branch had at least some opportunities for improvement. Storm drain marking was recommended in all but one neighborhood assessed; it not only engages residents, but the markers also serve as a visual reminder not to dump potentially dangerous materials into the storm drain and the connection between their actions and streams. It can also be easily paired with other education efforts, for example, with education regarding residential lot runoff and the possibility of disconnecting downspouts so that rooftop runoff has time to infiltrate the ground rather than entering the storm drain via impervious surfaces, or information about the importance of picking up pet waste to prevent excess bacteria and nutrients from entering the local streams. Rain barrels serve as temporary storage of roof runoff, decreasing the volume of stormwater running off site. Tree planting opportunities were also spread throughout the subwatershed with four neighborhoods recommended for the planting of at least 100 trees each (Figure 4-26). Projects on this scale may encourage widespread community engagement and are ideal opportunities for children and families to participate and become involved with their watershed in a concrete way.

A BMP retrofit was recommended near a storm drain inlet in NSA_N_39 at the dead end of a street (Figure 4-27), which would allow for increased stormwater treatment and infiltration. In addition, actions as simple as adjusting mowing practices and tree plantings along stream channels and drainage ditches may help to slow down high stream flows that cause bank erosion and intercept additional nutrients and pollutants before they enter the aquatic ecosystem. One such recommendation, made for NSA_N_55, would involve planting trees in a meadow to increase the forested riparian width along a stream (Figure 4-28).

Figure 4-26: Opportunities for Open Space Trees in NSA_N_58

Figure 4-27: Area for Potential Retrofit near a Storm Drain Inlet in NSA_N_39

Figure 4-28: Buffer Improvement Opportunity at NSA_N_55

Hotspots

There were three facilities assessed in the Jennifer Branch subwatershed during the uplands assessment of the Lower Gunpowder Falls (Urban) watershed. Two of the three were classified as confirmed hotspots; the remaining site visited was not a hotspot and was found to be clean and well-maintained. Table 4-26 summarizes potential pollution sources from facilities visited in Jennifer Branch. Crews noted certain conditions during the field investigations that they felt merited immediate notification of Baltimore County for further investigation and/or follow-up action. The field crew reports, as well as subsequent actions taken by the County are documented in Section 4.3 of the Watershed Characterization Report (Appendix E).

Table 4-26: Hotspot Summary – Jennifer Branch

Site ID	HSI Status (# filled circles)	Description	POTENTIAL POLLUTION SOURCES						Notes
			Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf / Landscaping	Stormwater	
HSI_N_306	Confirmed (12)	Commercial - Strip mall with supermarket							Five uncovered and/or lidless dumpsters. Trash strewn throughout facility. Unmarked, 2-gallon container of fats in rear.
HSI_N_319	Confirmed (10)	Commercial - Small machinery repair/landscaping services		✓					This location is more severe than the HSI implies. The site has lots of bare soil and erosion from heavy equipment, used oil drums, and outdoor fueling.
HSI_N_320	Not a hotspot (5)	Commercial - Shopping center							Clean site. Open dumpster was the only issue noted.

The first confirmed hotspot was at a strip mall, anchored by a supermarket (HSI_N_306). Most of the issues at this facility were related to waste manangement issues, including dumpsters with trash spilling out and trash sitting outside of the dumpster (Figure 4-29). The other confirmed hotspot was a small machinery repair shop, co-located with a landscaping service facility (HSI_N_319). In this case the facility had piles of mulch and other materials sitting uncovered, allowing for materials to be washed away during rain events. Other issues included washing of equipment and machinery without proper washwater containment, outdoor fueling operations, and leaking containers (Figure 4-30).

Figure 4-29: Trash Spilling from Dumpster with Its Lid Hanging Open

Figure 4-30: Outdoor Fueling Station and Leaking Barrels without Secondary Containment

Institutions

All six institutional sites investigated by staff in Jennifer Branch subwatershed consisted of privately-owned, faith-based facilities. A summary of opportunities for restoration are presented in Table 4-27.

Table 4-27: ISI Recommendations – Jennifer Branch

Site ID	Name	Public/ Private	RECOMMENDED ACTIONS							Notes
			Storm Drain Marking	# Trees for Planting	Downspout Disconnection	Stormwater Retrofit	Impervious Cover Removal	Buffer Improvement	Trash Management	
ISI_N_306	Linden Heights Methodist Church	Private		7	✓					
ISI_N_317	Carney Assembly of God	Private		6		✓	✓	✓		
ISI_N_318	Kingdom Hall of Jehovah's Witnesses	Private		2		✓			✓	Channelization evident at north side of property where road runoff enters.
ISI_N_319	Christus Victor Lutheran Church	Private		2	✓	✓				Some staining on side of southeast building annex.
ISI_N_320	Zion Presbyterian Church	Private		7		✓			✓	
ISI_N_321	Atonement Evangelical Lutheran Church	Private	✓	8		✓				

The most frequent restoration opportunity type found by investigators in Jennifer Branch subwatershed was stormwater retrofits. Types of retrofits that were recommended included: rain garden for rooftop disconnection, bioretention with impervious cover removal, and parking lot bioretention. At Linden Heights Methodist Church (ISI_N_306), directly-connected downspouts can be disconnected and the storm runoff diverted to a rain garden (Figure 4-31), thereby reducing the quantity of water and pollutants reaching streams through the storm drain system. At Carney Assembly of God (ISI_N_317), bioretention can be installed at the foot of the rear parking lot, in conjunction with impervious cover removal in the buffer zone of the stream that flows behind the church property. Such a tradeoff serves the dual purpose of treating polluted runoff from paved surfaces on the church property and applying the natural treatment ability of a buffer. To remedy the loss of parking area, the area behind the parsonage can be utilized with appropriate stormwater treatment. At both the Kingdom Hall of Jehovah's Witnesses (ISI_N_318) and nearby Christus Victor Lutheran Church (ISI_N_319), edge-of-lot bioretention can be installed in available space at the southeastern foot of both parcels to lessen the impact to the receiving stream from the impervious areas used for parking (Figure 4-32). At Atonement Evangelical Lutheran Church (ISI_N_321), recent stormwater management upgrades can be augmented with bioretention pre-treatment using available space along a grassy swale.

Figure 4-31: Downspout Disconnection Opportunity at ISI_N_306 (left) and Combination Impervious Surface Removal and Bioretention Opportunity at ISI_N_317 (right)

Figure 4-32: Bioretention Opportunities at ISI_N_318 (left) and ISI_N_319 (right)

Investigators identified tree planting opportunities at each site in Jennifer Branch subwatershed, with the most available space found at Linden Heights Methodist Church, Carney Assembly of God, Zion Presbyterian Church (ISI_N_320), and Atonement Evangelical Lutheran Church. Trees are a valuable resource for any institution because they naturally shade heat-producing impervious surfaces, slow down and filter stormwater runoff through their root systems, improve the aesthetics of the property, stabilize soil, and provide additional habitat. Memorial trees may be an attractive incentive for congregations to enhance their canopy cover. At Carney Assembly of God, additional trees abutting the existing wooded area near the stream channel will have the added benefit of fortifying the stream buffer, which naturally increases filtration of runoff as it flows toward the stream channel (Figure 4-33). At Atonement Evangelical Lutheran Church, much open space adjacent to Old Harford Road is readily available for tree planting (Figure 4-33).

Figure 4-33: Tree Planting Opportunities at ISI_N_317 (left) and ISI_N_321 (right)

Waste Management concerns were noted by investigators at Kingdom Hall of Jehovah's Witnesses and Zion Presbyterian Church. At the Kingdom Hall, an open rollaway dumpster was placed on an impervious surface (Figure 4-34), which may allow pollutants to easily leach and travel toward the stream via the parking lot surface. At Zion Presbyterian Church, an open dumpster was located on the parking lot; an open dumpster allows rainfall to enter and increases the likelihood that pollutants that may be stored in the dumpster will leach out and reach points downstream. Waste management conditions that may adversely impact streams may be improved by conducting educational outreach to church maintenance staff.

Figure 4-34: Waste Management Improvement Opportunities at ISI_N_318 (left) and ISI_N_320 (right)

Pervious Areas

Pervious area restoration has the potential to convert areas of turf, often with high nutrient inputs, to forest, which can absorb and filter rather than contribute nutrients. Six pervious areas were assessed for restoration potential in Jennifer Branch; these include several County open space parcels, an equestrian center, and Proctor Lane Apartments Open Space.

The County Open Space - A site is located off Goldenrod Lane, near its intersection with Red Clover Court; it is owned and maintained by Baltimore County, and is easily accessible by foot, vehicle, or heavy equipment. A small perennial stream flows through part of the site and reforestation of the site would require verification that it would not interfere with the current use of the site and tree planting could be a potential community project. Invasive plant species management should be implemented prior to tree planting, particularly in the parcel immediately north of Goldenrod Lane.

The Proctor Lane Apartments Open Space site is located to the immediate south of Proctor Lane, near the intersection with Cold Stream Way and is privately owned by the community HOA. A small perennial stream flows through the southern-most part of the site and the mature deciduous forest in the riparian area of the stream forms part of the southern boundary of the site. Tree planting in this corridor would likely be most beneficial. Reforestation of the site would require verification that it would not interfere with the current use of the site and tree planting could be a potential community project.

The County Open Space – B site is located to the immediate south of Jomat Avenue, near its intersection with Harford Road. It is a Park and Ride facility owned and maintained by Baltimore County and Jennifer Branch flows near the southeastern corner of the site, adjacent to a stormwater BMP. Reforestation of this site would require verification that it would not interfere with the current uses of the site and tree planting could be a potential community project.

The Graham Equestrian Center is a non-profit organization located within Gunpowder Falls State Park, to the east of Harford Road, near its intersection with Knoll Acres Drive. This parcel is currently managed as an equestrian center. Fields are separated by numerous large, sturdy horse fences, and turf in the horse pastures is generally very thin and sparse from the constant grazing and trampling by the horses. The site presents some valuable opportunity for tree planting, particularly in the eastern part, in the riparian area of several headwater streams. These open areas, however, currently consist of well-used horse pastures. Reforestation of this site would require verification that it would not interfere with its current uses and future planning.

The County Open Space – I site is located south of Northwind Road, off of North Trail. It is directly adjacent to an approximately 250-foot-wide Baltimore Gas & Electric electric transmission line right-of-way, and possesses a small perennial stream that flows along its northern boundary. Most of the area along the stream was formerly wooded, but was recently cleared (most likely when BGE cleared along their ROW). The site presents an excellent opportunity for tree planting, as it is almost completely turf and possesses riparian wetlands. Some focused invasive plant species management should be implemented prior to tree planting at the site (Japanese honeysuckle, mile-a-minute, and porcelainberry were all observed here). Reforestation of this site would also require verification that it would not interfere with the current uses of the site and tree planting could be a potential community project.

The County Open Space – J site is located south of Erie Avenue, between Superior Avenue and Montego Avenue, and functions as a small neighborhood green space. The site presents a reasonable opportunity for tree planting, as it is almost completely turf, has relatively easy access (on foot, and with small equipment), and receives full sun exposure. Reforestation of this site, however, would require verification that it would not interfere with the current uses of the site and tree planting could be a potential community project.

A summary of these sites is provided in Table 4-28.

Table 4-28: PAA Summaries – Jennifer Branch

Site ID	Location	Description	Acres	Ownership
PAA_N_302	County Open Space - A	Vacant land	Parcel - 4.67 Recommended planting - 0.84	Public
PAA_N_304	Proctor Lane Apartments Open Space	Vacant land	Parcel - 11.2 Recommended planting - 0.43	Private
PAA_N_305	County Open Space - B	Park & Ride/Bus Stop (with adjacent lawn)	Parcel - 5.89 Recommended planting - 1.84	Public
PAA_N_311	Baltimore City Property	Equestrian Center	Parcel - 192.87 Recommended planting - 6.17	Public
PAA_N_314	County Open Space - I	County Open Space	Parcel - 2.49 Recommended planting - 2.02	Public
PAA_N_315	County Open Space - J	County Open Space	Parcel - 1 Recommended planting - 0.62	Public

Stream Restoration Recommendations

There were no stream restoration projects recommended for Jennifer Branch. However, approximately 6,000 linear feet of stream have been restored in this subwatershed in 2013.

Illicit Discharges

Jennifer Branch contains 13 major outfalls, 1 of which is rated priority 0, three of which are rated priority 1, two of which are rated priority 2, and the other seven of which are rated priority 3. Priority 0 outfalls are outfalls with insufficient data to determine a priority rating. This may be due to inaccessibility or if there has been only a single screening. Priority 1 outfalls have major problems that require immediate correction and/or close monitoring, or outfalls with recurring problems. These outfalls are sampled four times each year. Priority 2 outfalls have minor to moderate problems that have the potential to become severe and are sampled once a year. Priority 3 outfalls with minor or no problems that do not require close monitoring. These outfalls are sampled on a 10-year cycle. Baltimore County will continue its Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

Stormwater Conversions

Jennifer Branch subwatershed contains 11 stormwater management dry ponds. Baltimore County EPS has selected one of these dry ponds as a priority for conversion.

Subwatershed Management Strategy

Figure 4-35 provides a visual summary of restoration opportunities in the watershed.

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout rain barrel and rain garden installation measures in neighborhoods according to Table 4-25.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-25.
3. Raise awareness among citizens about the benefits and importance of Bayscaping for the recommended neighborhoods in Table 4-25.
4. Raise awareness among property owners about improving stream buffer management at locations indicated in Table 4-25.
5. Encourage communities to plant open space trees. Table 4-25 shows potential neighborhoods for planting as many as 850 open space trees.
6. Raise awareness among staff and members of institutional sites about the importance of proper trash management and outdoor material storage techniques at sites listed in Table 4-27.
7. Engage institutional sites listed in Table 4-27 in other recommended restoration actions including downspout disconnection, storm drain marking, tree planting, and stream buffer improvement.
8. Investigate the pervious areas described in Table 4-28 for potential tree planting.

Municipal Actions

1. Investigate both of the retrofit opportunities for parking lots noted in Table 4-25 and, if possible, engage the communities and pursue those opportunities.
2. Work with the institution owners to pursue retrofit and impervious cover removal opportunities at public institutions noted in Table 4-27.
3. Follow-up regarding conditions at confirmed hotspots noted in Table 4-26. Pursue outreach and raise awareness regarding site housekeeping practices, and improved outdoor materials storage and vehicle operations.
4. Continue to monitor illicit discharges. Conduct follow-up investigations of outfalls with insufficient data for priority rating.
5. Address issues at outfalls with major problems. Conduct follow-up investigations at those outfalls with problems that have the potential to become severe as described above and in the Watershed Characterization Report.
6. Move forward with retrofitting the stormwater pond that EPS identified for conversion.

