Final Report

# Tidal Back River Small Watershed Action Plan

Volume I



Prepared for

BALTIMORE COUNTY MARYLAND

Department of Environmental Protection and Resource Management

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# CHAPTER 1: INTRODUCTION

## 1.1 Purpose

This Small Watershed Action Plan (SWAP) is a strategy for the restoration of the Tidal Back River watershed. This report presents recommendations for watershed restoration, describes management strategies for each of the 10 subwatersheds comprising Tidal Back River, and identifies priority projects for implementation. A schedule for implementation over a 10-year time frame is presented in addition to planning level cost estimates where feasible. Financial and technical partners for plan implementation are suggested for the various recommendations. This SWAP is intended to assist the Back River Restoration Committee (BRRC), Baltimore County Department of Environmental Protection and Resource Management (DEPRM) and other partners to keep moving forward with restoration of the Tidal Back River.

## 1.2 Background

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

Over the past year, Tidal Back River 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 develop the Tidal Back River SWAP. This includes Baltimore City and Baltimore County personnel, members of the local watershed organization (BRRC), and leaders from the local community. The Steering Committee met regularly throughout SWAP development. Tidal Back River Steering Committee members are listed below:

<u>BRRC</u>

- Larry Farinetti
- Carl Hobson
- George Malone
- Brian Schilpp
- Capt. Jerry Ziemski

<u>North Point Peninsula Community Coordinating Council</u>

- Harry Wujek, Jr.

<u>Back River Neck Peninsula Community Association</u>

- Douglas Celmer

<u>Back River Wastewater Treatment Plant (Baltimore City)</u>

- John Martin

<u>Baltimore County DEPRM</u>

- Candace Croswell
- Nathan Forand
- Nancy Pentz
- Steve Stewart
- Erin Wisnieski

<u>Parsons Brinckerhoff</u>

- Kelly Brennan
- Regina Williams

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

- ***Stakeholder Meeting #1*** (July 8, 2009; 156 attendees): This meeting included an introduction of the SWAP process, the local watershed organization (BRRC), and Tidal Back River SWAP Steering Committee members. A description of watersheds, County goals, environmental requirements (see Section 1.3), and a SWAP framework was presented. The current conditions of the Tidal Back River watershed were also presented based on desktop analyses and field assessment conducted. The County described the Capital Waterway Improvement Program including environmental restoration projects such as shoreline enhancement and protection, waterway dredging, stream restoration and submerged aquatic vegetation (SAV) and those projects already completed within the Back River watershed. Also discussed was the trash issue within the watershed and potential options to address trash (e.g., trash collector device, community mudflats cleanup, and public outreach/education). Two surveys were conducted during the meeting: 1) Vision & Goals Questionnaire where attendees were asked to rate the importance of a list of eight watershed goals; and 2) Slogan Contest where attendees were asked to vote on a watershed slogan from a list of 10 ideas or to provide their own ideas. Attendees were also given an opportunity to fill out a "blue card" to report the type and location of environmental problems (e.g., dumping, erosion, illicit discharges, etc.) in the watershed.

- ***Stakeholder Meeting #2*** (October 7, 2009; 99 attendees): This meeting included an update on the SWAP process and discussion of restoration options. Introductions were made by the Baltimore County Executive and DEPRM Director. The SWAP update included a review of the overall SWAP process, a review of watersheds and the connection between the Upper and Tidal Back River watersheds, finalized watershed goals, potential restoration strategies, and status updates (e.g., "blue card" responses, trash boom, midge monitoring, volunteer clean up projects, WWTP tours completed, etc.). There was also a vote on the top four watershed slogans from the previous meeting. "Scenic Back River – Discover the Hidden Treasure" was selected by attendees as the slogan for Tidal Back River. Upland assessment methods and results for neighborhoods, institutions, open spaces, and hotspots were discussed. Potential restoration actions appropriate for the watershed based on data collected were presented (e.g., downspout disconnection, bayscaping, tree planting, etc.). A citizen actions survey was conducted to gage interest in the potential restoration options and help build a successful SWAP. The Maryland Transportation Authority (MTA) also discussed erosion control and mitigation measures on the I-95 Toll Lanes Projects in response to citizen concern.

- ***Stakeholder Meeting #3*** (January 27, 2009; 127 attendees): An overview of the Draft SWAP developed for Tidal Back River was presented at this meeting including the SWAP process, watershed vision and goals, watershed profile, key municipal citizen-based strategies (e.g., stormwater management, reforestation, etc,), pollutant removal analysis results, subwatershed prioritization, and SWAP implementation and evaluation. The progress of Back River restoration was also discussed including County restoration projects such as Essex Sky Park shoreline enhancement design, Pleasure Island channel dredging and beneficial use, midge task force updates, mudflat cleanups, and potential billboard opportunity for trash campaign. Citizen actions that residents can participate with in their community, with BRRC, in neighborhoods, and at individual homes to assist with SWAP implementation were also discussed. Following the presentation, citizen action displays and sign-ups were setup for attendees to obtain more information regarding storm drain marking, ReUse Directory, new recycling collection information, Back River cleanups, downspout disconnection and rain barrels, midge monitoring, and the Growing Home Program.

## 1.3 Environmental Requirements

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

- National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit assessment and planning requirements
- Total Maximum Daily Load (TMDL) reductions for nutrients (i.e., nitrogen and phosphorus) for Back River
- Anticipated TMDL development for the Chesapeake Bay for nutrient and sediment reductions to meet water quality standards
- Targets for submerged aquatic vegetation (SAV) and water clarity

### 1.3.1 NPDES MS4 Permits

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

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

The County's NPDES permit also requires the County to address 10 percent of the impervious cover during each 5-year permit term. The County aims to address 20 percent of impervious cover by 2010, when the current permit is up for renewal. It is anticipated that future permits will have the same requirement. 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 TMDLs

The Back River is listed as impaired in the Maryland 303(d) list of impaired waters for various pollutants of concern including nutrients (1996 listing), suspended sediments (1996 listing), chlordane (1996 listing), polychlorinated biphenyls (PCBs, 1998 listing), zinc (1998 listing), fecal coliform (2002 listing), and impacts to biological communities (2002 listing). All impairments were listed for the tidal waters with the exception of bacteria and impacts to biological communities, which are listed for the non-tidal region (i.e., Upper Back River planning area – see Chapter 1.4). Impairment listings reflect the inability to meet water quality standards for designated uses. Back River is designated as Use II – support of estuarine and marine aquatic life and shellfish harvesting – subcategories 1 (seasonal migratory fish), 2 (seasonal SAV), and 3 (open water fish and shellfish) according to the Maryland water quality standards.

The Maryland Department of Environment (MDE) has completed two TMDLs and one Water Quality Assessment (WQA) for addressing water quality impairments within the Tidal Back River planning area. TMDLs have been developed for nutrients (nitrogen and phosphorus) and one for chlordane. A Water Quality Assessment (WQA) for zinc was completed and approved by the U.S. Environmental Protection Agency (USEPA) in 2004. The WQA for zinc showed that the aquatic life criteria and designated uses associated with zinc are being met in the Back River and that a TMDL for zinc is not necessary to achieve water quality standards. This document is included as Appendix G. TMDL development is currently in progress for PCBs and is anticipated in the future for sediment and trash impairment.

TMDLs for nitrogen and phosphorus in the tidal segment of Back River were approved by USEPA in June 2005. The water quality goal for the nutrients TMDLs is to reduce high chlorophyll-a concentrations (maximum of 100 µg/L, target of less than 50 µg/L) and maintain dissolved oxygen levels (minimum of 5 mg/L) to meet the designated uses of Back River. Urban stormwater discharges and the Back River Wastewater Treatment Plant (WWTP) were identified as contributors to water quality degradation in Tidal Back River. The TMDL analysis determined that a 15 percent reduction in nitrogen and phosphorus loads from urban stormwater runoff is required to meet water quality standards. The TMDL analysis also showed that the Back River WWTP is the primary contributor to nutrient inputs to the Back River. The bulk of the nitrogen and phosphorus reductions required to meet the TMDLs and water quality standards for Tidal Back River will come from the Enhanced Nutrient Removal (ENR) improvements scheduled for completion in 2015. The TMDL report for nitrogen and phosphorus in Back River is included as Appendix E.

The TMDL for chlordane was developed by MDE in 1999 and is included as Appendix F. Chlordane was mostly used as a pesticide to control termites in building foundations. It was detected in certain Back River fish tissues, prompting a fish consumption advisory in 1986 and an impairment listing in 1996. The use of chlordane was restricted in 1975 and has been withdrawn from the market since 1988. There are no known existing sources of chlordane other than what exists in the sediment and data suggests that chlordane concentrations are decreasing. In addition, Household Hazardous Waste Collection Days are held by Baltimore County which provides a means for homeowners to properly dispose of any remaining chlordane products. For these reasons, the TMDL for chlordane identified a strategy of natural recovery and periodic monitoring of fish and sediment contaminant levels to meet water quality standards.

### 1.3.3 Chesapeake Bay Nutrient and Sediment Impairment

The Chesapeake Bay Program (CBP) is currently developing the Phase 5 Watershed Model. This model, in conjunction with the Estuary Model, will be used to determine the sources and reductions of nitrogen, phosphorus, and sediment needed to meet Chesapeake Bay tidal water quality standards. Previous efforts under the previous version, Phase 4.3 Watershed Model and Maryland Tributary Strategy development indicated reductions in excess of 20 percent for nitrogen and phosphorus. The new data will be used to develop a Chesapeake Bay-wide TMDL and may possibly be used to assign nutrient and sediment load reductions to individual local jurisdictions based on the segment loads by the end of 2010. At this time, the loads and the reductions are not known. Once the loads and load reductions are known, if this document identifies restoration opportunities that are insufficient in providing the load reductions to meet the Chesapeake Bay TMDL, the Steering Committee will re-convene to update the SWAP.

### 1.3.4 SAV and Water Clarity

Targets have been established for submerged aquatic vegetation (SAV) and water clarity since these are both indicators of good water quality and habitat. SAV coverage of 340 acres and water clarity to 0.5 meters (1.64 feet) are proposed for Tidal Back River.

## 1.4 USEPA Watershed Planning A-I Criteria

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

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

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

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

**B.** Estimates of pollutant load reductions expected through implementation of proposed nonpoint source (NPS) management measures.

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

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

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

**F.** A schedule for implementing the NPS management measures.

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

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

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

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

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

| Report Section | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| Chapter 1 | | ✓ | | | | | | | |
| Chapter 2 | | ✓ | | | | | | | |
| Chapter 3 | ✓ | ✓ | ✓ | | ✓ | | | | |
| Chapter 4 | | | ✓ | | ✓ | | | | |
| Chapter 5 | | | | | | | ✓ | ✓ | ✓ |
| Appendix A | | | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| Appendix B | | | | ✓ | | | | | |
| Appendix C | | ✓ | | | | | | ✓ | |
| Appendix D | ✓ | | | | | | | | |
| Appendix E | ✓ | | | | | | | | |
| Appendix F | ✓ | | | | | | | | |
| Appendix G | | | | | | | | | |

## 1.5 Partner Capabilities

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

The Baltimore Watershed Agreement commits Baltimore County and Baltimore City to work together along with the local watershed associations to address environmental issues in our shared watersheds. This agreement provides the framework for continued cooperation and progress in meeting the environmental issues detailed above. Currently, five workgroups are developing action strategies as part of the Baltimore Watershed Agreement to address: stormwater, trash, public health, greening, and development/redevelopment. These action strategies overlap with the actions detailed in this report and provide further incentive to move forward with restoration activities.

### 1.5.1 Baltimore County

Baltimore County has a waterway restoration program to implement restoration projects, including stream restoration, stormwater conversions and retrofits, reforestation, and shoreline enhancement projects. In the Back River watershed a total of two miles of streams have been restored, 598 acres of urban land has been either addressed with new stormwater management (SWM) practices or existing SWM has been retrofitted (enhanced) to provide additional water quality improvements. Approximately $9.5 million have been spent to date on restoration activities within the entire Back River watershed. An additional $1.0 million has been allocated for restoration in Back River, which is underway. Many of the projects have additional funding provided through grant programs.

Baltimore County has an extensive monitoring program that assesses the current ambient water quality, 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.

The County also initiated a comprehensive dredging program in 1987 to address the demand for dredging and to identify and control the sources of sedimentation. Dredging of tidal waterways to restore or enhance use and navigability for both recreational and commercial boat traffic is an integral component in the management of the County's 219 miles of shoreline. Baltimore County DEPRM administers the dredging program which includes: collecting the necessary data to determine the need for dredging; identifying environmental constraints; evaluating dredged material placement opportunities; applying for State and Federal Permits; assisting spur applicants with permit applications; and the design and construction management for the project. Baltimore County also identifies problems and implements necessary corrections to improve water quality for each creek through water quality improvement projects. Baltimore County DEPRM has planned, designed, permitted and overseen the construction of dredging projects on several tributaries in Back River including: Lynch Point Cove (1991); Muddy Gut and Greenhill Cove (1996); and Duck and Deep Creeks (2008). Maintenance dredging of the main channels and twenty associated spurs for Muddy Gut, Greenhill Cove and Lynch Point Cove was completed in February 2006. Baltimore County DEPRM also maintains the aids to navigation on the aforementioned waterways and conducts annual spring and summer submerged aquatic vegetation surveys. Bathymetry surveys in the next several years will help to determine the need and frequency of future maintenance dredging.