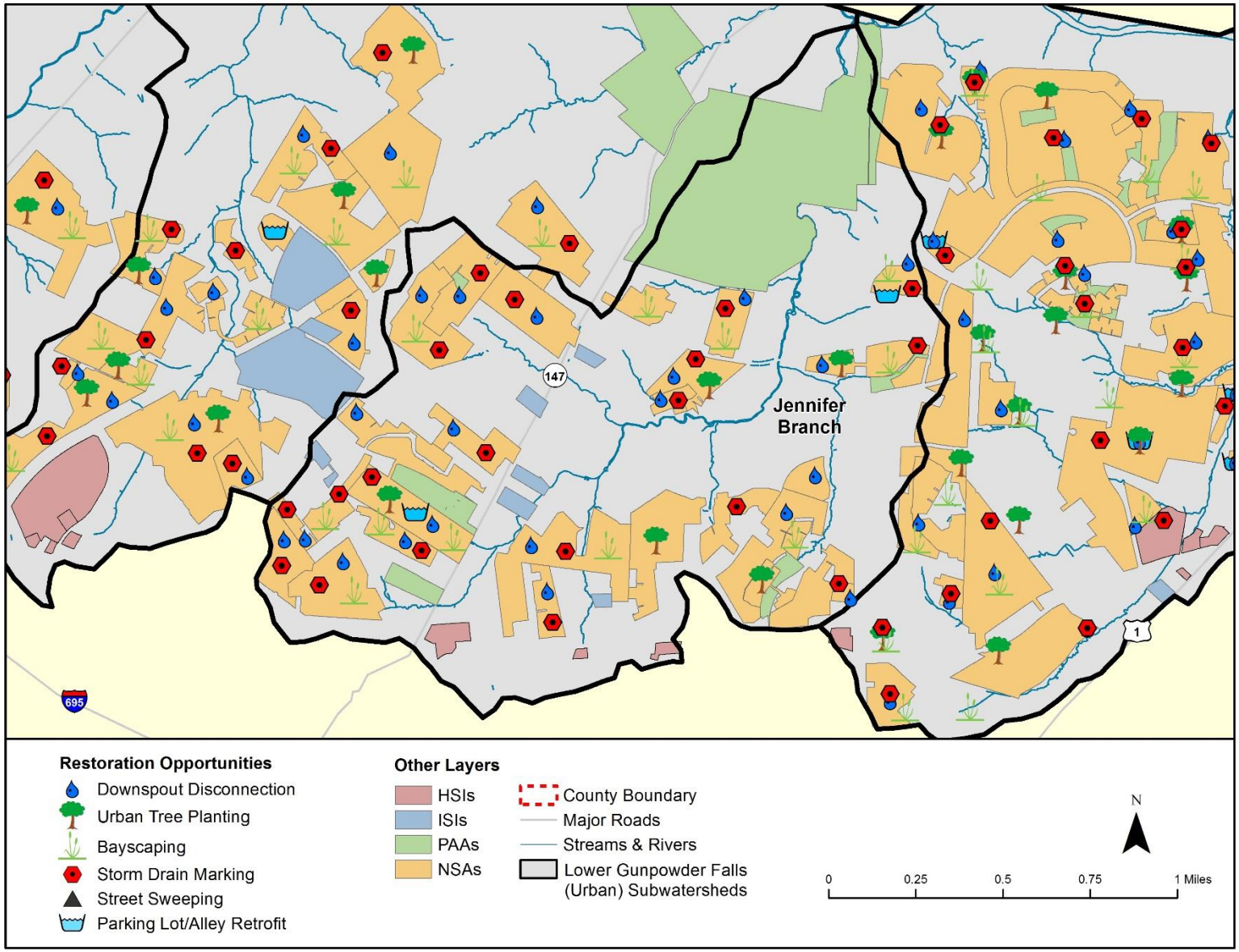


Figure 4-35: Restoration Opportunities in Jennifer Branch

4.3.4 Lower Gunpowder Falls-B (Subwatershed Code 400)

Lower Gunpowder Falls-B, where Perry Hall is located, is the second smallest subwatershed with the largest number of stream miles in the Lower Gunpowder Falls (Urban) watershed; it is situated in the central portion of the watershed. The subwatershed is primarily urban, with the highest residential land use (over 70%) of any subwatershed; this accounts for it also having the largest population among the subwatersheds. Table 4-29 summarizes key subwatershed characteristics of Lower Gunpowder Falls-B.

Table 4-29: Key Subwatershed Characteristics – Lower Gunpowder Falls-B

Drainage Area	1,989.7 acres (3.11 sq. mi.)	
Stream Length	13.4 miles	
Population	10,798 (2010 Census) 5.4 people/acre	
Land Use/Land Cover	Very Low Density Residential: Low Density Residential: Medium Density Residential: High Density Residential: Commercial: Industrial: Institutional: Extractive: Open Urban Land: Agriculture: Forest: Barren Land: Water/Wetlands: Transportation:	1.6% 3.8% 48.6% 18.0% 4.2% 0.4% 2.5% 0.0% 0.2% 1.5% 19.2% 0.0% 0.0% 0.0%
Impervious Cover	21% of subwatershed	
Soils	A Soils (low runoff potential): B Soils: C Soils: D Soils (high runoff potential):	28.0% 46.9% 17.9% 7.2%
SWM Facilities	49% of urban land use treated	
Restoration Priority Rating	Very High	

Neighborhoods

A total of 28 distinct neighborhoods were identified and assessed within Lower Gunpowder Falls-B during the uplands assessment of the Lower Gunpowder Falls (Urban) watershed. Recommendations for neighborhoods in this subwatershed included: downspout disconnection, rain barrels, rain gardens, storm drain marking, Bayscaping, stream buffer improvement and tree planting. A summary of neighborhood recommended actions is presented in the Table 4-30.

Table 4-30: NSA Recommendations – Lower Gunpowder Falls-B

Site ID	Lot Size (acres)*	RECOMMENDED ACTIONS												Notes
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Pet Waste	Trash Management	Buffer Improvement	Parking Lot/Alley Retrofit	Street Sweeping	# of Street Trees	# of Open Space Trees	
NSA_N_20	1/4	10	✓		✓							0	50	Potential tree planting in mowed open space at Colenbourne Rd. Well-maintained lawns.
NSA_N_21	1/4	15	✓									0	0	Some driveways and road edges are crumbling, could become a source of sediment.
NSA_N_22	1/2	10	✓		✓	✓						0	0	No curbs, some degrading of edge of road - potential sediment source. Inlet at end of road has potential for BMP installation.
NSA_N_23	1/4	50	✓		✓	✓						0	0	All houses have the infrastructure for downspouts to be piped to road; about 50% have been disconnected. Possible BMP location at pipe inlet.
NSA_N_24	1/4	60	✓		✓	✓						0	0	Infrastructure for downspouts to drain to road; some downspouts already disconnected. Some high-maintenance lawns, but does not seem to be significant source of nutrients.
NSA_N_25		95	✓	✓	✓							0	0	Storm drain inlets near end of Jumpers Cir. could be replaced with BMPs.
NSA_N_26	1/4	40	✓		✓	✓			✓			0	0	Infrastructure for downspouts to drain to street; some houses already disconnected. Stenciling is present but worn and barely visible.
NSA_N_27	<1/4	40	✓		✓							0	0	Small yards do not have large potential for Bayscaping.
NSA_N_28	1/4	75	✓		✓	✓						0	300	Nearly all downspouts are connected to infrastructure draining to the street.
NSA_N_29	<1/4	15	✓		✓		✓					0	20	Inlet in open space -currently mowed grass, could convert to an infiltration BMP. Tree planting in small common area (~0.1 acre). Possible BMP installation in mowed common area behind homes.

Site ID	Lot Size (acres)*	RECOMMENDED ACTIONS												Notes
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Pet Waste	Trash Management	Buffer Improvement	Parking Lot/Alley Retrofit	Street Sweeping	# of Street Trees	# of Open Space Trees	
NSA_N_30	1/4	35	✓		✓							0	0	Infrastructure for downspouts to drain to street; most houses disconnected.
NSA_N_31	1/4	15	✓		✓	✓						0	60	Possible tree planting near ephemeral stream.
NSA_N_33	1/4	15	✓		✓	✓			✓			0	0	Possible encroachment on ephemeral stream buffer (already noted during PAA).
NSA_N_34		80	✓		✓					✓		0	0	Large parking lot at Fencerow Ct.; could convert center or area around inlet to a BMP.
NSA_N_35		60	✓		✓	✓				✓		0	700	Possible BMP at inlet in parking lot at Borgia Ct. Many open mowed areas w/ potential for tree planting.
NSA_N_36		100	✓		✓	✓			✓			0	0	Downspouts piped underground but no outlet is visible. May go to inlets - separate from storm drain inlets (maybe an underground BMP?).
NSA_N_37	1/4	25	✓	✓	✓	✓						0	0	In general, neighborhood has more landscaping than others did - may be more amenable to rain gardens.
NSA_N_38	<1/4	10	✓		✓							0	30	Some storm drain stencils visible, but very faded. All could be redone.
NSA_N_40	1/4	20	✓		✓	✓						0	300	Possible tree planting - areas in west end may be utility ROW.
NSA_N_41		15	✓	✓	✓	✓						20	700	Street trees possible in bump outs with possible utility conflict; may be a utility constraint at some bump outs. Asphalt degrading in many areas leading to sediment in gutters.
NSA_N_42		35	✓	✓	✓	✓						0	200	Very small front yards could be converted from grass to Bayscaping or rain gardens, where large enough. Planting of common areas already recommended in PAA.
NSA_N_43	1/4	5	✓	✓		✓	✓					0	150	Long driveway off Morn Mist Ct. had asphalt breaking up, lots of sediment in road. Wide roadways, could do curb bump-out BMPs.

Site ID	Lot Size (acres)*	RECOMMENDED ACTIONS												Notes
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Pet Waste	Trash Management	Buffer Improvement	Parking Lot/Alley Retrofit	Street Sweeping	# of Street Trees	# of Open Space Trees	
NSA_N_44		50	✓	✓	✓	✓			✓			5	100	Space for rain gardens between some buildings, but slopes may be too steep. All grassy areas between buildings and around perimeter could be planted with trees.
NSA_N_45		100	✓		✓	✓			✓			0	25	Mowed grass in a few parts of stream buffer, but mostly forested.
NSA_N_46		15	✓		✓	✓						0	0	Several potential tree planting areas.
NSA_N_47		40	✓		✓							0	0	Most downspouts disconnected. About 15 ft. of grass available for disconnection in front of townhouses.
NSA_N_48	1/4	10	✓	✓		✓						0	0	Potential impervious removal on side street - Simms Ave.
NSA_N_49		5	✓	✓		✓						0	100	

*Lot sizes are only available for single family homes – blanks indicated apartments or condominiums.

All of the neighborhoods assessed within Lower Gunpowder Falls-B had opportunities for improvement. In a few neighborhoods, while downspout disconnection would be desirable, small lot sizes constrained potential retrofits (Figure 4-36). Storm drain marking was recommended in almost every neighborhood (Figure 4-37). Storm drain marking is popular because this relatively easy and inexpensive action can have a great effect by reminding residents not to dump potentially dangerous materials into the storm drain. It can also be easily paired with other education efforts, for example, with education regarding the effects of pet waste on water quality, in neighborhoods where both were recommended. Rain barrels serve as temporary storage of roof runoff, decreasing the volume of stormwater running off site.

Eight neighborhoods were also noted as providing an opportunity to plant at least 100 trees each (Figure 4-38). Projects on this scale may encourage widespread community engagement and are ideal opportunities for children and families to participate and become involved with their watershed in a concrete way. In addition, actions as simple as adjusting mowing practices and tree plantings along stream channels and drainage ditches may help to slow down high stream flows that cause bank erosion and intercept nutrients and toxins before they enter the aquatic ecosystem.

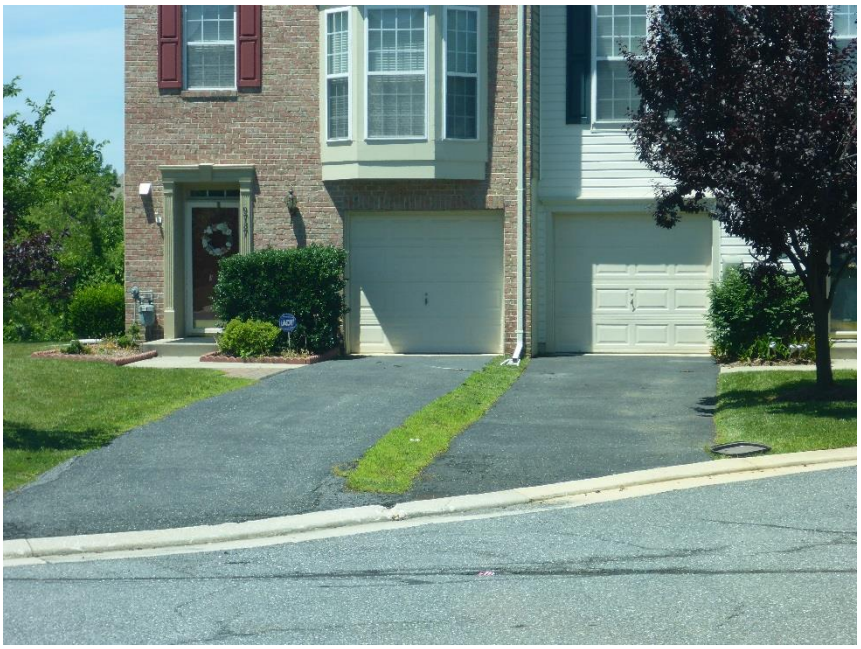


Figure 4-36: Limited Space for Downspout Disconnection Found in Some Neighborhoods Such as in NSA_N_32

Figure 4-37: Storm Drain Marking Opportunities in NSA_N_31 (left) and NSA_N_40 (right)

Figure 4-38: Large Areas of Mowed Grass Present Excellent Opportunities for Tree Planting Such as at NSA_N_28 (left) and NSA_N_35 (right)

Hotspots

There were eight facilities assessed in the Lower Gunpowder Falls-B subwatershed during the uplands assessment of the Lower Gunpowder Falls (Urban) watershed. Three were found to be confirmed hotspots, and an additional site was considered to be a potential hotspot; the other four locations visited were not considered to be hotspots. Table 4-31 summarizes the potential pollution sources from facilities visited in Lower Gunpowder Falls-B. Crews noted certain conditions during the field investigations that they felt merited immediate notification of Baltimore County for further investigation and/or follow-up action. The field crew reports, as well as subsequent actions taken by the County are documented in Section 4.3 of the Watershed Characterization Report (Appendix E).

Table 4-31: Hotspot Summary – Lower Gunpowder Falls-B

Site ID	HSI Status (# filled circles)	Description	POTENTIAL POLLUTION SOURCES						Notes
			Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf / Landscaping	Stormwater	
HSI_N_405	Confirmed (14)	Commercial - Shopping center							Significant garbage in bushes at border of property. 55-gallon drum, contents unknown. 5-gallon, leaking pail, contents unknown. Two unsealed 55-gallon grease drums behind grocery store. A second 55-gallon, blue plastic drum, contents unknown.
HSI_N_411	Potential hotspot (6)	Commercial - Strip mall with restaurant							Relatively clean site. No staining, but pavement is new. Opportunity to direct stormwater into grassy area rather than directing it straight into stream. Noticed some suds behind the restaurant, which may be a sign of washwater being dumped behind the building.
HSI_N_412	Not a hotspot (4)	Commercial - Restaurant							Even though not a hotspot based on HSI form, site was reported for its waste management issues. Grease leakage is a big problem at this site.
HSI_N_415	Confirmed hotspot (11)	Commercial - Fast food restaurant							Only concern is an unsealed 55-gallon drums of fats inside dumpster enclosure.
HSI_N_416	Not a hotspot (5)	Commercial - Fast food restaurant							Grassed area outside of parking lot could accommodate a large tree
HSI_N_417	Confirmed hotspot (14)	Commercial - Auto repair							Despite the high number of filled circles on HSI form, the site is orderly. Biggest issue is an uncovered dumpster with car parts in it. No easy retrofits.
HSI_N_418	Not a hotspot (4)	Commercial - Strip mall and restaurant							Dumpster area is a little messy. Some trash blowing around in back. Stains leading out of kitchen door - likely dumping washwater out the door.
HSI_N_434	Not a hotspot (5)	Commercial - Pizza restaurant and granite sales							Sheet flow towards bank. Dumpsters and grease bin look well-maintained.