### 1.5.2 Back River Restoration Committee (BRRC)

The Back River Restoration Committee (BRRC) is a grassroots, volunteer-based watershed organization. BRRC mobilizes volunteers for environmental stewardship through outreach, public education, and advocacy. Their main focus has been on removing trash and debris in streams and tidal areas to improve water quality in the Back River. Several community cleanups have been organized by BRRC in partnership with Baltimore County to date including Bread & Cheese Creek and mudflats near I-695 bridge. About 260 volunteers helped remove over 300 tires and 10 tons of waste from the Back River during the first mudflats cleanup in August 2009.

### 1.5.3 Baltimore City

Baltimore City has a history of implementing restoration projects including stream restoration, stormwater retrofits, and various trash collection devices. In Upper Back River, the City has an extensive monitoring network that includes chemical and biological monitoring to determine current water quality status as well as trends over time. The City also has an Illicit Connection Detection and Elimination Program where two monitoring programs are used to detect the presence of illicit connections: stream impact sampling and ammonia screening. If either of these programs indicates a potential illicit connection, a pollution source tracking investigation is initiated to locate and eliminate the source.

Like Baltimore County, the City is under a consent decree to address Sanitary Sewer Overflows. 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 Upper Back River and ultimately, Tidal Back River.

Baltimore City also operates street sweeping and inlet cleaning programs throughout the city. These programs result in the removal of sediment and nutrients before they reach waterways. The City and County participated in a study by the Center for Watershed Protection (CWP) to determine pollutant removal efficiencies for street sweeping and inlet cleaning. These results will be used to determine how much sediment, nitrogen, and phosphorus are removed as a result of these activities.

As previously mentioned, the Back River WWTP is a primary contributor to nutrient inputs to the Back River. The Back River WWTP currently employs Biological Nitrogen Removal (BNR) technology which removes nitrogen to approximately 8 mg/L on an annual average basis. Baltimore City is in the design phase of an Enhanced Nutrient Removal (ENR) upgrade for the plant. This upgrade will include a large denitrification filter as well as a pumping station and chemical addition facilities required for proper operation. This may also require additional capacity in the form of aeration tanks and clarifiers in the secondary treatment process to meet stringent discharge limitations. The bulk of the nitrogen and phosphorus reductions required to meet the TMDLs and water quality standards for Tidal Back River will come from the ENR improvements scheduled for completion in 2015.

## 1.6 Tidal Back River Watershed Overview

The Tidal Back River watershed is one of two planning areas that represent the larger Back River watershed. The Tidal Back River planning area comprises the lower portion and is approximately 7,720 acres (12 square miles) or 22 percent of the Back River watershed. The remaining 78 percent is occupied by the Upper Back River planning area (27,717 acres, 43 square miles) as shown in Figure 1-1. A SWAP for the Upper Back River was completed in November 2008.

The Tidal Back River watershed was subdivided into 10 subwatersheds for planning and management purposes and is also shown in Figure 1-1. The smaller drainage areas are intended to focus restoration, preservation and monitoring efforts. The *Tidal Back River Watershed Characterization Report* includes detailed analyses and descriptions of the current watershed conditions and potential water quality issues. This is included as Appendix D of this report. A summary of the key watershed characteristics for Tidal Back River based on the characterization report is provided in the table below.

**Table 1-2: Tidal Back River Key Watershed Characteristics**

| | | |
|---|---|---|
| **Drainage Area** | 7,720 acres (12 sq. mi.) | |
| **Stream Length** | 33.1 miles | |
| **Coastline Length** | 33.8 miles | |
| **Tidal Waters** | 3,947 acres (6.2 sq. mi.) | |
| **Jurisdictions** | Baltimore County | |
| **Population** | 44,024 (2000 Census) | |
| **Land Use/Land Cover** | Low Density Residential:<br>Medium Density Residential:<br>High Density Residential:<br>Commercial:<br>Industrial:<br>Institutional:<br>Other Urban:<br>Forest:<br>Agriculture:<br>Water/Wetlands: | 2.4%<br>23.0%<br>8.6%<br>7.2%<br>3.5%<br>4.4%<br>11.4%<br>32.1%<br>4.4%<br>3.0% |
| **Impervious Cover** | 18.4% of watershed | |
| **Soils** | A Soils (low runoff potential):<br>B Soils:<br>C Soils:<br>D Soils (high runoff potential): | 1.5%<br>32.3%<br>40.8%<br>25.4% |