The first confirmed hotspot (HSI_N_405) is a shopping center where significant garbage was found along the border of the property. There were also multiple drums found whose contents were unknown. The second confirmed hotspot (HSI_N_415) was a fast food restaurant which had its dumpster situated near a storm drain inlet and grease drums sitting outside of its dumpster enclosure (Figure 4-39). The final confirmed hotspot was an auto repair facility (HSI_N_418); its main issue was an uncovered dumpster with used car parts inside. The parts being exposed to precipitation would allow chemicals and contaminants to wash off of the parts and enter the storm drain system.

Figure 4-39: Dumpster Located near Storm Drain Inlet (left) and Grease Drums Located outside Dumpster Enclosure (left)

The potential hotspot (HSI_N_411) was a small strip mall with a restaurant. The main issue encountered there was suds noticed outside the building, indicating that soapy washwater was being dumped out the back door of the facility. One site that did not rate as a hotspot on the HSI form (HSI_N_412) was nonetheless reported to the County; a restaurant was found to have grease leaking from containers behind the facility; additionally, the leakage from and conditions around the dumpsters at this site were also problems (Figure 4-40).

Figure 4-40: Leaking Dumpster with Trash Collecting outside of Dumpster

Institutions

Four institutions were assessed in Lower Gunpowder Falls-B subwatershed, consisting of three privately owned churches and an elementary school. Recommended actions at the above sites are summarized in Table 4-32.

Table 4-32: ISI Recommendations – Lower Gunpowder Falls-B

Site ID	Name	Public/ Private	RECOMMENDED ACTIONS							Notes
			Storm Drain Marking	# Trees for Planting	Downspout Disconnection	Stormwater Retrofit	Impervious Cover Removal	Buffer Improvement	Trash Management	
ISI_N_412	Perry Hall Baptist Church and Christian School	Private		56		✓		✓		Channel downstream of parking lot highly impacted.
ISI_N_413	Gunpowder Elementary School	Public	✓	N/A		✓	✓		✓	
ISI_N_414	East Baltimore Church of Christ	Private		30		✓				
ISI_N_416	Perry Hall Presbyterian Church	Private		4	✓	✓	✓	✓		
N/A = Not Applicable. Tree planting at public schools is being coordinated under a separate effort.										

Opportunities to plant a large number of trees are available at Perry Hall Baptist Church (ISI_N_412) and East Baltimore Church of Christ (ISI_N_414). At both locations, large areas of green space can be utilized to increase tree canopy cover, which will loosen the soil and thereby promote infiltration and slow down storm runoff and consequent erosion to receiving channels (Figure 4-41). At Perry Hall Baptist Church, tree plantings would be appropriate mainly on the eastern portion of the property, which at present does not have parking areas or other buildings. At East Baltimore Church of Christ, available areas for tree planting are present on the northwest portion that abuts Dawnvale Road (part of which has already been planted on a berm), the eastern corner, and south of the main parking (Figure 4-41). At Perry Hall Presbyterian Church (ISI_N_416), strategic placement of trees will strengthen the buffer of the stream that flows through and adjacent to the property.

Figure 4-41: Tree Planting Opportunities at ISI_N_412 (left) and ISI_N_414 (right)

Investigators identified stormwater retrofits at each of the church properties as well as at the elementary school. Most critically, a stormwater retrofit at Perry Hall Baptist Church will likely have the immediate effect of reducing the erosion rate of the heavily impacted receiving channel (Figure 4-42). Presently nearly all impervious cover drains to this receiving channel. Improved stormwater management at Perry Hall Baptist Church may take the form of installing underground storage in the lower portion of the lot, eliminating 10 feet of impervious cover along the foot of the lot and installing a bioretention facility, or both. At East Baltimore Church of Christ, a portion of the parking lot can be treated by placing a bioretention area along the southeastern flank, where a grassy swale is currently located. While the swale provides a measure of stormwater quality improvement benefit, further reductions in pollutant concentrations in stormflow will be realized using the bioretention treatment (Figure 4-42).

Figure 4-42: Underground Storage Opportunity at ISI_N_412 (left) and Bioretention Opportunity at ISI_N_414 (right)

Several stormwater retrofits present themselves at Gunpowder Elementary School (ISI_N_413). The grassy area in the middle of the bus parking loop is currently free of structures and other obstacles that would restrict installation of a bioretention or sand filter treatment facility (Figure 4-43). Two similar facilities could be installed at the northern and southern edges of the faculty parking lot. The cumulative result of these retrofits would be treatment of approximately 80% of parking lots, which are a prime source of polluted runoff that contains hydrocarbons, metals, and

suspended solids. An additional benefit of the retrofits would be to illustrate stream protection technologies as a part of an environmental education curriculum. Investigators also noted prominent Baltimore Ravens stenciling on sidewalks. The same enthusiastic stenciling effort could be applied to attracting attention to storm drain inlets and illustrating the connection of the watershed's namesake school facility footprint to receiving streams (Figure 4-46). As was noted for other school facilities in Lower Gunpowder Watershed, Gunpowder Elementary School has an impervious apron surrounding most of the building. The removal of the apron would reduce the school's impervious footprint and further enhance infiltration of stormwater and protection of receiving waters (Figure 4-48). Waste management concerns, in the form of open dumpsters positioned up-gradient of storm drain inlets, were also identified by investigators (Figure 4-48).

Figure 4-43: Bioretention Retrofit (left) and Storm Drain Stenciling (right) Opportunities at ISI_N_413

Figure 4-44: Impervious Cover Removal (left) and Waste Management Improvement (right) Opportunities at ISI_N_413

Pervious Areas

Pervious area restoration has the potential to convert areas of turf, often with high nutrient inputs to forest, which can absorb and filter rather than contribute nutrients. Seven pervious areas were

assessed for restoration potential in Lower Gunpowder Falls-B; these include several County open space parcels and Georgetown Square Homeowners Association (HOA) open space.

The County Open Space – C site is located to the west of Cedarside Drive, near its intersection with Belair Road; it is a stormwater facility owned and maintained by Baltimore County. Parts of the site possess a dense stand of common reed (this area likely contains nontidal wetlands). A small perennial stream flows through the length of the site. Reforestation of this site would require verification that it would not interfere with the current uses of the site and tree planting could be a potential community project.

The County Open Space – D site is located immediately south of Oak Park Drive, between Bellfalls Way and Sylvan Park Court and functions as a small neighborhood green space. Reforestation of this site would require verification that it would not interfere with the current uses of the site and tree planting could be a potential community project.

The County Open Space – E site is located immediately west of Hickoryhurst Drive, near its intersection with Oak Park Drive; it functions as a medium-sized neighborhood green space. The site presents a reasonably good opportunity for tree planting, as it is almost completely turf, has relatively easy access, and receives full sun exposure. It also connects to an existing forested plot off site to the north. Reforestation of this site, however, would require verification that it would not interfere with the current uses of the site and tree planting could be a potential community project.

The County Open Space – F site is located south of Stone Way Place, and north of Stone Falls Court and Sylvan Oak Way, and functions as a small neighborhood green space. The site presents a reasonable opportunity for tree planting, as it is almost completely turf, has relatively easy access, and receives full sun exposure. Reforestation of this site, however, would require verification that it would not interfere with the current uses of the site and tree planting could be a potential community project. There is precious little usable existing open green space in the vicinity.

The County Open Space – H site is located west of Hickoryhurst Drive, and immediately south of Hurst Court; functions as a small neighborhood green space. There is also a small tract of urban upland woods offsite to the immediate south. The site presents a reasonable opportunity for tree planting, as it is almost completely turf, has relatively easy access, and receives full sun exposure. Reforestation of this site, however, would require verification that it would not interfere with the current uses of the site and tree planting could be a potential community project. There is precious little usable existing open green space in the vicinity.

The County Open Space – K site is located west of Hickoryhurst Drive, adjacent to Stone Park Place. It functions as a small neighborhood green space; it is accessible by foot, vehicle, or heavy equipment. It is almost completely covered by turf (90%), with a few small landscaping trees around its peripheries. There is also a small tract of urban upland woods offsite to the north and east. The site presents a reasonable opportunity for tree planting, as it is almost completely turf, has relatively easy access, and receives full sun exposure. Reforestation of this site, however, would require verification that it would not interfere with the current uses of the site and tree planting could be a potential community project. There is precious little usable existing open green space in the vicinity.

The Georgetown Square HOA site is located south of Proctor Lane, and west of west of Seven Courts Drive. It consists of three small parcels of neighborhood green space and is privately

owned by the community HOA. There is a small perennial stream with a narrow forested buffer bordering the site to the south. The site presents a good opportunity for tree planting, especially in the southern part, closest to the stream corridor. Reforestation of this site, however, would require verification that it would not interfere with the current uses of the site and tree planting could be a potential community project.

A summary of these sites is provided in Table 4-33.

Table 4-33: PAA Summaries – Lower Gunpowder Falls-B

Site ID	Location	Description	Acres	Ownership
PAA_N_406	County Open Space - C	Open area along stream	Parcel - 1.27 Recommended planting - 0.5	Public
PAA_N_407	County Open Space - D	County Open Space	Parcel - 2.22 Recommended planting - 1.69	Public
PAA_N_408	County Open Space - E	County Open Space	Parcel - 6.5 Recommended planting - 4.77	Public
PAA_N_409	County Open Space - F	County Open Space	Parcel - 2.47 Recommended planting - 1.65	Public
PAA_N_413	County Open Space - H	County Open Space	Parcel - 1.02 Recommended planting - 0.67	Public
PAA_N_416	County Open Space - K	County Open Space	Parcel - 1.9 Recommended planting - 0.33	Public
PAA_N_417	Georgetown Square HOA	HOA Open Space	Parcel - 4.54 Recommended planting - 2.33	Private

Stream Restoration Recommendations

In Section 3.6 of the Watershed Characterization Report (Appendix E), two past studies were reviewed: the Lower Gunpowder Falls Water Quality Management Study (WQMS) by Parsons Brinkerhoff (1999) and the Lower Gunpowder Falls Watershed Assessment (WA) by McCormick Taylor (2011). The purpose of this review was to identify previously recommended stream restoration projects that were the best opportunities for future restoration efforts. 4,705 linear feet of stream in Lower Gunpowder Falls-B were recommended for restoration. Approximately 8,000 linear feet of stream have been restored (or construction is underway on projects) in this subwatershed.

Illicit Discharges

Lower Gunpowder Falls-B subwatershed contains 10 major outfalls, five of which are rate priority 0, and the other five of which are rated priority 2. Priority 0 outfalls are outfalls with insufficient data to determine a priority rating. This may be due to inaccessibility or if there has been only a single screening. Priority 2 outfalls have minor to moderate problems that have the potential to become severe and are sampled once a year. These outfalls are sampled on a 10-year cycle. Baltimore County will continue its Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

Stormwater Conversions

Lower Gunpowder Falls-B subwatershed contains 21 stormwater management dry ponds. Baltimore County EPS has selected three of these dry ponds as a priority for conversion.

Subwatershed Management Strategy

Figure 4-45 provides a visual summary of restoration opportunities in the watershed.

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout rain barrel and rain garden installation measures in neighborhoods according to Table 4-30.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-30.
3. Raise awareness among citizens about the benefits and importance of Bayscaping and pet waste management in the neighborhoods indicated in Table 4-30.
4. Raise awareness among property owners about improving stream buffer management at locations indicated in Table 4-30.
5. Encourage communities to plant open space trees. Table 4-30 shows potential neighborhoods for planting as many as 2,735 open space trees.
6. Raise awareness among staff and members of institutional sites about the importance of proper trash management and outdoor material storage techniques at sites listed in Table 4-32.
7. Engage institutional sites listed in Table 4-32 in storm drain marking and stream buffer management.
8. Investigate the pervious areas described in Table 4-33 for potential tree planting.

Municipal Actions

1. Distribute pollution prevention material to commercial property owners about importance of proper trash management and outdoor material storage techniques at hotspots identified in Table 4-31.
2. Continue to monitor conditions at potential hotspot, and the reported non-hotspot recommended to the County for follow-up action, indicated in Table 4-31.
3. Continue to monitor illicit discharges.
4. Conduct follow-up investigations of outfalls with insufficient data for priority rating and those with minor to moderate problems that have the potential to become severe as described above and in the Watershed Characterization Report.
5. Move forward with retrofits at the three stormwater management ponds described in this section, noted as priorities by EPS.
6. Consider stream restoration options for the 8,000 feet of stream identified in this study.

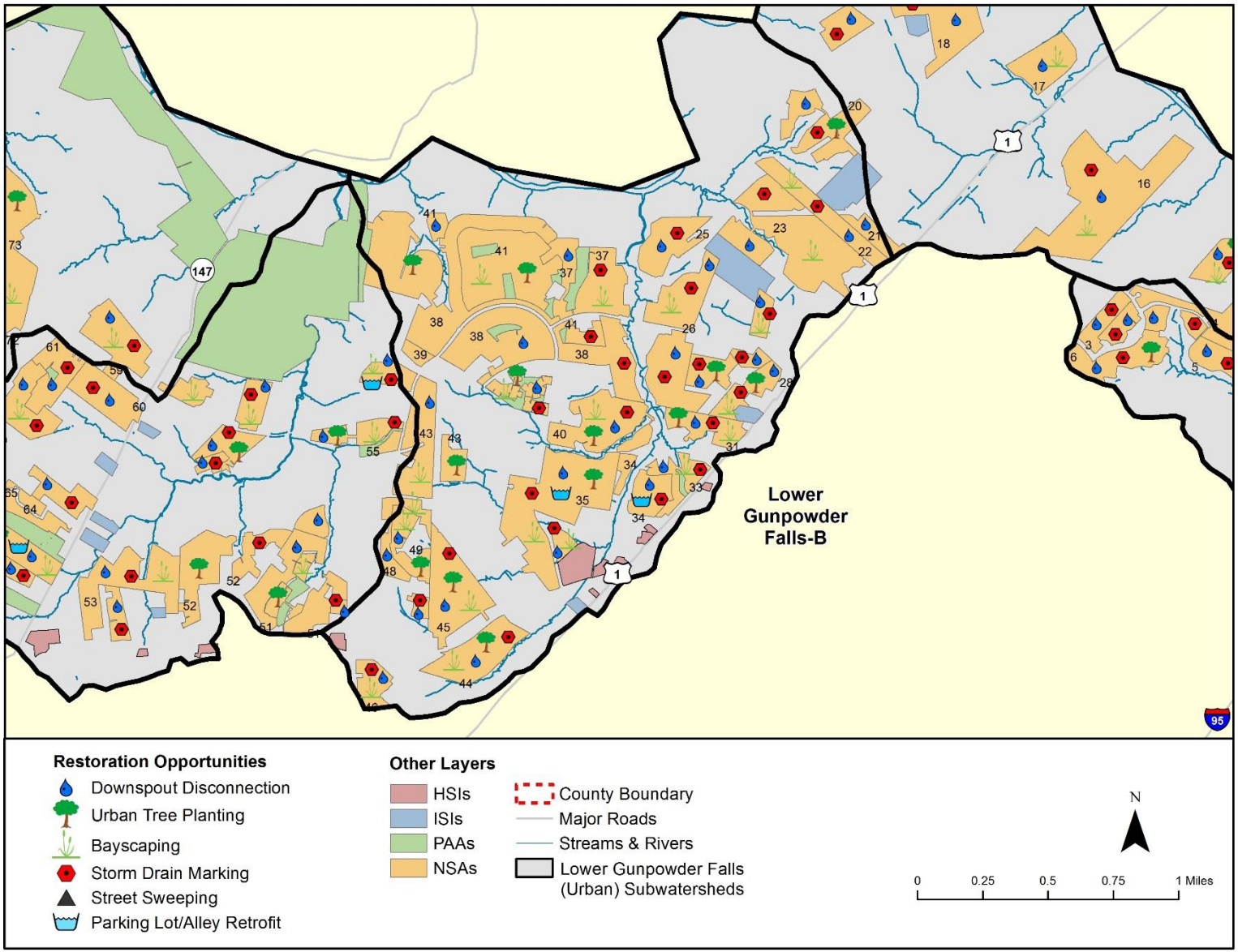


Figure 4-45: Restoration Opportunities in Lower Gunpowder Falls-B

4.3.5 Lower Gunpowder Falls-C (Subwatershed Code 500)

Lower Gunpowder Falls-C is the third smallest subwatershed and ranks next to last in population size. The land use in this subwatershed reflects a high degree of urbanization; however, 40% of the land use remains forest, while another 9% is cropland. Because of the mix of land uses, Lower Gunpowder Falls-C has the lowest percent of impervious surface. Table 4-34 summarizes key subwatershed characteristics of Lower Gunpowder Falls-C.

Table 4-34: Key Subwatershed Characteristics – Lower Gunpowder Falls-C

Drainage Area	1,360.4 acres (2.13 sq. mi.)	
Stream Length	8.9 miles	
Population	2,092 (2010 Census) 1.5 people/acre	
Land Use/Land Cover	Very Low Density Residential:	8.2%
	Low Density Residential:	23.0%
	Medium Density Residential:	17.8%
	High Density Residential:	0.0%
	Commercial:	1.5%
	Industrial:	0.0%
	Institutional:	0.8%
	Extractive:	0.0%
	Open Urban Land:	0.0%
	Agriculture:	8.6%
	Forest:	40.1%
	Barren Land:	0.0%
	Water/Wetlands:	0.0%
	Transportation:	0.0%
Impervious Cover	8% of subwatershed	
Soils	A Soils (low runoff potential):	1.3%
	B Soils:	82.6%
	C Soils:	13.4%
	D Soils (high runoff potential):	2.7%
SWM Facilities	19% of urban land use treated	
Restoration Priority Rating	Low	

Neighborhood

A total of seven distinct neighborhoods were identified and assessed within Lower Gunpowder Falls-C during the uplands assessment of the Lower Gunpowder Falls (Urban) watershed. Recommendations for these neighborhoods included rain barrels, rain gardens, storm drain marking, and Bayscaping. A summary of neighborhood recommended actions is presented in Table 4-35.

Table 4-35: NSA Recommendations – Lower Gunpowder Falls-C

Site ID	Lot Size (acres)*	RECOMMENDED ACTIONS												Notes
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Pet Waste	Trash Management	Buffer Improvement	Parking Lot/Alley Retrofit	Street Sweeping	# of Street Trees	# of Open Space Trees	
NSA_N_4	1/4	15	✓		✓							0	0	Well-maintained lawns. Only open space consists of fenced storm ponds.
NSA_N_14	1	50	✓	✓	✓	✓			✓			0	70	Potential for tree planting or Bayscaping on private property. Few properties have space for rain gardens.
NSA_N_15	1/4	5	✓	✓	✓	✓						0	200	Open area has existing ring of trees, but there is space for more planting.
NSA_N_16	1/4	50	✓		✓	✓						0	0	
NSA_N_17	1/2	10	✓	✓		✓						0	0	Sediment from asphalt breaking up.
NSA_N_18	1/2	5	✓	✓	✓	✓						0	0	Sediment around inlets from a gravel driveway and degrading asphalt. Inlets are degrading; some could have rain gardens/bioretention installed around them.
NSA_N_19	1/4	25	✓		✓							0	0	Large homes on small, well-maintained lots.

*Lot sizes are only available for single family homes – blanks indicated apartments or condominiums.

Storm drain marking was recommended for all but one of the neighborhoods in this subwatershed, which offers an opportunity to not only engage residents, but to serve as a visual reminder of the downstream effects of residents' actions. It also can be combined with additional education on the benefits of rain barrels and rain gardens for local water quality and stream health. Bayscaping was also recommended in several neighborhoods (Figure 4-46). This practice provides an attractive way for landscaping to improve stormwater infiltration, nutrient absorption and pollutant filtration on-site, while also enhancing the aesthetic value of the property. Tree planting opportunities were found in two of the neighborhoods visited (Figure 4-47).

Figure 4-46: Opportunity to Reduce Turf and Increasing Native Plant Cover through Bayscaping in NSA_N_15

Figure 4-47: Opportunities for Tree Planting in NSA_N_14 (left) and NSA_N_15 (right)

Hotspots

No hotspot investigations were performed within Lower Gunpowder Falls-C during the uplands assessments.

Institutions

The single institution visited in Lower Gunpowder Falls-C subwatershed consisted of the Perry Hall Mansion (ISI_N_511). Restoration recommendations pertaining to the publicly owned mansion are summarized in Table 4-36.

Table 4-36: ISI Recommendations – Lower Gunpowder Falls-C

Site ID	Name	Public/ Private	RECOMMENDED ACTIONS							Notes
			Storm Drain Marking	# Trees for Planting	Downspout Disconnection	Stormwater Retrofit	Impervious Cover Removal	Buffer Improvement	Trash Management	
ISI_N_511	Perry Hall Mansion	Public		56						Peeling paint, mold under eaves, and rotting boards covering crawl spaces.

The sole restoration action identified by investigators at the Perry Hall Mansion was tree planting. Due to the availability of open, underutilized space, a total of 56 trees can be planted on the property, thus augmenting local tree cover. Trees, especially a large number that can be linked contiguously with other tree cover, provide a host of water quality benefits including filtration, runoff reduction, and soil stabilization. Together with a restoration of the mansion, additional trees will also provide an aesthetic benefit to the property (Figure 4-48).

Figure 4-48: Tree Planting Opportunity at ISI_N_511

Pervious Areas

No assessments of pervious areas were performed within Lower Gunpowder Falls-C subwatershed during the uplands assessments.

Stream Restoration Recommendations

In Section 3.6 of the Watershed Characterization Report (Appendix E), two past studies were reviewed: the Lower Gunpowder Falls Water Quality Management Study (WQMS) by Parsons Brinkerhoff (1999) and the Lower Gunpowder Falls Watershed Assessment (WA) by McCormick Taylor (2011). The purpose of this review was to identify previously recommended stream

restoration projects that were the best opportunities for future restoration efforts. 1,539 linear feet of stream in Lower Gunpowder Falls-C were recommended for restoration.

Illicit Discharges

Lower Gunpowder Falls-C contains one major outfall, which is rated priority 2. Priority 2 outfalls have minor to moderate problems that have the potential to become severe and are sampled once a year. Baltimore County will continue its Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

Stormwater Conversions

Lower Gunpowder Falls-C subwatershed contains no stormwater management dry ponds, therefore there were no dry ponds for Baltimore County EPS to select as a priority for conversion.

Subwatershed Management Strategy

Figure 4-33 provides a visual summary of restoration opportunities in the watershed.

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout rain barrel and rain garden installation measures in neighborhoods according to Table 4-35.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-35.
3. Raise awareness among citizens about the benefits and importance of Bayscaping and stream buffer management in the neighborhoods indicated in Table 4-35.
4. Encourage communities to plant open space trees. Table 4-30 shows potential neighborhoods for planting as many as 270 open space trees.
5. Engage with owners of institution noted in Table 4-36 to encourage and get involved in tree planting effort.

Municipal Actions

1. Consider stream restoration options for the 1,539 feet of stream identified in this study.
2. Continue to monitor illicit discharges. Conduct follow-up investigations at the outfall with minor to moderate problems that has the potential to become severe as described above and in the Watershed Characterization Report.

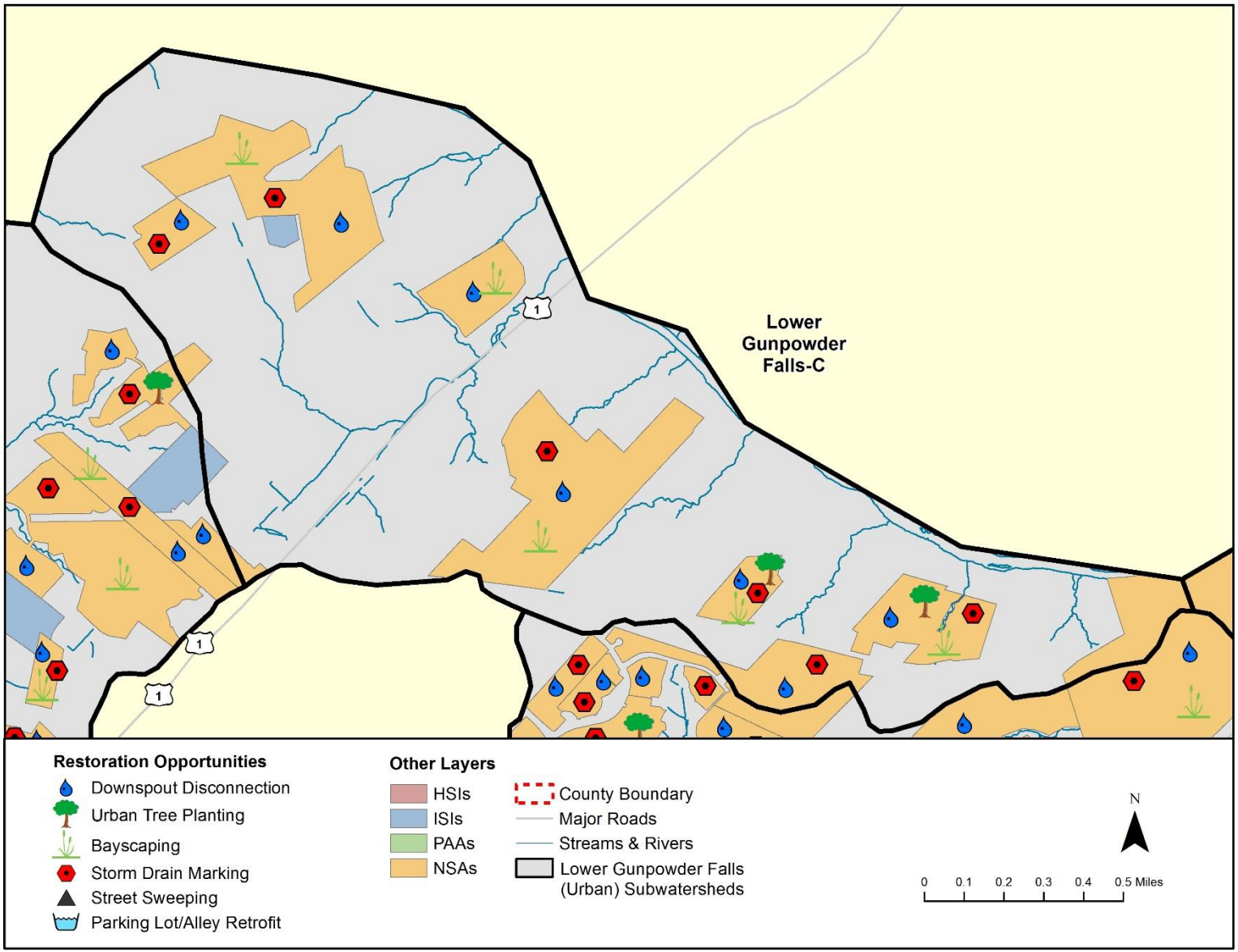


Figure 4-49: Restoration Opportunities in Lower Gunpowder Falls-C

4.3.6 Bean Run (Subwatershed Code 600)

Bean Run is the smallest subwatershed and is located in the eastern portion of the Lower Gunpowder Falls (Urban) watershed, along the northern edge of White Marsh. Despite having a relatively small overall population, this is one of the more densely populated subwatersheds due to the high percentage (64%) of land use in that is residential. Table 4-37 summarizes key subwatershed characteristics of Bean Run.

Table 4-37: Key Subwatershed Characteristics – Bean Run

Drainage Area	916.2 acres (1.43sq. mi.)	
Stream Length	5.7 miles	
Population	4,205 (2010 Census) 4.6 people/acre	
Land Use/Land Cover	Very Low Density Residential: Low Density Residential: Medium Density Residential: High Density Residential: Commercial: Industrial: Institutional: Extractive: Open Urban Land: Agriculture: Forest: Barren Land: Water/Wetlands: Transportation:	3.6% 23.9% 30.9% 5.9% 1.9% 0.5% 1.0% 0.0% 0.0% 6.1% 20.9% 0.9% 0.0% 4.4%
Impervious Cover	18% of subwatershed	
Soils	A Soils (low runoff potential): B Soils: C Soils: D Soils (high runoff potential):	10.5% 40.3% 32.3% 10.9%
SWM Facilities	58% of urban land use treated	
Restoration Priority Rating	Low	

Neighborhoods

A total of 11 distinct neighborhoods were identified and assessed within Bean Run during the uplands assessment of the Lower Gunpowder Falls (Urban) watershed. The primary recommendations for neighborhoods in this subwatershed included rain barrels, storm drain marking, Bayscaping, and tree planting. A summary of neighborhood recommended actions is presented in Table 4-38.

Table 4-38: NSA Recommendations – Bean Run

Site ID	Lot Size (acres)*	RECOMMENDED ACTIONS												Notes
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Pet Waste	Trash Management	Buffer Improvement	Parking Lot/Alley Retrofit	Street Sweeping	# of Street Trees	# of Open Space Trees	
NSA_N_1	1/4	84	✓		✓							0	300	Well-maintained homes and lawns, overall clean. Possible tree planting in four locations (~1.5 acres total).
NSA_N_2		50	✓		✓							0	0	Open space between houses was inundated near storm drain. Potential for rain barrels in backyards; less chemical lawn treatment
NSA_N_3	<1/4	5	✓		✓							0	0	Well-maintained lawns; only room for a rain garden on a couple of properties due to large houses on small lots.
NSA_N_5	<1/4	20	✓		✓							0	0	Well-maintained lawns. Only common area is playground; no space for tree planting.
NSA_N_6		75	✓		✓							0	15	Possible tree planting between buildings - likely only one or two rows. Potential for a BMP in common area with storm drain inlet.
NSA_N_7	1/2	15	✓	✓	✓	✓						0	0	
NSA_N_8	1	15	✓	✓	✓	✓			✓			0	0	Encourage less mowing in stream buffer. Because of large lot size, all downspouts should be able to be redirected to pervious surface, rain barrels, or rain gardens.
NSA_N_9	1/2	10	✓	✓	✓	✓			✓			0	0	Stream buffer encroachment on Bush Rd. Several properties have suitable space for rain gardens. In general, large, well-maintained lawns.
NSA_N_10	1/4	15	✓	✓	✓		✓					0	500	Potential to replace storm drain inlets in yards with rain gardens. Chickens ranging near Apperson Rd. Several open areas with tree planting potential.
NSA_N_11	1/4	10	✓		✓							0	175	Tree planting in open space on Aubree Ln. Well-maintained lawns.

Site ID	Lot Size (acres)*	RECOMMENDED ACTIONS												Notes
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Pet Waste	Trash Management	Buffer Improvement	Parking Lot/Alley Retrofit	Street Sweeping	# of Street Trees	# of Open Space Trees	
NSA_N_32		70	✓		✓							0	0	Some potential for BMP installation in common space at storm drain inlet.