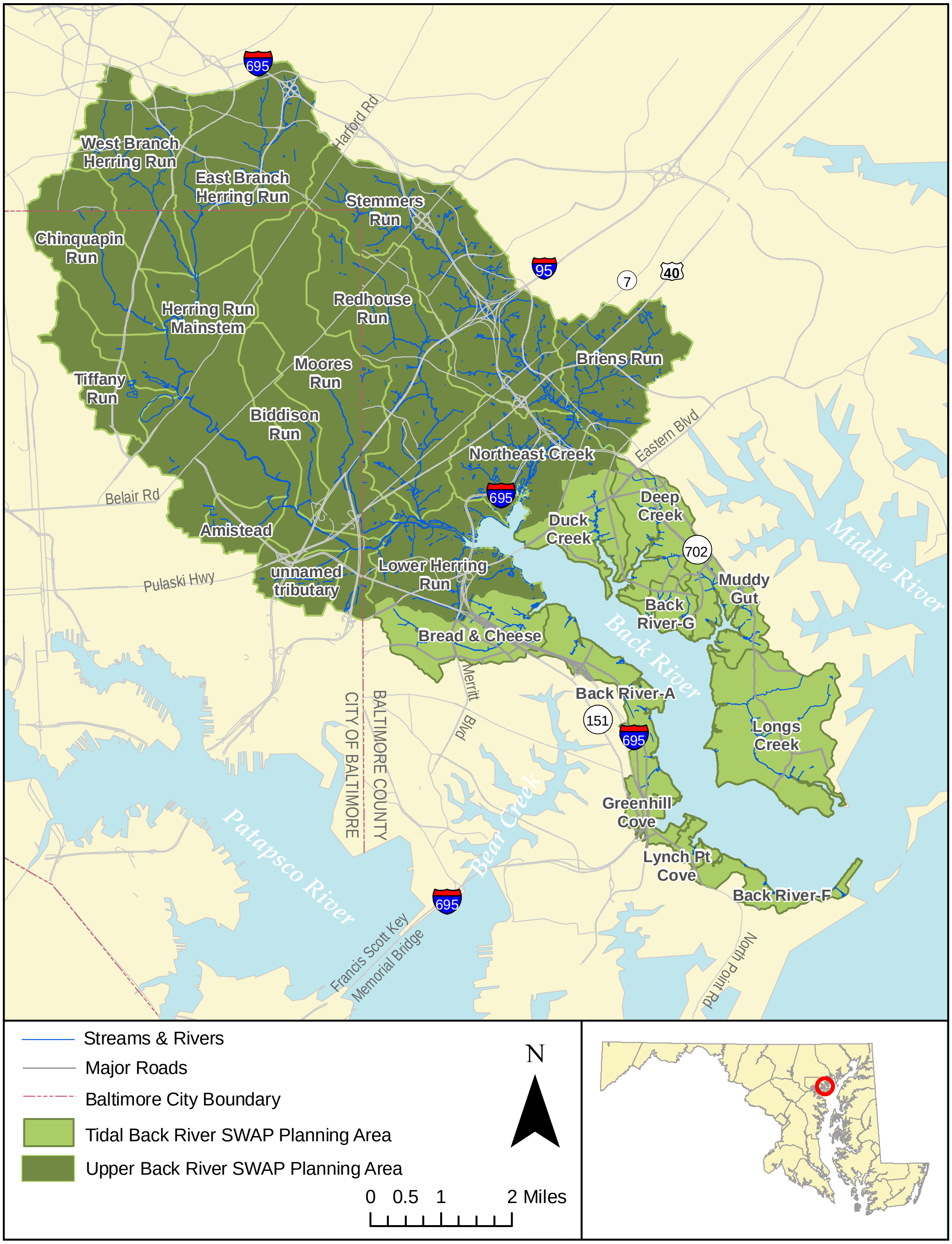


**Figure 1-1: Tidal Back River SWAP Planning Area and Subwatersheds**

## 1.7 Report Organization

This report is organized into the following five major chapters:

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

Chapter 2 presents the watershed vision, goals and objectives for restoring the Tidal Back River.

Chapter 3 describes the types of watershed restoration practices recommended for Tidal Back River and estimated pollutant load reductions.

Chapter 4 discusses prioritization of the 10 subwatersheds in the Tidal Back River watershed and summarizes subwatershed-specific restoration strategies.

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

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

- Appendix A : Tidal Back River Action Strategies
- Appendix B: Cost Analysis and Potential Funding Sources
- Appendix C: Chesapeake Bay Program Pollutant Load Reduction Efficiencies

A second volume (Volume II) includes the following appendices with supporting documentation related to the current conditions of the Tidal Back River watershed:

- Appendix D: Tidal Back River Watershed Characterization Report (PB 2009)
- Appendix E: TMDLs for Nitrogen and Phosphorus in Back River (MDE 2005)
- Appendix F: TMDL for Chlordane in Back River (MDE 1999)
- Appendix G: Water Quality Assessment of Zinc in Back River (MDE 2004)

# CHAPTER 2: VISION, GOALS AND OBJECTIVES

## 2.1 Vision Statement

The Tidal Back River Steering Committee adopted the following vision statement that served as a guide in the development of the SWAP:

> *We envision a healthy and vibrant stream system leading to the tidal portions of Back River, with good water quality and diverse aquatic life. Our watershed conserves treasured natural resources including the Tidal Back River, wetlands, forests and parkland. It supports active recreation and a balance of healthy communities with thriving commercial, institutional and industrial enterprises. It protects historic places while accommodating and managing development for future generations.*

## 2.2 Tidal Back River SWAP Goals & Objectives

A total of six goals were identified for restoring the Tidal Back River watershed based on the vision statement and input from both Steering Committee and Stakeholder meetings. The goals were developed through discussions with the Tidal Back River SWAP Steering Committee and refined based on feedback from watershed residents at the Stakeholder meetings. Stakeholders were given the opportunity to rank the importance of goals 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. Stakeholder participation is important to ensure the implementation and success of the plan.

The following sections present a discussion of each of the six goals for restoring the Tidal Back River 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 15%.” 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 “reducing fertilizer use on 100 acres of high maintenance lawns” in a given watershed. The action strategies developed to achieve these objectives and goals are summarized in Appendix A and discussed further in Chapter 3.

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

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

### 2.2.1 Goal 1: Improve and Maintain Clean Water

The Back River watershed is identified as being impaired by nutrients and bacteria as indicated in the Maryland 303(d) list of impaired waters. To rectify this impairment, a TMDL analysis has been completed for nitrogen, phosphorous and bacteria. The objectives below are designed to meet the nitrogen and phosphorous TMDL reduction requirements in the Tidal Back River watershed, and address the TMDL for bacteria.

**Objectives:**

1. Reduce annual average Total Nitrogen load from the Back River Waste Water Treatment Plant (WWTP) to the permitted level according to the waste water treatment plant schedule developed by Maryland Department of the Environment (MDE).
2. Reduce annual average Total Nitrogen and Total Phosphorous loads (urban stormwater) from the Tidal Back River watershed by 15% compared to the loading estimated for the baseline period to meet the requirements developed by the Back River watershed TMDL analysis. (The baseline period is 1992-1997.)
3. Reduce annual average Total Phosphorous loadings from the Tidal Back River watershed and Total Nitrogen loadings to meet Maryland's Tributary Strategy requirements and meet the goals of the Chesapeake Bay 2000 Agreement when developed as a bay-wide TMDL.
4. Improve water clarity to meet the water quality standard of 0.5 meters.
5. Complete sewer projects as identified and scheduled by the Federal Consent Decrees to address the Back River TMDL analysis for bacteria.
6. Reduce other sources of bacteria.

### 2.2.2 Goal 2: Reduce Trash and Promote Recycling

Trash is one of the most noticeable pollutants in the Tidal Back River. Trash is generated throughout the watershed and readily moves through storm drains and tributaries and by wind into the river. Trash is also thrown directly into the water. Besides the glaring visual detriment to the river's natural beauty, trash contributes toxins and presents a hazard to water fowl, other wildlife and people. Reducing trash and increasing recycling is mainly an issue of public awareness and stewardship. By engaging citizens of all ages to help clean up the trash and to dispose of trash responsibly, the stage will be set to change behaviors, leading to other positive actions for a healthier Tidal Back River.