*Lot sizes are only available for single family homes – blanks indicated apartments or condominiums.

Storm drain marking was recommended for all 11 of the neighborhoods in this subwatershed (Figure 4-50), which offers an opportunity to not only engage residents, but to serve as a visual reminder of the downstream effects of residents' actions. It can also be combine with effort to educate citizens about the benefits of pet waste management, where indicated, and how it helps reduce bacteria and nutrients entering the stream system and improves local water quality.

Bayscaping was recommended for three neighborhoods (Figure 4-51). This practice provides an attractive way for landscaping to improve stormwater infiltration, nutrient absorption and pollutant filtration on-site, while also enhancing the aesthetic value of the property. Tree planting opportunities were also spread throughout the subwatershed with three neighborhoods recommended for the planting of more than 150 trees each (Figure 4-52). Projects on this scale may encourage widespread community engagement and are ideal opportunities for children and families to participate and become involved with their watershed in a concrete way. In addition, actions as simple as adjusting mowing practices and tree plantings along stream channels and drainage ditches may help to slow down high stream flows that cause bank erosion and intercept nutrients and toxins before they enter the aquatic ecosystem.

Figure 4-50: Areas Recommended for Storm Drain Marking in NSA_N_3 (left) and NSA_N_7 (right)

Figure 4-51: Area Recommended for Bayscaping in NSA_N_9

Figure 4-52: Tree Planting Opportunities in NSA_N_1 (left) and NSA_N_11 (right)

Hotspots

No hotspot investigations were performed within Bean Run during the uplands assessments.

Institutions

No institutional site investigations were performed within Bean Run during the uplands assessments.

Pervious Areas

No assessments of pervious areas were performed within Bean Run during the uplands assessments.

Stream Restoration Recommendations

In Section 3.6 of the Watershed Characterization Report (Appendix E), two past studies were reviewed: the Lower Gunpowder Falls Water Quality Management Study (WQMS) by Parsons Brinkerhoff (1999) and the Lower Gunpowder Falls Watershed Assessment (WA) by McCormick Taylor (2011). The purpose of this review was to identify previously recommended stream restoration projects that were the best opportunities for future restoration efforts. A total of 383 linear feet of stream in Bean Run were recommended for restoration.

Illicit Discharges

There are no major outfalls in Bean Run subwatershed; for that reason, illicit discharge screening is not performed in this subwatershed.

Stormwater Conversions

Bean Run subwatershed contains no stormwater management dry ponds, therefore there were no dry ponds for Baltimore County EPS to select as a priority for conversion.

Subwatershed Management Strategy

Figure 4-53 provides a visual summary of restoration opportunities in the watershed.

Engaging Citizens & Watershed Groups

1. Conduct appropriate rain barrel and rain garden installation measures in neighborhoods according to Table 4-38.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-38.
3. Raise awareness among citizens about the benefits and importance of Bayscaping in neighborhoods indicated in Table 4-38.
4. Encourage communities and neighborhoods to plant open space trees. Table 4-38 shows the potential for 990 open space trees.
5. Raise awareness among property owners about improving stream buffer management at locations indicated in Table 4-38.

Municipal Actions

1. Consider stream restoration options for the 383 feet of stream identified in this study.

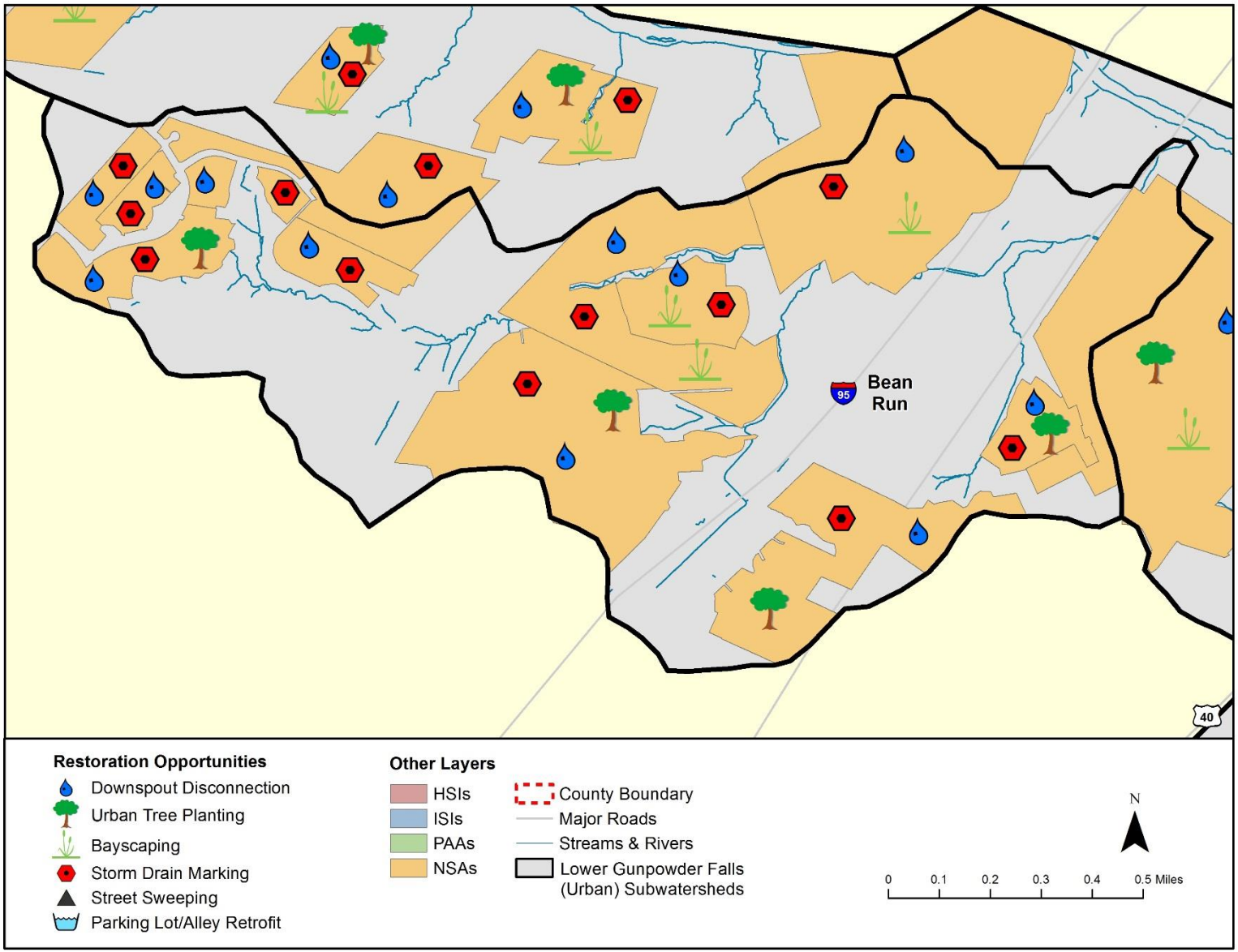


Figure 4-53: Restoration Opportunities in Bean Run

4.3.7 Lower Gunpowder Falls-D (Subwatershed Code 700)

Lower Gunpowder Falls-D is the second smallest subwatershed in the SWAP area and is in the eastern portion of the Lower Gunpowder Falls (Urban) watershed. It has the highest percentage (44%) of forest of any of the subwatersheds, due to the large block of the subwatershed that is within Gunpowder Falls State Park. As the subwatershed with the least residential land use, this subwatershed also has the smallest population and the lowest population density of any of the subwatersheds. Table 4-39 summarizes key subwatershed characteristics of Lower Gunpowder Falls-D.

Table 4-39: Key Subwatershed Characteristics – Lower Gunpowder Falls-D

Drainage Area	1,081.7 acres (1.69 sq. mi.)	
Stream Length	5.5 miles	
Population	1,356 (2010 Census) 1.3 people/acre	
Land Use/Land Cover	Very Low Density Residential:	0.5%
	Low Density Residential:	19.9%
	Medium Density Residential:	3.6%
	High Density Residential:	0.0%
	Commercial:	2.8%
	Industrial:	2.9%
	Institutional:	0.0%
	Extractive:	2.7%
	Open Urban Land:	0.0%
	Agriculture:	7.9%
	Forest:	43.5%
	Barren Land:	13.4%
	Water/Wetlands:	0.9%
	Transportation:	1.9%
Impervious Cover	10% of subwatershed	
Soils	A Soils (low runoff potential):	1.0%
	B Soils:	52.4%
	C Soils:	28.0%
	D Soils (high runoff potential):	18.6%
SWM Facilities	10% of urban land use treated	
Restoration Priority Rating	Low	

Neighborhoods

Two distinct neighborhoods were identified and assessed within Lower Gunpowder Falls-B during the uplands assessment of the Lower Gunpowder Falls (Urban) watershed. Recommendations for this neighborhood included rain barrels, rain gardens, Bayscaping, and stream buffer improvements. A summary is presented in the Table 4-40.

Table 4-40: NSA Recommendations – Lower Gunpowder Falls-D

Site ID	Lot Size (acres)*	RECOMMENDED ACTIONS												Notes
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Pet Waste	Trash Management	Buffer Improvement	Parking Lot/Alley Retrofit	Street Sweeping	# of Street Trees	# of Open Space Trees	
NSA_N_12	1	5	✓	✓		✓			✓			0	20	Circle at Carreylan Dr. could be Bayscaped; opportunity for tree planting. Soil pile at the top of driveway upslope of stream is a sediment source. Inlets in grassed areas have retrofit potential.
NSA_N_13	1/4	15	✓		✓	✓						0	46	Tree planting in open parcel behind houses on Jerome Ave. Well-maintained lawns.

*Lot sizes are only available for single family homes – blanks indicated apartments or condominiums.

There are several opportunities for action in the neighborhoods assessed. Rain barrels could serve as temporary storage of roof runoff, decreasing the volume of stormwater running off site. Rain gardens may provide an area for roof runoff to infiltrate, as well as plants that can absorb excess nutrients and filter out pollutants. Bayscaping was also recommended in this neighborhood (Figure 4-54). This practice provides an attractive way for landscaping to improve stormwater infiltration, nutrient absorption and pollutant filtration on-site, while also enhancing the aesthetic value of the property.

Tree planting opportunities also exist in these neighborhoods, though not on as large a scale (<100 trees) as those in other subwatersheds. Still, these small-scale projects may encourage greater community engagement and are great opportunities for children and families to participate and become involved with their watershed in a concrete way. In addition, actions as simple as adjusting mowing practices and tree plantings along stream channels and drainage ditches may help to slow down high stream flows that cause bank erosion and intercept nutrients and toxins before they enter the aquatic ecosystem.

Figure 4-54: Typical Yard in NSA_N_12 with Opportunities for Rain Barrels, Rain Gardens, and/or Bayscaping

Hotspots

No hotspot investigations were performed within Lower Gunpowder Falls-D during the uplands assessments.

Institutions

No institutional site investigations were performed within Lower Gunpowder Falls-D during the uplands assessments.

Pervious Areas

No assessments of pervious areas were performed within Lower Gunpowder Falls-D during the uplands assessments.

Stream Restoration Recommendations

There were no stream restoration projects recommended for Lower Gunpowder Falls-D

Illicit Discharges

Lower Gunpowder Falls-D subwatershed contains two major outfalls, both of which are rated priority 0. Priority 0 outfalls are outfalls with insufficient data to determine a priority rating. This may be due to inaccessibility or if there has been only a single screening. Baltimore County will continue its Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

Stormwater Conversions

Lower Gunpowder Falls-D subwatershed contains no stormwater management dry ponds, therefore there were no dry ponds for Baltimore County EPS to select as a priority for conversion.

Subwatershed Management Strategy

Figure 4-55 provides a visual summary of restoration opportunities in the watershed.

Engaging Citizens & Watershed Groups

1. Conduct appropriate rain barrel and rain garden installation measures in NSA_N_12 and NSA_N_13.
2. Raise awareness among citizens about the benefits and importance of Bayscaping.
3. Raise awareness among residents about the importance of streamside buffers and encourage more environmentally friendly buffer treatments in NSA_N_12.
4. Encourage communities to plant open space trees. Table 4-40 shows potential neighborhoods for planting as many as 66 open space trees.

Municipal Actions

1. Continue to monitor illicit discharges. Conduct follow-up investigations of outfalls with insufficient data for priority as described above and in the Watershed Characterization Report.

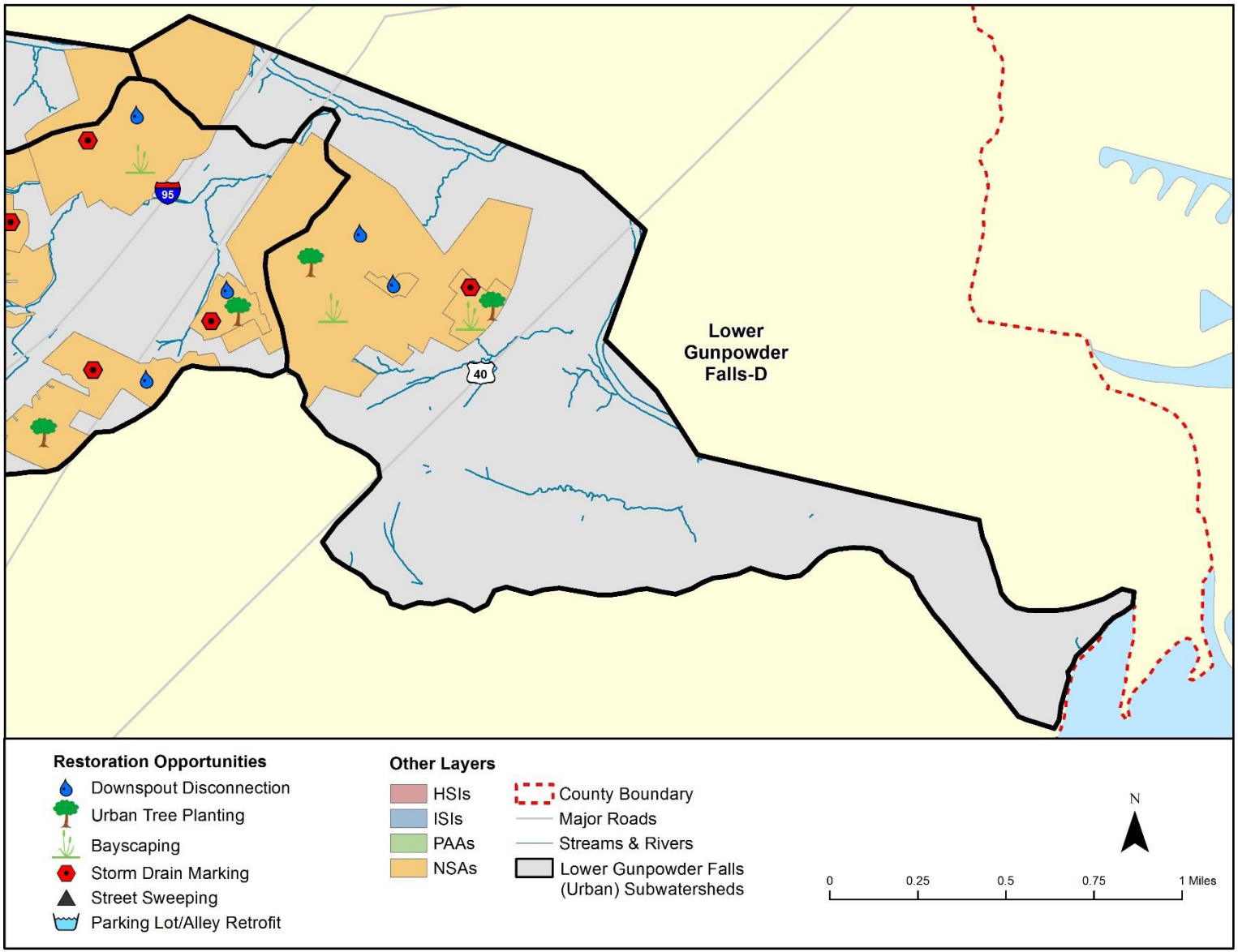


Figure 4-55: Restoration Opportunities in Lower Gunpowder Falls-D

4.4 WATERSHED-WIDE STRATEGIES

Some of the action strategies described in Chapter 3 and Appendix A apply to the entire Lower Gunpowder Falls (Urban) watershed and were not included under the specific subwatershed management strategies. This is because these actions are recommended for the watershed as a whole in order to be effective and help achieve restoration goals and objectives.

County Strategies: One example of a county action is the work implemented under the 2005 consent decree issued by USEPA and MDE to eliminate sanitary sewer overflows (SSOs). The capital improvement projects, operations improvements, and maintenance programs will result in a reduction of nutrients and bacteria entering streams throughout the entire Lower Gunpowder Falls (Urban) watershed.

Citizen-based Strategies: Actions associated with citizen awareness and participation also relate to the entire watershed in order to promote a positive perception of the Lower Gunpowder Falls (Urban) watershed and to effectively meet water quality goals and objectives. Examples of watershed-wide citizen actions include conducting tours of completed water quality BMPs and stream restoration projects and encouraging community stream clean-ups.

Chapter 5: **PLAN EVALUATION**

5.1 INTRODUCTION

The Lower Gunpowder Falls (Urban) SWAP is based on a 10-year implementation schedule (2025 endpoint). This timeframe is necessary to implement restoration measures that meet the Chesapeake Bay nutrient TMDL and address other impairments. The ability to implement this plan within the 10-year timeframe is dependent upon the availability of staff and sufficient funding. The Lower Gunpowder Falls (Urban) 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, an annual progress report and a biennial report on water quality monitoring results will be produced. An adaptive management approach will be used to meet watershed goals and objectives based on SWAP evaluation data. 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. As the Phase II Watershed Implementation Plan (WIP) addressing the Chesapeake Bay TMDL is implemented, or if other water quality issues arise, the Lower Gunpowder Falls (Urban) SWAP Implementation Committee will initiate a revision of the plan within six months of new TMDL approval or when a water quality issue arises.

Progress and success of the Lower Gunpowder Falls (Urban) 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. Actions will be organized into two year milestones, with the first interval being December 1, 2015 – November 30, 2017, and the final interval being December 1, 2023 – November 30, 2025. The progress and success of actions in Appendix A will be evaluated on an annual basis. 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 an annual 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 used in the Chesapeake Bay Program's (CBP) Phase 5.3 Watershed Model for various nonpoint source BMPs. These pollutant removal efficiencies will continue to be used to measure progress in meeting the TMDL reduction goals (i.e., 32.2% reduction in Total Nitrogen (TN) loads from urban stormwater discharges). CBP-approved BMP removal efficiencies are summarized in the tables included as Appendix D. Actions and associated pollutant load reductions will be reevaluated if CBP revises/updates pollutant removal efficiencies within the 10-year timeframe to ensure that the nutrient TMDL reductions are met.

5.4 IMPLEMENTATION TRACKING

Baltimore County intends to track implementation of the SWAP using a Geographic Information System (GIS), which will allow the County to record and map actions taken per the SWAP. The data generated from the GIS will be provided to the Lower Gunpowder Falls (Urban) SWAP Implementation Committee to assess annual progress through a comparison between completed restoration activities and the performance measures detailed in Appendix A. Pollutant load reductions that have been achieved through implementation of various restoration projects will also be calculated and tracked.

5.5 MONITORING

Baltimore County currently conducts water quality monitoring programs within the Lower Gunpowder Falls (Urban) watershed. 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 Lower Gunpowder Falls (Urban) watershed. These are described in detail in Chapter 3.4 of the Lower Gunpowder Falls (Urban) Watershed Characterization Report (Appendix E) and listed below:

- County Trend Chemical Monitoring Program – One sampling location (Minebank Run), measuring chemical concentrations and pollutant loads over time, including nutrients, suspended solids, and metals;
- County Biological Monitoring Program – Randomly selected locations in the Lower Gunpowder Falls watershed using characteristics of benthic macroinvertebrates as a water quality indicator; and
- Illicit Discharge Detection and Elimination Program – Routine outfall screening and prioritization system to track and reduce illicit connections and discharges. Future Hotspot Site Investigations (HSIs) will also be conducted under this 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 identified 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 street sweeping. Subwatershed monitoring will measure overall improvement in water quality as a result of multiple restoration activities within a subwatershed. There is potential to coordinate a citizen-based stream monitoring program, as the County has an active and interested partner in Gunpowder Valley Conservancy (GVC). The group currently organizes workshops, tree plantings and stream cleanups throughout the greater Gunpowder River watershed. Monitoring activities will be coordinated among SWAP participants (Baltimore County and GVC) through participation in the Lower Gunpowder Falls (Urban) SWAP Implementation Committee.

Chapter 6: **REFERENCES**

EPS (Baltimore County Department of Environmental Protection and Sustainability). 2012. *Baltimore County Phase II Watershed Implementation Plan.* July 2012. Baltimore County, MD. http://www.mde.state.md.us/programs/Water/TMDL/TMDLImplementation/Documents/FINAL_PhaseII_Report_Docs/Final_County_WIP_Narratives/Baltimore_County_WIPII_2012.pdf

EPS (Baltimore County Department of Environmental Protection and Sustainability). 2014. *NPDES Municipal Stormwater Discharge Permit - 2014 Annual Report.* EPS – Watershed Management and Monitoring Section. Baltimore County, MD.

McCormick Taylor. 2011. Lower Gunpowder Falls Watershed Assessment (WA). Prepared for Baltimore County Department of Environmental Protection and Sustainability (EPS). Towson, MD.

MDE (Maryland Department of the Environment). 2000. *2000 Maryland Stormwater Design Manual, Volumes I & II.* Prepared by the Center for Watershed Protection. Ellicott City, MD. Revised May 2009.

MDE (Maryland Department of the Environment). 2014. *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated – Guidance for NPDES Stormwater Permits*. Baltimore, MD.

Parsons Brinckerhoff Quade & Douglas, Inc. 1999. Lower Gunpowder Falls Water Quality Management Study (WQMS). Prepared for Baltimore County Department of Environmental Protection and Resource Management (EPS). Baltimore, MD.

Schueler, T. and B. Stack. 2013. *Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects.* Final Approval by Watershed Quality Goal Implementation Team: May 13, 2013. Revised: September 8, 2014. *http://www.chesapeakebay.net/documents/Final_CBP_Approved_Expert_Panel_Report_on_Stream_Restoration_revised102813_LONG.pdf*

Schueler, T. and C. Lane. 2013. *Recommendations of the Expert Panel to Define Removal Rates for Urban Nutrient Management – CBP Final Approved Report.* Approved by Water Quality Goal Implementation Team: March 11, 2013. *http://www.chesapeakebay.net/documents/Final_CBP_Approved_Expert_Panel_Report_on_Urban_Nutrient_Management--short.pdf*

USEPA (U.S. Environmental Protection Agency). 2008. *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*. EPA 841-B-08-002. Washington, D.C.

APPENDIX A: LOWER GUNPOWDER FALLS (URBAN) WATERSHED ACTION STRATEGIES

Lower Gunpowder Falls (Urban) Watershed Action Strategies

This appendix presents the actions related to the goals and objectives presented in Chapter 2 of the Lower Gunpowder Falls (Urban) Small Watershed Action Plan (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, as indicated in the table. Some of the key columns included in Table A-1 are briefly described below.

Goals and Objectives

Overall goals and objectives are listed in Chapter 2 of the SWAP report, and are referred to by number in Table A-1.

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
  - Sediment Reduction
  - Stormwater Management
  - Urban Tree Canopy
  - Trash Management
  - Stream Corridor Restoration
- 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

This column denotes 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).

Partners

Those tasked with a given action are denoted by a numeric code in this column. This does not imply a legal obligation. Partners are indicated by numerals as follows:

1. Baltimore County EPS,
2. Gunpowder Valley Conservancy (GVC), and
3. Lower Gunpowder Falls (Urban) SWAP Implementation Committee.

Table A- 1: Lower Gunpowder Falls (Urban) Watershed Action Strategies

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Partners
RESTORATION ACTIONS							
Nutrient Reductions							
1	1,2, 5	Continue municipal road maintenance street sweeping activities	Existing Operations – bulk removal rates reported	On-going	Pounds removed	Existing staff	1
1	1,2	Develop a community awareness program which discusses the impacts of nutrients to the watershed, Gunpowder River and Chesapeake Bay	Community awareness work plan developed	2 years	Awareness program developed	Existing staff	1, 2
4	3						
1	1,4	Continue to meet the requirements of the consent decree for the elimination of sanitary sewer overflows	Status report	On-going	Status Report	Existing staff	1
2	3						
Stormwater Management							
1	1,2,5	Convert 4 existing dry detention ponds identified for water quality treatment; continue evaluation other dry ponds for conversion	4 existing detention ponds identified as having physical expansion x 100% projected participation = 4 conversions	8 years	1 conversion per 2 year period	$3,200 per drainage area acre treated	1
2	1						
1	1,2,5	Work with institutional partners and to reduce impervious cover at the 6 institutional sites identified	Maximum potential of 0.3 acre of impervious cover removal identified x 50% participation rate (assumes 50% of acreage) = removal of 0.15 acres	6 years	1 institution per year	$25,000 per acre	1, 2
2	1						
1	1,2,5	Develop and implement a downspout disconnection program; promote redirection of downspouts for downspout disconnection in the 32 recommended neighborhoods	80.3 acres of impervious rooftop identified x 66% participation rate = 53.0 acres	10 years	Address 5.5 rooftop acres per year	$152,374/acre	2, 3
2	1						
4	3						
1	1,2,5	Promote rain barrel and/or rain garden use in the 88 neighborhoods where such actions were recommended	Conduct 10 rain barrel and/or rain garden awareness seminars targeting 9 neighborhoods per event (303.5 acres of area of impervious rooftop identified x 10% participation rate = 30.4 acres)	10 years	1 event per year	$500 / event	2, 3
2	1						
4	3						

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Partners
1	1,2,5	Investigate the feasibility of implementing stormwater retrofits to treat runoff from impervious surfaces (parking lots, rooftops) at the 3 hotspots identified as having retrofit potential	3 hotspot sites investigated for feasibility of stormwater retrofits	2 years	Feasible retrofit sites identified	Existing staff	1
2	1						
4	3						
1	1,2,5	Investigate the feasibility of implementing stormwater retrofits to treat runoff from impervious surfaces (parking lots, rooftops) at the 15 institutional sites identified	15 institutional sites identified as being possible for stormwater retrofits	2 years	Feasible retrofit sites identified	Existing staff	1, 2
2	1						
4	3						
1	1,2,5	Design and implement stormwater retrofits at all feasible sites	15 Institutions + 3 Hotspots x 50% participation rate = 9 stormwater retrofits	9 years	1 retrofits per year	$3,200 per drainage area acre treated	1, 2
2	1						
4	3						
1	1,2,5	Triennial Inspection and maintenance of stormwater conversions and retrofits	4 conversions + 9 retrofits = 13 projects	10 years	4-5 inspections per year	Existing staff	1
4	3						
Urban Tree Cover							
1	1,2,5	Investigate the feasibility of planting riparian stream buffers on open pervious land	406 acres of open pervious land identified within the 100-foot stream buffer through GIS analysis	2 years	Feasible buffer planting sites identified	Existing staff	1, 2
2	1,2						
3	3						
5	3						
1	1,2,5	Reforest stream buffer at feasible sites with a minimum width of 35 feet	406 acres of open pervious land identified in the GIS analysis x 80% participation rate = 325 acres	10 years	Reforest 33 acres per year	$15,000 per acre	1,2
2	1,2						
3	3						
5	3						
1	1,2,5	Plant trees on Pervious Area Assessment (PAA) sites, focusing efforts on sites identified as mostly open pervious cover type requiring minimal site preparation; this includes working with MD SHA to plant trees in suitable medians and rights-of-way	38 acres of PAA sites x 75% = 29 acres	10 years	Reforest 3 acres per year	$6,000 per acre	1,2
2	1,2						
3	3						
5	3						
1	1,2,5	Encourage street and open space tree planting in the 35 recommended neighborhoods	Maximum potential of 6,353 trees x (1 acre/100 trees) = 63.5 acres x 50% participation rate = 31.8 acres (or 3,180 trees)	10 years	Plant 318 trees per year	$175 per tree	1,2,3
2	1,2						
4	3						

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Partners
1	1,2,5	Encourage institutions to plant trees on available open space at the 11 sites identified	Maximum potential of 181 trees x (1 acre/100 trees) = 1.8 acres x 75% participation rate = 1.4 acres (or 140 trees)	10 years	Plant 14 trees per year	$175 per tree	1,2,3
2	1,2						
4	3						
1	1,2,5	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	On-going	Acres preserved	Existing staff	1
2	1,2						
3	3						
4	3						
1	1,2,5	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 = 369.2 acres	5 years	Maintain 369.2 acres per year	$1300 per acre per year	1,2,3
2	1,2						
3	1,2,3						
4	3						
3	1,2,3	Improve forest habitat by organizing exotic invasive species removal activities every year	Organize 1 exotic species removal activity addressing 1 acre per year	10 years	Exotic species removed from 1 acre per year	$500 per year	2,3
4	3						
5	3						
1	1,2,5	Support the state's No-Net-Loss of Forest Policy	On-going, keep track of existing forest coverage; prioritize forest conservation; off-set all forest losses	On-going	Stabilization of the rate of loss by 2020 with the goal of maintaining the County's existing forest coverage	Existing staff	1
2	2						
3	3						
5	1						
Trash Management							
2	3	Develop a trash and litter management work plan	Work plan developed	2 years	Plan completed	Existing staff	1
4	3						
5	1,3						
1	1,2,5	Investigate hotspots and institutions identified as having trash management related problems and/or recommended for future education for enhancing trash management, and identify areas where additional trash cans, covered receptacles, and/or better maintenance measures are needed; enforce additional measures and better maintenance where necessary	13 hotspots and 7 institutions with trash management problems identified, schedule site visits to discuss/review trash management solutions	5 years	Perform 4 site visits per year	Existing staff	1
2	1,3						
4	1						