**Objectives:**

1. Reduce trash in neighborhoods identified in Neighborhood Site Assessments.
2. Increase recycling of bottles, cans, plastic bags and paper.
3. Reduce dumping of trash and other materials.
4. Develop and promote a PR campaign to ensure proper disposal of trash.
5. Implement trash collection devices.
6. Support and encourage community clean-ups.

### 2.2.3 Goal 3: Increase Citizen Participation with Restoration Projects

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) are readily available labor sources. All restoration projects should be recognized as celebrations of our natural heritage.

**Objectives:**

1. Increase cross-age citizen participation in hands-on restoration projects on private and public sites.
2. Increase the number and variety of watershed restoration projects.
3. Continue funding for community clean-ups and restoration projects.

### 2.2.4 Goal 4: Restore and Maintain Fisheries and Habitat

Physical damage to aquatic and terrestrial habitats has resulted over time from development of land and shorelines, poor land management practices, introduction of exotic invasive species, obstructions to upstream breeding sites, boating in shallow water, etc. The objectives for this goal relate to the improvement of degraded river conditions that result in poor conditions for aquatic life.

**Objectives:**

1. Implement habitat restoration projects to remove the biological impairments in the tidal Back River watershed.
2. Monitor for sources of water pollution and aquatic habitat degradation, and trends over time.
3. Track improvements to the aquatic environment as a result of BMPs.
4. Use the information collected to identify, prioritize and implement cleanups and other habitat restoration projects.
5. Achieve 340 acres of SAV coverage by 2020.
6. Post shallow water signs on the bridge supports near the mudflats.
7. Expand beneficial aquatic habitat.

### 2.2.5 Goal 5: Encourage Safe Recreational Boating and Public Access

The Tidal Back River community relies upon the recreational boating industry to help support its local economy and way of life. This goal relates to the need for public access to the river and safe boating conditions, as well as an improved public perception of Back River.

**Objectives:**

1. Increase awareness of public access to Tidal Back River for recreational use.
2. Add channel markers to keep boats in the channel (Riverside Marina to the mouth).
3. Improve the image and appeal of Back River for recreational boating activities.
4. Create safer navigation on the water.

### 2.2.6 Goal 6: Enhance Natural Resources on Public Property

Government should “lead by example” to encourage businesses and neighborhood communities to employ best management practices on their sites to enhance natural resources. Publicly-owned properties should be valued as opportunities for construction of BMPs, and have a secondary purpose as demonstrations of BMPs that are being promoted throughout the community.

**Objectives:**

1. Improve the condition of natural resources on public property.
2. Showcase completed natural resource enhancement projects on public properties as models for the community.

# 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 Tidal Back River 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 Tidal Back River 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. 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 (Chapter 3.2) and citizen-based strategies (Chapter 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 Tidal Back River watershed is discussed in Chapter 3.3. Chapter 3.4 discusses the pollutant removal calculations for proposed BMPs (i.e., key restoration strategies discussed in Chapters 3.2 and 3.3) to ensure that TMDL requirements are met in Tidal Back River.

## 3.2 Municipal Strategies

Baltimore County and Baltimore City governments work together through the Baltimore Watershed Agreement to restore local streams and improve water quality through capital improvement projects and municipal management activities (e.g., development review, street sweeping, illicit connection programs, etc.) This plays an important role in the SWAP implementation process. Key municipal strategies proposed for restoring Tidal Back River are discussed in the following sections.

### 3.2.1 Stormwater Management

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

A total of 49 existing SWM facilities are located within the Tidal Back River watershed including dry and wet ponds, wetlands, infiltration/filtration practices, extended detention, proprietary BMPs, a stilling basin, and underground detention facilities. Existing SWM facilities treat a total drainage area of approximately 268 acres of urban land or 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 (flood control) and therefore, provide almost no pollutant removal. Therefore, they are good candidates for conversion to a type of facility that provides water quality benefits in addition to quantity control. The four existing detention ponds within the Tidal Back River watershed were investigated for potential conversion to water quality management facilities. 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 provide flood control. Out of the 4 detention ponds assessed, two were considered to have potential for conversion for water quality.

### 3.2.3 Stormwater Retrofits

Stormwater retrofits involve implementing BMPs in existing developed areas where SWM practices do not exist to help improve water quality. Stormwater retrofits improve water quality by capturing and treating runoff before it reaches receiving water bodies. Based on initial field and desktop evaluations, several sites were identified as having sufficient open space for stormwater retrofits to treat runoff from impervious parking lots or alleys. These include 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 naturally seeping into the ground. As a result, impervious surface runoff can result in erosion, flooding, habitat destruction, and increased pollutant loads to receiving water bodies. Subwatersheds with high amounts of impervious cover are more likely to have more 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 to pervious or forested land will help promote infiltration of runoff and reduce pollutant loads. Unused or unmaintained impervious surfaces with the potential for removal were identified at several institutions, mostly on school properties. The areas of these impervious surfaces were used to estimate potential pollutant load reductions as a result of impervious cover removal activities. 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 Shoreline Enhancement Projects

The Tidal Back River watershed consists of tidal waters and shoreline areas that have numerous benefits and uses for recreation, wildlife habitat, aquatic life, and water quality. Baltimore County DEPRM has a well established program for waterway improvement and coastal management to protect these and other County resources and meet public demands for access and recreation. The County has implemented seven shoreline enhancement projects within Tidal Back River between 1990 and 2002. These include the following projects (more detail is provided in Chapter 3.4.2.1):

1. Cox's Point Park Shoreline Enhancement and Wetland Planting
2. Cox's Point II Shoreline Enhancement
3. Rocky Point Beach Park Shore Erosion Control Project
4. Rocky Point Longs Creek Shoreline Erosion Control Project
5. Rocky Point Park Ballestone Area Shoreline Erosion Control Project
6. Rocky Point Habitat Creation and Shoreline Enhancement Site 2
7. Rocky Point Habitat Creation and Shoreline Enhancement Site 3

DEPRM also completed a shoreline enhancement study to support shoreline management and the integration of watershed management, resource conservation, and waterway improvements (DEPRM 1998). In the study, conceptual shoreline enhancement projects were developed including erosion protection, ecological and recreational benefits. The following six conceptual shoreline enhancement projects were developed to protect shoreline resources within Tidal Back River:

1. Norris Farm Landfill – Marsh creation and beneficial use of dredged material
2. North Point State Park – Structural shoreline protection and marsh planting
3. Back River WWTP – Marsh creation and beneficial use of dredged material
4. Essex Sky Park – Marsh creation, beneficial use of dredged material, wetland planting, structural shoreline protection
5. Rocky Point Park Golf Course – Structural shoreline protection, marsh planting, and fish reef
6. Rocky Point Park Longs Creek – Wetland planting and structural shoreline protection

### 3.2.5 Stream Restoration

Stream restoration practices are used to enhance the appearance, stability and aquatic function of urban stream corridors. Stream restoration practices range from routine stream cleanups and simple stream repairs such as vegetative bank stabilization and localized grade control to comprehensive repairs such as full channel redesign and realignment. Stream corridor assessments (SCAs) performed in Tidal Back River showed opportunities for stream repair, stream cleanups, and buffer reforestation. Stream corridors noted as having significant erosion and channel alteration during the SCAs are used to estimate pollutant load reductions for potential stream repair efforts. For both cases, stabilizing the stream channel improves water quality by preventing eroded soils, and the pollutants contained in them, from entering the stream and Back River. In addition, lengths of eroded and altered channel segments were recorded during SCAs.