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Partners
2	3	Implement recycling and add separate receptacles for recycling on public properties such as parks and county-owned golf courses	Add recycling receptacles at public parks, county-owned golf courses, and other feasible sites	5 years	Recycling implemented at feasible sites	Existing staff	1
4	3						
Stream Corridor Restoration							
1	1,2	Evaluate the restoration potential and feasibility of restoring eroded stream banks and channel alterations identified in the stream corridor assessments	Identify feasible restoration projects at any Countywide stream survey sites that noted severely eroding/unstable banks	2 years	Feasible restoration projects identified	Existing staff	1
2	1,2						
1	1,2,5	Conduct a follow up inspection of the outfalls rated as potentially severe or severe-moderate issues identified during outfall screening in the Illicit Discharge and Elimination Program	7 outfall locations rated as Priority 1 (Critical) and 21 outfall locations rated as Priority 2 (High) = 28 locations total	3 years	Conduct 9-10 inspections per year	Existing staff	1
2	1,3						
1	1,2	Complete stream restoration identified in the stream corridor assessments where feasible	Stabilize and restore all unstable stream reaches in the Lower Gunpowder Falls (Urban) watershed (9,516 feet) identified during previous studies that are considered to still be viable projects streams to provide water quality improvement	10 years	952 Ln ft per year	$350 / Ln ft	1
2	1,2						
OUTREACH & AWARENESS							
1	1,2,5	Distribute pollution prevention information to facilities falling within hotspot categories identified in 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	13 potential hotspot sites assessed; Categories identified: shopping centers, restaurants, equipment rental, and commercial services; Conduct 3 workshops and distribute outreach material	6 years	Conduct 1 workshop every 2 years	$500 /workshop	1,2,3
2	1,3						
4	3						
1	1	Develop a community outreach campaign to raise awareness about homeowner actions aimed towards nutrient reduction	Publicize several actions in E-News Stream and other media, and at environmental events	On-going	4 announcements per year	Existing Staff	1,2,3
2	1						
4	3						

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Partners
1	1,2,5	Form partnerships with institutions and discuss the best management practice (BMP) recommendations from the institutional assessments and implementation options; include implementing/enhancing recycling programs on their properties	15 institutions assessed with potential for stormwater management retrofit	5 years	3 institution meetings per year	Existing staff	1,3
2	1						
4	3						
1	1,2,5	Work with community groups to install storm drain markers in the 78 recommended neighborhoods.	Mark storm drains in 25% (20 of the 78) potential neighborhoods identified	10 years	2 neighborhoods per year	$400 /neighborhood	2,3
2	1,3						
4	3						
1	1,2,5	Work with the institutional sites to install storm drain markers at the 6 recommended sites	Mark storm drains at the 6 institutional sites identified	3 years	2 institutions per year	$400 /institution	1,2,3
2	1,3						
4	3						
4	3	Develop and implement signs and educational material for a recycling campaign in the watershed	Develop signs and post throughout watershed	3 years	Develop material, post signs	Existing staff	1,3
5	3						
1	1	Implement trash and litter management work plan	Submit in the NPDES Report the progress toward implementing the trash and litter work plan	5 years	Annual	Existing staff	1
2	1,3						
2	3	Encourage institutional partners, community groups, and patrons of public properties to sign and support a trash treaty (a pledge to implement strategies aimed at reducing litter and promoting awareness on the effects of pollution)	Have sign-up events	10 years	1 sign-up event per year	Existing staff	1,3
4	3						
5	3						
1	1	Encourage and support community education and signage in the 4 neighborhoods identified as having issues with pet waste	4 neighborhoods identified as having pet waste issues	4 years	Post signage in 1 community per year	Existing staff	1,2,3
2	3						
1	5	Encourage and support waterway cleanups in streams	Conduct at least three waterway cleanups per year; cost includes supplies and tire removal	10 years	3 waterway cleanups per year	$1000 per cleanup	1,2,3
2	1,3						
4	3						
4	3	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, stormwater conversion)	10 years	1 tour per 5 years	Existing staff	1

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Partners
4	1,3	Using various media, develop and distribute information about public access points along the Lower Gunpowder Falls for recreational purposes	Distribute information to the public on access points.	10 years	1 per year	Existing staff	1,2,3
4	All	Increase public awareness about the Lower Gunpowder Falls (Urban) SWAP (in an easily digestible format) and promote awareness about the extent of and connection to the Lower Gunpowder Falls	SWAP Implementation Committee to design a messaging campaign (including pamphlet about the SWAP and signs to inform people they are entering or within the Lower Gunpowder Falls (Urban) watershed, as well as a strategy for distribution and placement)	2 years	Design, creation and distribution/posting of pamphlets and signs	Existing staff	1,2,3
1	1,2	Encourage lawn reduction and promote Bayscaping in the 55 neighborhoods identified	Conduct 10 Bayscaping awareness events targeting 5-6 recommended neighborhoods per event (842 acres of lawn identified for Bayscaping x 5% participation rate = 42.1 acres)	5 years	2 events every year	$500 per event	2,3
4	3						
4	3	Direct some of the outreach and education events to areas that are presently still in good condition and use those opportunities to inform residents of their ability to prevent impairment/degradation of the healthy resources in their area	Pursue education and outreach efforts within the very high priority “Protection Subwatersheds” listed in Section 4.2.11 of SWAP Report	10 years	1 event per year in each of the top three priority protection subwatersheds (total of 3 events per year)	Cost already noted above	2,3
4	3	GVC to help facilitate a meeting between Lower Gunpowder Falls (Urban) SWAP Implementation Committee and Clear Creeks representatives	Meeting held where productive and successful strategies used by Clear Creeks may be shared Lower Gunpowder Falls (Urban) SWAP Implementation Committee in order to help guide the Committee as they begin working towards achieving the SWAP goals	1 year	Meeting held with Clear Creeks group	Existing staff	2,3
MONITORING							
1	1,2,5	Continue to remove illicit connections when discovered through the Illicit Connect Program	As per NPDES Permit, perform 150 screenings County-wide per year	On-going	Reported annually in NPDES Permits	Existing staff	1

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Partners
1	1,2,5	Continue the illicit connection monitoring at the major outfalls in the watershed and complete one inspection at each of the minor outfalls	46 major outfall locations and 234 minor outfall locations = 280 outfall inspections	10 years	28 outfalls per year	Existing staff	1
2	3						
1	1,2,5	Continue to implement the citizen-based stream watch program to increase the ability to monitor/identify sources of water quality and habitat degradation	Promote watershed awareness and additional identification on sources of impairment, and potential restoration locations	10 years	Number of stream watcher volunteers	Existing staff	1,2,3
2	1,4						
4	3						
1	1,2,5	Conduct periodic inspection of BMPs and provide on-going maintenance to assure their continued proper functioning	Assure that each facility is inspected every 3 years	On-going	Inspections completed	Existing staff	1
2	4	Continue probabilistic biological monitoring program	Biological monitoring stations in the Lower Gunpowder Falls watershed are monitored in even-numbered years – report produced	Odd-numbered years	Stations monitored, report produced	Existing staff	1
1	1,2,5	Work with teachers to develop meaningful watershed environmental education (MWEE) activities for students at Baltimore County public schools	5 public schools identified as having education opportunities for possible BMP monitoring (among other potential action opportunities at these sites)	10 years	1 school every 2 years	Existing staff	1,2,3
4	3						
FUNDING							
1	1	Coordinate grant funding requests to secure funding and implement restoration projects to meet TMDL nutrient reduction requirements	Seek a minimum of 1 grant per year to meet the TMDL requirements within 10 years	10 years	1 grant proposal per year	Existing staff	2,3
1	1,2	Support Soil Conservation District (SCD) and their ability to reduce pollution from agriculture lands and increasing Critical Area enforcement by supporting increased funding and staffing within State budget	Increase in number of staff within Soil Conservation District office	On-going	Contacting local legislators regarding State budget priorities	Existing staff	2,3
2	1,2						
4	3						
1	1,2	Increase applications for the Baltimore County – Green Building Tax Credit Program	Provide incentive for landowners to install BMPs to address water quality and habitat	5 years	# of applications	Existing staff	1,2,3
4	3						

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Partners
REPORTING							
All	All	Lower Gunpowder Falls (Urban) SWAP Implementation Committee will meet to discuss implementation progress and assess any changes needed to meet the goals	Meet on a semi-annual basis	10 years	2 meetings per year	Existing staff	3
All	All	Coordinate restoration activities between and among Baltimore County and GVC	Documented in NPDES annual report	On-going	NPDES annual report	Existing staff	1,2
1	4	Designate county personnel to provide updates to the SWAP Implementation Committee on the status of the consent decree projects for sewer infrastructure repair	Present updates at the semi-annual SWAP Implementation Committee meetings	10 years	2 meetings per year	Existing staff	1
All	All	Produce State of Our Watersheds report	Report is produced biennially	2 years	Report is produced every 2 years	$11,000 per 2 years	1
All	All	Track progress toward meeting TMDL reduction requirements using GIS and other data tracking tools	Track progress using system similar to that being used for similar SWAPs (e.g., Northeastern Jones Falls, Bird River, Middle Gwynns Falls, etc.)	2 years	Annual update to Lower Gunpowder Falls (Urban) SWAP Implementation Committee	Existing staff	1,3
1	1,2,5	Update the status of citizen-based restoration projects and BMPs	Provide update of progress made in annual NPDES report	On-going	NPDES annual report	Existing staff	1,2
2	1,2						
4	3						
1	All	Continue to update status of county capital budget restoration projects and BMPs	Provide update of progress made in annual NPDES report	On-going	NPDES annual report	Existing staff	1
2	1,2,3						

APPENDIX B: U.S. ENVIRONMENTAL PROTECTION AGENCY A THROUGH I CRITERIA FOR WATERSHED PLANNING

U.S. Environmental Protection Agency
A Through I Criteria for Watershed Planning

Background

EPA's Section 319 Grant program was established to provide funding for efforts to reduce nonpoint source (NPS) pollution, including that which occurs though stormwater runoff. The EPA provides funds to state and tribal agencies, which are then allocated via a competitive grant process to organizations to address current or potential NPS concerns.

Section 319 funds may be used to demonstrate innovative best management practices (BMPs), support education and outreach programs, establish TMDLs for a watershed, or to restore impaired streams or other water resources. 303(d) listed waters approved by the EPA are the top priority for incremental funds.

The EPA requires that nine elements (labeled "a" though "i") be included in a watershed plan for impaired waters funded using Section 319 funds. Although there is no formal requirement for EPA to approve watershed plans, the plans must address the nine elements discussed below if they are developed in support of a section 319-funded project. Below, we review how the development of the Lower Gunpowder Falls (Urban) Small Watershed Action Plan addresses each of the nine elements.

Addressing the Nine Elements for the Lower Gunpowder Falls (Urban) Watershed

The County's progress in addressing the nine elements ("a" thru "i") required for 319 funding is described below:

a) ***Causes of Impairment:*** *Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan. Sources that need to be controlled should be identified at the significant subcategory level along with estimates of the extent to which they are present in the watershed.*

   This element will usually include an accounting of the significant point and nonpoint sources in addition to the natural background levels that make up the pollutant loads causing problems in the watershed. If a TMDL exists, this element may be adequately addressed. (USEPA 2008)

Impairments to Chesapeake Bay are well recognized and are being addressed by multiple agency efforts under the Chesapeake Bay TMDL for nitrogen, phosphorus, and sediment. There are no watershed-specific impairments listed for the area covered by the Gunpowder Falls (Urban) SWAP.

Section 1.3.3 of the SWAP contains further information on the Chesapeake Bay TMDL, a copy of which is in the Appendix H of the Characterization Report (Appendix E). Chapter 3 of the Characterization Report includes estimates of pollutant loads.

b) ***Estimate Load Reductions:*** *On the basis of the existing source loads estimated for element "a" above, you will similarly determine the reductions needed to meet the water quality standards. You will then identify various management measures (see element "c" below) that will help to reduce the pollutant loads and estimate the load reductions expected as a result of these management measures to be implemented, recognizing the difficulty in precisely predicting the performance of management measures over time. In cases where a TMDL for affected waters has already been developed and approved or is being developed, the watershed plan should be crafted to achieve the load reductions called for in the TMDL.* (EPA 2008)

Expected nitrogen and phosphorus load reductions were calculated based on Maryland Assessment Scenario Tool (MAST) load reduction criteria. These load reduction criteria are presented in Appendix D. The nitrogen, phosphorus, and sediment load reductions for the various proposed actions in the Lower Gunpowder Falls (Urban) watershed were calculated and summarized in Chapter 3 of the SWAP.

Estimated load reductions needed are as follows:

- Reduce annual Total Nitrogen (TN) and Total Phosphorus (TP) loadings from urban land in the Lower Gunpowder Falls (Urban) SWAP area by 32.2% and 47.0% respectively to meet the requirements of the Chesapeake Bay TMDL.

MAST (CBP-approved) BMP removal efficiencies are summarized in the tables included as Appendix D. These pollutant removal efficiencies will continue to be used to measure progress in meeting the nutrient TMDL reduction goal. Actions and associated pollutant load reductions will be reevaluated if CBP revises/updates pollutant removal efficiencies within the 10-year timeframe to ensure that the TMDL reductions are met.

c) ***Description and location of NPS management measures:*** *A description of the NPS management measures that will need to be implemented to achieve load reductions, and a description of the critical areas in which those measures will be needed to implement this plan. This description should be detailed enough to guide implementation activities and can be greatly enhanced by identifying on a map priority areas and practices.* (EPA 2008)

This Small Watershed Action Plan, by definition, identifies strategies for bringing a small watershed into compliance with water quality criteria. The strategies employed in this SWAP include a combination of government capital projects, actions in partnership with local watershed associations, citizen awareness campaigns and volunteer activities. Chapter 3 summarizes restoration strategies/NPS management measures. Specifically, information on the achievement of the phosphorus and nitrogen reduction goals is provided in Section 3.4. Chapter 4 specifies implementation locations, by subwatershed, detailing management measures recommended for each subwatershed in the SWAP study area. The management measures that will need to be implemented to achieve the goals are detailed further in Appendix A.

Note that the projected, practicable implementation of proposed restoration BMPs, shown in Table 3-17 and Table 3-18 will only achieve slightly more than half of the 32.2% reduction for nitrogen and will exceed the 47.0% reduction for phosphorus loads needed to meet water quality standards for the Lower Gunpowder Falls (Urban) watershed as specified by Chesapeake Bay TMDL for nutrients (Appendix E).

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 and tours of completed projects). However, these types of actions are not included in the pollutant removal analysis because reductions efficiencies are not well known and difficult to estimate.

d) ***Estimate of the amounts of technical and financial assistance*** *needed associated costs, and/or the sources and authorities that will be relied upon to implement this plan. This includes implementation and long-term operation and maintenance of management measures, information/education activities, monitoring, and evaluation activities. You should also document which relevant authorities might play a role in implementing the plan. Plan sponsors should consider the use of federal, state, local, and private funds or resources that might be available to assist in implementing the plan. Shortfalls between needs and available resources should be identified and addressed in the plan. The estimate of financial and technical assistance should take into account the following* (EPA 2008)*:*

- *Administration and management services, including salaries, regulatory fees, and supplies, as well as in-kind services efforts, such as the work of volunteers and the donation of facility use;*
- *I/E efforts;*
- *The installation, operation, and maintenance of management measures; and*
- *Monitoring, data analysis, and data management activities.*

Appendix A details the anticipated cost for each action on an annual or unit basis and details the organizations that will be responsible for implementation of the each action. Appendix C provides a cost analysis and anticipated funding sources to implement the actions.

Baltimore County's NPDES program generally, as well the program infrastructure needed to implement this SWAP, is already well-established as demonstrated by previously completed technical Water Quality Management Plans, such as the 1999 Lower Gunpowder Falls Water Quality Management Study and the 2011 Lower Gunpowder Falls Watershed Assessment, which this effort builds upon. Additionally, Lower Gunpowder Falls (Urban) watershed partners have worked together over the past year, conducting assessments, identifying restoration opportunities, and engaging the community, in order to build a successful SWAP.

A Lower Gunpowder Falls (Urban) SWAP Steering Committee, consisting of various watershed partners, was formed to develop this SWAP. This includes Baltimore County EPS and Department of Planning personnel, Gunpowder Valley Conservancy, staff from Maryland Department of Natural Resources, Alliance for the Chesapeake Bay, Master Gardeners, and various community associations and concerned citizens. The Steering Committee met regularly throughout the SWAP development and will form the basis for a similar group to carry out SWAP implementation.

e) ***An information and education component*** *used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented*. (EPA 2008)

The participation of citizens in watershed restoration is an essential part of the SWAP process. Citizen participation is critical to the implementation and long-term maintenance of restoration activities. Two citizen stakeholder meetings were held as part of the SWAP process (see Chapter 1). Key citizen-based strategies proposed for restoring Lower Gunpowder Falls (Urban) including nutrient management, lawn maintenance education, Bayscaping, downspout disconnection, tree planting, stream buffer management (see Chapter 3). This demands continued participation by citizen stakeholders. Specific strategies by subwatershed which include an information and education component are detailed in Chapter 4. Outreach and awareness components by action are detailed in Appendix A.

f) ***Schedule for implementing the NPS management measures*** *identified in this plan that is reasonably expeditious. The schedule should reflect the milestones you develop in measure "g".* (EPA 2008)

Each action strategy listed in Appendix A has a timeline and where appropriate, a temporal performance measure. It is anticipated that the restoration will require a 10-year timeframe. Some actions have a shorter time frame based on sequencing of actions, or on the urgency of the actions. However, most management measures have annual performance measures that will determine if the restoration is on pace to be completed within the time frame. The limitations on the pace of the implementation include staffing, and funding. Increases in staffing and funding will be used to accelerate the restoration timeline. Chapter 5 presents an adaptive management approach to implementation.

g) ***A description of interim measurable milestones*** *for determining whether NPS management measures or other control actions are being implemented. These milestones will measure the implementation of the management measures, such as whether they are being implemented on schedule, whereas element h (see below) will measure the effectiveness of the management measures, for example, by documenting improvements in water quality. (EPA 2008)*

Actions will be organized into two year milestones, with the first interval being July 1, 2016 - June 30, 2018, and the final interval being July 1, 2024 – June 30, 2026. Additionally, most action strategies (listed in Appendix A) have an associated time-sensitive performance measure. Additionally each will be evaluated on an annual basis and may be modified and/or new actions may be proposed based on this annual evaluation. New actions proposed will also be evaluated on an annual basis and modified as necessary to meet watershed goals and objectives and if new TMDLs are approved.

Chapter 5 provides a plan for evaluation of NPS management measures implementation. This includes formation of the Lower Gunpowder Falls (Urban) SWAP Implementation Committee which will meet twice per year to assess progress in meeting watershed goals and objectives and generation of an annual progress report. A biennial report on water quality monitoring results will be produced as well.

Additionally, Baltimore County intends to track implementation of the SWAP using a Geographic Information System (GIS), which will allow the County to record and map all actions taken per the SWAP. The data generated from the GIS will be provided to the Lower Gunpowder Falls (Urban) SWAP Implementation Committee to assess annual progress through a comparison between completed restoration activities and the performance measures detailed in Appendix A. Pollutant

load reductions that have been achieved through implementation of various restoration projects will also be calculated and tracked.

h) ***A set of criteria that can be used to determine whether loading reductions are being achieved*** *over time and substantial progress is being made toward attaining water quality standards (WQS). The criteria in element h (not to be confused with water quality criteria in state regulations) are the benchmarks or waypoints to measure against through monitoring. These interim targets can be direct measurements (e.g., fecal coliform concentrations) or indirect indicators of load reduction (e.g., number of beach closings). You should also indicate how you'll determine whether the watershed plan needs to be revised if interim targets are not met. (EPA 2008)*

Appendix A gives a "performance measure" which 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.

Current pollutant load reduction scenarios and calculations for proposed actions are presented in Chapter 3 of the SWAP. These are mainly based on CBP-approved, pollutant removal efficiencies for various nonpoint source BMPs used in the Maryland Assessment Scenario Tool (MAST). These pollutant removal efficiencies will continue to be used to measure progress in meeting the nutrient TMDL reduction goals. Actions and associated pollutant load reductions will be reevaluated if CBP revises/updates pollutant removal efficiencies within the 10-year timeframe to ensure that the nutrient TMDL reductions are met.

As mentioned in element "g" above, the Lower Gunpowder Falls (Urban) SWAP Implementation Committee will generate a biennial report on water quality monitoring results and action strategies will be modified as required to respond to a lack of substantial progress and/or new TMDL.

i) ***A monitoring component*** *to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item h immediately above. The monitoring component should be designed to determine whether loading reductions are being achieved over time and substantial progress in meeting water quality standards is being made. (EPA 2008)*

Chapter 5 details the monitoring that will occur to evaluate the effectiveness of implementation. The monitoring results will be compared to the predicted load reductions determined under item (h), above. Baltimore County conducts chemical, biological, and illicit connection monitoring within the Lower Gunpowder Falls (Urban) watershed which are appropriate for measuring changes in loading. Additional monitoring is anticipated in order to assess the effectiveness of restoration projects and progress in meeting nutrient TMDL reductions. Current applicable monitoring is described in detail in Chapter 3.4 of the Watershed Characterization Report (Appendix E) and listed below:

- County Trend Chemical Monitoring Program – 1 sampling location (GU08 – Minebank Run), measuring total suspended solids (TSS), nutrients, metals, and chloride;
- County Biological Monitoring Program – Randomly selected locations in the Lower Gunpowder Falls (Urban) watershed using characteristics of benthic macroinvertebrates as a water quality indicator; and

- Illicit Discharge Detection and Elimination Program – Routine outfall screening and prioritization system to track and reduce illicit connections and discharges.

Project specific monitoring will be identified 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 lawn care 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.

Monitoring activities will be coordinated among SWAP participants (e.g., Baltimore County, Maryland DNR, and GVC) through participation in the Lower Gunpowder Falls (Urban) SWAP Implementation Committee. There is potential to coordinate a citizen-based stream watch program since the existing water quality monitoring stations are limited in the Lower Gunpowder Falls (Urban) watershed.

APPENDIX C: 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 Lower Gunpowder Falls (Urban) SWAP. Each is described below. The cost analysis is based on the actions detailed in Appendix A. Cost estimates are summarized in Tables C-1 and C-2.

Table C-1 presents cost estimates based on the maximum implementation scenario described in Chapter 3. Table C-2 presents costs estimates based on the projected participation rates needed to achieve the reduction in nutrient loads and sediment from urban runoff, also described in Chapter 3.

For both scenarios, estimates provided are in current dollars and represent total cost estimates for the anticipated 10-year implementation timeframe. Unit costs are based on a combination of local information and previous SWAPs completed for other local watersheds (e.g., Tidal Back River, Lower Patapsco River, and Bird River). BMP costs are not annualized over the 10-year implementation timeframe and do not include costs of existing staff. Costs are also presented in dollars per pound of nitrogen, phosphorus, and TSS 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 **$22,026,717** for maximum implementation and **$16,619,316** based on projected participation rates. This does not include cost associated with sanitary sewer overflow prevention.

Potential Funding Sources

Funding sources for the implementation of the Lower Gunpowder Falls (Urban) SWAP include local government funding for Baltimore County, monetary and time contributions to the Lower Gunpowder Falls (Urban) SWAP Implementation Committee, 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. The capital budget is projected for six years, with a two-year cycle for changes. The Lower Gunpowder Falls (Urban) watershed as a whole currently has $1.1 million allocated for restoration projects over the six-year period. 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 C-2, additional funding from grants will be required. Table C-3 presents potential funding sources to support the implementation of the Lower Gunpowder Falls (Urban) 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 (Trust Fund):** Established during the 2008 Legislative Session by Senate Bill 213 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 from the Trust Fund, 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:** Approximately $1,000,000 of federal money for restoration implementation is available annually through MDE.

- **Bay Restoration Fund (MDE):** The Bay Restoration Fund offers financial assistance to local governments for voluntary stream and creek restoration projects that improve water quality and restore habitat. Funds are targeted to seriously degraded water bodies in Maryland. Types of projects funded include: stream channel reconstruction, stream bank stabilization, vegetative buffers, wetlands creation, treatment of acid mine drainage, and dredging.

- **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 of between $200,000 and $1,000,000 each 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), and the U.S. Department of 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 C-1. Maximum Estimated Costs for Lower Gunpowder Falls (Urban) SWAP Implementation

BMP or Action	Cost	Unit	Projected	Quantity	Proj. Total Cost	Proj. TN Load Reduction (lbs/year)	Proj. Cost/ lb of TN Removal*	Proj. TP Load Reduction (lbs/year)	Proj. Cost/lb of TP Removal*	Proj. TSS Load Reduction (lbs/year)	Proj. Cost/lb of TSS Removal*
Dry pond Conv.	$3,200	/acre	42	acres	$134,400	172	$781.40	14	$9,600.00	16,459	$8.17
Stormwater Retrofits: Bioretention	$3,200	/acre	11.65	acres	$37,280	63.2	$589.87	8.7	$4,285.06	13,410	$2.78
Stream Buffer Reforestation (pervious areas)	$15,000	/acre	406	acres	$6,090,000	4,559	$1,335.82	179	$34,022.35	206,659	$29.47
Pervious Area Reforestation	$6,000	/acre	38	acres	$228,000	328	$695.12	7	$32,571.43	7,125	$32.00
Stream Corridor Restoration	$350	/Linear foot	9,516	ft	$3,330,600	714	$4,664.71	647	$5,147.76	427,078	$7.80
Downspout Disconnection	$152,374	/acre	80	acres	$12,189,920	699	$17,439.08	73	$166,985.21	140,710	$86.63
Neighborhood Tree Plantings	$175	/tree	64	acres	$11,200	553	$20.25	12	$933.33	12,007	$0.93
Institution Tree Plantings	$175	/tree	1.81	acres	$317	16	$19.80	0.35	$905.00	342	$0.93
Bayscaping Education	$500	/event	10	Events	$5,000	**	**	**	**	**	**
Street Sweeping	***	/mile	150	Miles	***	343	***	137	***	41,132	***
				Total:	**$22,026,717**						

* This projected cost is for the first year. Cost per pound removed decreases for every subsequent year the device is functioning.

** Removal efficiencies for BayScaping have not been set and incorporated into MAST at this time, so estimated load reductions could not be calculated.

*** Street sweeping does not add to the cost of the SWAP Implementation. It is assumed that existing Baltimore County staff would be responsible for the action, and therefore not additional cost would be incurred.

Table C-2. Projected Estimated Costs for Lower Gunpowder Falls (Urban) SWAP Implementation

BMP or Action	Cost	Unit	Projected	Quantity	Proj. Total Cost	Proj. TN Load Reduction (lbs/year)	Proj. Cost / lb of TN Removal*	Proj. TP Load Reduction (lbs/year)	Proj. Cost/lb of TP Removal*	Proj. TSS Load Reduction (lbs/year)	Proj. Cost/lb of TSS Removal*
Dry pond Conv.	$3,200	/acre	42	acres	$134,400	172	$781.40	14	$9,600.00	16,459	$8.17
Stormwater Retrofits: Bioretention	$3,200	/acre	5.83	acres	$18,656	31.6	$590.38	4.33	$4,308.55	6,705	$2.78
Stream Buffer Reforestation (pervious areas)	$15,000	/acre	325	acres	$4,875,000	3,647	$1,336.72	143	$34,090.91	165,327	$29.49
Pervious Area Reforestation	$6,000	/acre	29	acres	$174,000	246	$707.32	5.54	$31,407.94	5,344	$32.56
Stream Corridor Restoration	$350	/Linear foot	9,516	ft	$3,330,600	714	$4,664.71	647	$5,147.76	427,078	$7.80
Downspout Disconnection	$152,374	/acre	53	acres	$8,075,822	461	$17,518.05	48	$168,246.29	92,868	$86.96
Neighborhood Tree Plantings	$175	/tree	32	acres	$5,600	276	$20.29	6	$933.33	6,004	$0.93
Institution Tree Plantings	$175	/tree	1.36	acres	$238	12	$19.83	0.27	$881.48	257	$0.93
Bayscaping Education	$500	/event	10	Events	$5,000	**	**	**	**	**	**
Street Sweeping	***	/mile	150	Miles	***	343	***	137	***	41,132	***
				Total:	**$16,619,316**						

* This projected cost is for the first year. Cost per pound removed decreases for every subsequent year the device is functioning.

** Removal efficiencies for BayScaping have not been set and incorporated into MAST at this time, so estimated load reductions could not be calculated.

*** Street sweeping does not add to the cost of the SWAP Implementation. It is assumed that existing Baltimore County staff would be responsible for the action, and therefore not additional cost would be incurred.

Table C-3: Lower Gunpowder Falls (Urban) 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	1 Year
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-profit 501(c) with a board on which half the members participate meaningfully and at least one paid staff (or a part-time paid 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

Table C-3: Lower Gunpowder Falls (Urban) SWAP Potential Funding Sources (Cont.)

Managing Agency	Funding Source	Application Eligibility	Eligible Projects	Funding Amount	Cost Share / In-Kind	Project Period
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 Government	Green restoration projects	None specified	50% / YES	None specified
MDE/DNR	Chesapeake and Atlantic Coastal Bays Trust Fund	Non-profits 501(c) Local government	Non-point source best manage-ment practices reducing nitrogen, phosphorous and sediment	None specified	Unknown	Annual
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	Watersheds 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	Unknown	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

Table C-3: Lower Gunpowder Falls (Urban) SWAP Potential Funding Sources (Cont.)

Managing Agency	Funding Source	Application Eligibility	Eligible Projects	Funding Amount	Cost Share / In-Kind	Project Period
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 D: POLLUTANT REMOVAL EFFICIENCIES FROM THE MARYLAND ASSESSMENT SCENARIO TOOL (MAST)

(Approved by the Chesapeake Bay Program)

Table D-1: Pollutant Removal Efficiencies from MAST*

BMP	Nitrogen Effectiveness (%)	Phosphorus Effectiveness (%)	Sediment Effectiveness (%)
Bioretention/rain gardens - A/B soils, no underdrain	80	85	90
Bioretention/rain gardens - A/B soils, underdrain	70	75	80
Bioretention/rain gardens - C/D soils, underdrain	25	45	55
Bioswale	70	75	80
Dry Detention Ponds and Hydrodynamic Structures	5	10	10
Dry Extended Detention Ponds	20	20	60
MS4 Permit-Required Stormwater Retrofit	25	35	65
Permeable Pavement w/ Sand, Veg. - A/B soils, no underdrain	80	80	85
Permeable Pavement w/ Sand, Veg. - A/B soils, underdrain	50	50	70
Permeable Pavement w/ Sand, Veg. - C/D soils, underdrain	20	20	55
Permeable Pavement w/o Sand, Veg. - A/B soils, no underdrain	75	80	85
Permeable Pavement w/o Sand, Veg. - A/B soils, underdrain	45	50	70
Permeable Pavement w/o Sand, Veg. - C/D soils, underdrain	10	20	55
Stormwater Management by Era 1985 to 2002 MD	17	30	40
Stormwater Management by Era 2002 to 2010 MD	30	40	80
Stormwater to the Maximum Extent Practicable (SW to the MEP)	50	60	90
Street Sweeping 25 times a year-acres (formerly called Street Sweeping Mechanical Monthly)	3	3	9
Urban Filtering Practices	40	60	80
Urban Forest Buffers	25	50	50
Urban Infiltration Practices w/ Sand, Veg. - A/B soils, no underdrain	85	85	95
Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no underdrain	80	85	95
Vegetated Open Channels - A/B soils, no underdrain	45	45	70
Vegetated Open Channels - C/D soils, no underdrain	10	10	50
Wet Ponds and Wetlands	20	45	60

*MAST values as of June 2015; additional information on MAST, visit http://www.mastonline.org/