### 3.2.6 Street Sweeping

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

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

### 3.2.7 Illicit Connection Detection/Disconnection

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

### 3.2.8 Sanitary Sewer Consent Decree

In September 2005, USEPA and MDE issued a consent decree to Baltimore County with deadlines to reduce and eliminate sanitary sewer overflows (SSOs). Implementation of work (capital projects, equipment, operations and maintenance improvements) in compliance with the consent decree will result in a reduction of nutrients and bacteria entering streams in the Tidal Back River 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 otherwise. Citizen participation is critical to the implementation and long-term maintenance of restoration activities. Key citizen-based strategies proposed for restoring Tidal Back River are discussed in the following sections.

### 3.3.1 Reforestation

Trees help improve water quality by capturing and removing pollutants in runoff including excess nutrients through their roots before the pollutants enter groundwater and streams. Tree leaves and stems also intercept precipitation 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 and the Growing Home Campaign for private property, can help increase the success of planting efforts. Several areas throughout the watershed are targeted for reforestation opportunities and are described below.

***Riparian Buffer***

Stream and shoreline riparian buffers are critical to maintaining healthy streams and rivers. Forested buffer areas along streams and shorelines 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 uplands and stream surveys conducted throughout the watershed. Areas on privately-owned land (e.g., residential properties) can be targeted for buffer awareness initiatives to encourage landowners to plant trees and/or create a no-mow area adjacent to streams and shorelines. Open pervious areas identified within the 100-foot stream and shoreline buffer areas via a GIS analysis in the *Watershed Characterization Report* are good candidates for tree planting and are targeted for initial buffer reforestation efforts.

***Upland Pervious Areas***

Converting open areas in the upland portion of the watershed to forested areas through tree plantings can also reduce nutrient inputs to nearby streams and reduce erosion. Large open areas identified in the pervious area assessments (PAAs) should be further investigated for tree planting potential. Publicly-owned lands requiring minimal site preparation should be targeted for initial reforestation efforts.

***Street and Shade Tree Plantings***

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

### 3.3.2 Downspout Disconnection

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 the Herring Run Watershed Association (HWRA) and Center for Watershed Protection (CWP). Results from these programs can be used to determine successful techniques and strategies for Tidal Back River.

### 3.3.3 Urban Nutrient Management

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

***Lawn Maintenance Education***

A well-maintained lawn can be beneficial to the watershed. However, lawn maintenance activities often involve over-fertilization, poor pest-management, and over-watering resulting in pollutant stormwater runoff to local streams. Lawns with a dense, uniform grass cover or signs designating poisonous lawn care indicate high lawn maintenance activities. Neighborhoods identified as having high lawn maintenance issues should be targeted for awareness programs emphasizing responsible fertilizing techniques such as proper application amounts, proper time of year for fertilization, soil testing for nutrient requirements and keeping fertilizers away from impervious surfaces. Lawn maintenance education can be achieved through door-to-door canvassing, informational brochures/mailings, excerpts in community newsletters, or demonstrations at community meetings. Information on organic alternatives to chemical lawn treatments should also be included in these outreach efforts.

***Bayscaping***

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

## 3.4 Pollutant Loading & Removal Analyses

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

### 3.4.1 Pollutant Loading Analysis

A pollutant loading analysis was performed to estimate total nitrogen and phosphorus loads currently generated by all non-point sources (i.e., runoff from all land uses) present within the Tidal Back River watershed. Estimates were based on Maryland Department of Planning's (MDP) 2007 Land Use/Land Cover (LU/LC) GIS layer and pollutant loading rates developed by MDE for non-urban land uses and CBP for urban land uses. The pollutant loading analysis is described in detail in Chapter 3.3 of the *Watershed Characterization Report* (Appendix D). The table below 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: Tidal Back Nitrogen and Phosphorus Loads**

| | | Nitrogen | | Phosphorus | |
|---|---|---|---|---|---|
| Source | Area (acres) | Rate (lbs/ac) | Load (lbs/yr) | Rate (lbs/ac) | Load (lbs/yr) |
| Impervious Urban | 1,379 | 14.1 | 19,444 | 2.26 | 3,117 |
| Pervious Urban | 3,291 | 7.255 | 23,873 | 0.429 | 1,412 |
| Cropland | 335 | 13.54 | 4,532 | 0.69 | 231 |
| Pasture | 7 | 5.64 | 41 | 0.66 | 5 |
| Forest | 2,642 | 1.29 | 3,408 | 0.02 | 53 |
| Water | 66 | 10 | 656 | 0.57 | 37 |
| Bare soil | 1 | 5.64 | 4 | 0.66 | 0 |
| ***Totals*** | ***7,720*** | | ***51,959*** | | ***4,855*** |

As discussed in Chapter 1, a TMDL analysis showed that the Back River WWTP is the primary contributor to nutrient inputs to the Back River. The bulk of the nitrogen and phosphorus reductions required to meet the TMDLs and water quality standards for Tidal Back River will come from the ENR improvements scheduled for completion in 2015. However, the TMDL analysis also determined that a 15 percent reduction in nitrogen and phosphorus loads from urban stormwater discharges is necessary to meet water quality standards. The load reductions needed within Tidal Back River to achieve this additional 15 percent reduction are summarized in the table below. Note that a 15 percent reduction was applied to the pollutant load from urban runoff sources (i.e., impervious and pervious urban), since the nutrient TMDL relates to urban sources only.

**Table 3-2: Tidal Back River Nitrogen and Phosphorus Load Reductions**

| Source | Area (acres) | TN Load (lbs/yr) | TP Load (lbs/yr) |
|---|---|---|---|
| Urban | 4,670 | 43,318 | 4,528 |
| | ***15% Reduction:*** | ***6,498*** | ***679*** |

### 3.4.2 Pollutant Removal Analysis

The following sections present a quantitative analysis of pollutant removal capabilities of proposed BMPs to ensure that the 15 percent reduction in nutrient loads from urban runoff in the Tidal Back River watershed is achieved. Note that many of the removal efficiencies used to estimate pollutant reductions are based on the peer-reviewed and CBP-approved nonpoint source BMP tables developed for the Phase 5.0 CBP Watershed Model. These tables are included in Appendix C. Also note that the calculations and estimates presented in the following subsections represent maximum potential pollutant removal capabilities. A summary of overall pollutant load reduction estimates is presented at the end of this section for 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 several capital improvement projects in the Tidal Back River watershed including shoreline enhancements and wet ponds. Nutrient reductions associated with shoreline enhance projects estimated based on the following equation:

$$V_{eroded} \times \rho_b \times C_{TN,TP}$$

The first term, $V_{eroded}$, represents the volume of erosion that the project is theoretical preventing (i.e., approximate volume eroded before the shoreline enhancement project was implemented). The volume of annual erosion at a given shoreline site is calculated as: shoreline length (ft) x average annual erosion rate (ft/yr) x average bank height (ft). Shoreline lengths and average bank heights are estimated from engineering and project plans prepared by consultants for Baltimore County DEPRM. Erosion rates are obtained from DNR's shoreline website, *Maryland Shores Online* (http://shorelines.dnr.state.md.us/), which is a centralized database with state-wide shoreline and coastal hazards management data. Eroded volume ($ft^3$) is converted to weight (lbs) using a bulk density, $\rho_b$, of 93.6 $lbs/ft^3$. This weight is converted to tons using the corresponding ratio of 1 ton = 2000 lbs. Weight of eroded material (tons) is converted to a pollutant load reduction using concentrations of 0.73 lbs/ton for total nitrogen and 0.48 lbs/ton for total phosphorus. These are mean pollutant concentrations derived from the study, "Eroding Bank Nutrient Verification Study for the Lower Chesapeake Bay" (Ibison et. al 1992). The final value represents an approximate pollutant load reduction based on the eroded volume and load prevented via the shoreline enhancement measures. A summary of existing shoreline enhancement project reduction calculations and results are shown in the table below.

**Table 3-3: Completed Shoreline Enhancement Projects in Tidal Back River**

| Project Name | Year | Shore Length (ft) | Avg Bank Height (ft) | Erosion Rate (ft/yr) | Potential Volume Eroded (ft3/yr) | Potential Volume Eroded (tons/yr) | TN Load Reduction (lbs/yr) | TP Load Reduction (lbs/yr) |
|---|---|---|---|---|---|---|---|---|
| Cox's Point Park Shoreline Enhancement & Wetland Planting | 1990 | 220 | 5 | 3.0 | 3322 | 155 | 113 | 75 |
| Cox's Point II Shoreline Enhancement | 1995 | 1,950 | 6.9 | 3.0 | 40,634 | 1,902 | 1,388 | 913 |
| Rocky Point Beach Park Shore Erosion Control Project | 1995 | 1,110 | 20 | 1.7 | 38,628 | 1,808 | 1,320 | 868 |
| Rocky Point-Long Creek Shoreline Erosion Control Project | 1995 | 1,370 | 5 | 1.7 | 11,919 | 558 | 407 | 268 |
| Rocky Point Park Ballestone Area Shoreline Erosion Control Project | 1998 | 2,000 | 19.3 | 0.2 | 8,492 | 397 | 290 | 191 |
| Rocky Point Habitat Creation & Shoreline Enhancement Site 2 | 2002 | 100 | 18 | 0.2 | 324 | 15 | 11 | 7 |
| Rocky Point Habitat Creation & Shoreline Enhancement Site 3 | 2002 | 590 | 4 | 0.8 | 1,959 | 92 | 67 | 44 |
| ***Totals:*** | | 7,340 | | | 105,278 | 4,927 | ***3,597*** | ***2,365*** |

It should be noted that eroding shorelines are not included as a pollutant source in the watershed pollutant loading analysis summarized in Table 3-1. Therefore, nutrient reductions associated with completed shoreline enhancement projects are not included in the pollutant removal analysis for the Tidal Back River restoration strategy. The Chesapeake Bay Program (CBP) is currently evaluating pollutant loads from shoreline erosion as well as resuspension of bottom sediments. This component of the restoration strategy will be reevaluated and included when consistent Chesapeake Bay-wide estimates are developed.

The County has also implemented two wet pond capital improvement projects in Tidal Back River. Pollutant loads were estimated by the County based on the contributing drainage area (DA) and corresponding land use-specific pollutant loading rates. Load reduction is calculated as the product of the pollutant load and removal efficiency. Wet pond pollutant removal efficiencies are 30 percent for total nitrogen and 50 percent for total phosphorus per the values shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. A summary of existing wet pond load reductions are shown in the table below.

**Table 3-4: Wet Pond Load Reductions**

| Project | Year | TN Reduction (lbs/yr) | TP Reduction (lbs/yr) |
|---|---|---|---|
| Lynch Point Cove | 1997 | 52 | 6 |
| Greenhill Cove | 1998 | 151 | 16 |
| | ***Totals:*** | ***202*** | ***22*** |

### 3.4.2.2 Existing Stormwater Management (SWM)

As described in detail in Section 2.3 of the *Watershed Characterization Report* (Appendix D), there are 49 existing SWM facilities in the Tidal Back River watershed including dry and wet ponds, wetlands, infiltration/filtration practices, extended detention, proprietary BMPs and other types of SWM facilities (i.e., underground detention, stilling basin). The pollutant removal capability of existing SWM in the watershed is not accounted for in the pollutant loading analysis. Therefore, it is included in the pollutant removal analysis.

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

$$\left[9.28(lbs/ac/yr)\times DA(acres)\right]\times efficiency(\%)$$

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

$$\left[0.97(lbs/ac/yr)\times DA(acres)\right]\times efficiency(\%)$$

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in both of the above equations. The pollutant loading rates shown, 9.28 lbs TN/ac/yr and 0.97 lbs TP/ac/yr, represents 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 5.2. The percent pollutant removal efficiency depends on the type of facility and is based on the values shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. The total pollutant load reduction expected from existing SWM is a sum of the removal capacities of the individual facilities. A summary of existing SWM load reduction calculations and results are shown in the table below.

**Table 3-5: Existing SWM Load Reductions**

| SWM Facility Type | No. (#) | DA (acres) | TN Load from DA (lbs/yr) | TN Removal Efficiency (%) | Max Potential TN Load Reduction (lbs/yr) | TP Load from DA (lbs/yr) | TP Removal Efficiency (%) | Max Potential TP Load Reduction (lbs/yr) |
|---|---|---|---|---|---|---|---|---|
| Dry Pond | 4 | 18.2 | 169 | 5% | 8 | 18 | 10% | 2 |
| Wet Pond | 3 | 52.3 | 485 | 30% | 145 | 51 | 50% | 25 |
| Wetland | 3 | 9.5 | 88 | 30% | 26 | 9 | 50% | 5 |
| Infiltration/ Filtration | 20 | 68.6 | 636 | 50% | 318 | 66 | 70% | 47 |
| Extended Detention | 14 | 101.0 | 937 | 30% | 281 | 98 | 20% | 20 |
| Proprietary BMP | 2 | 13.3 | 123 | 5% | 6 | 13 | 10% | 1 |
| Stilling Basin | 1 | 4.0 | 37 | 5% | 2 | 4 | 10% | 0 |
| Underground Detention | 2 | 1.6 | 15 | 5% | 1 | 2 | 10% | 0.2 |
| ***Totals:*** | 49 | 268 | 2,490 | - | ***788*** | 260 | - | ***100*** |

### 3.4.2.3 Stormwater Management Conversions

As described previously, two out of the four existing detention ponds surveyed have the potential for conversion to an extended detention facility that has a 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 based on BMP efficiencies recommended by CBP for detention and extended detention facilities. The equation used to estimate total nitrogen (TN) load reductions for SWM conversions is expressed as:

$$\left[9.28(lbs/ac/yr) \times DA(acres)\right] \times 25\%$$

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

$$\left[0.97(lbs/ac/yr) \times DA(acres)\right] \times 10\%$$

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in the equations above. Similar to existing SWM, the pollutant loading rates shown, 9.28 lbs TN/ac/yr and 0.97 lbs TP/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. The increased pollutant removal capacity is represented by the second expression in the equations above. This is the difference between percent pollutant removal efficiencies of extended detention and detention facilities, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. A summary of SWM conversion load reduction calculations and results are shown in the table below.

**Table 3-6: SWM Conversion Load Reductions**

| | | REMOVAL EFFICIENCY | | | |
|---|---|---|---|---|---|
| Pollutant | Total DA for SWM Conversion (acres) | Detention Pond (%) | Extended Detention (%) | Increase in Efficiency (%) | Max Potential Load Reduction (lbs/yr) |
| TN | 5.71 | 5% | 30% | 25% | ***13*** |
| TP | 5.71 | 10% | 20% | 10% | ***1*** |

### 3.4.2.4 Stormwater Retrofits

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

$$[14.1(lbs/ac/yr) \times DA(acres)] \times 50\%$$

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

$$[2.26(lbs/ac/yr) \times DA(acres)] \times 70\%$$

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 14.1 lbs TN/ac/yr and 2.26 lbs TP/ac/yr, are the impervious urban rates used in the pollutant loading analysis (Table 3.20) since this represents the source of runoff being treated. Pollutant removal efficiencies are those reported for infiltration practices, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. A summary of stormwater retrofit load reduction calculations and results are shown in the table below.

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

| Pollutant | Impervious Urban Loading Rate (lbs/ac/yr) | Impervious Area for SW Retrofit (acres) | Load from DA (lbs/yr) | Removal Efficiency (%) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|---|
| TN | 14.1 | 12.7 | 179 | 50% | 89 |
| TP | 2.26 | 12.7 | 29 | 70% | 20 |

### 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 use conversion from impervious to pervious urban. The equation used to estimate total nitrogen (TN) load reductions for stormwater retrofits is expressed as:

$$[14.1(lbs/ac/yr) - 7.255(lbs/ac/yr)] \times \mathrm{Im}\,perviousArea(acres)$$

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

$$[2.26(lbs/ac/yr) - 0.429(lbs/ac/yr)] \times \mathrm{Im}\,perviousArea(acres)$$

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 used in the watershed pollutant loading analysis as shown in the first expression in brackets in the equations above. The approximate reduction in pollutant load is then the reduced loading rate multiplied by the area proposed for impervious cover removal. A summary of impervious cover removal reduction calculations and results are shown in the table below.

**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 | 14.1 | 7.255 | 6.845 | 1 | 6 |
| TP | 2.26 | 0.429 | 1.831 | 1 | 2 |

### 3.4.2.6 Stream Buffer Reforestation

The current vegetative condition of the stream riparian buffer (100 feet on either side of stream system) was analyzed in Chapter 2 of the *Watershed Characterization Report*. Buffer conditions were classified as impervious, open pervious, or forested areas. Open pervious areas are the best areas to initially target for restoration. Approximately 240 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 C). The equation used to estimate total nitrogen (TN) load reductions for the land use conversion portion of stream buffer reforestation is expressed as:

$$\text{Land Use Conversion (TN)} = [7.255(lbs/ac/yr) - 1.29(lbs/ac/yr)] \times OpenPerviousArea(acres)$$

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

$$\text{Land Use Conversion (TP)} = \left[0.429(lbs/ac/yr) - 0.02(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$$

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

An additional pollutant removal factor is added to the land use conversion to determine the total removal capacity of buffer reforestation. Per the BMP performance guidance in Appendix C, 1 acre of buffer treats approximately 4 acres of upland area for nitrogen with an efficiency of 25 percent for urban and mixed open buffers. The total nitrogen (TN) load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

$$\text{Buffer BMP Removal (TN)} = \left[OpenPerviousArea(acres) \times \frac{4(uplandacres)}{1(bufferacre)} \times 6.73(lbs/ac/yr)\right] \times 25\%$$

Similarly, 1 acre of buffer treats approximately 2 acres 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:

$$\text{Buffer BMP Removal (TP)} = \left[OpenPerviousArea(acres) \times \frac{2(uplandacres)}{1(bufferacre)} \times 0.63(lbs/ac/yr)\right] \times 50\%$$

The loading rates shown in the equations above, 6.73 lbs TN/ac/yr and 0.63 lbs TP/ac/yr, represent overall watershed loading rates. This is estimated as the total watershed nutrient load (51,959 lbs TN/yr and 4,855 lbs TP/yr) divided by the total watershed area (7,720 acres). These are used to calculate the pollutant load from the upland area that would be treated by buffer reforestation. As mentioned, the land use conversion and additional removal efficiency are added to yield a total pollutant load reduction. A summary of stream buffer reforestation reduction calculations and results are shown in the table below.

**Table 3-9: Stream Buffer Reforestation Load Reductions**

| | | LU CONVERSION | | BUFFER BMP REMOVAL | | | |
|---|---|---|---|---|---|---|---|
| Pollutant | Open Pervious Area (acres) | Reduced Loading Rate (lbs/ac/yr) | Land Use Conversion Reduction (lbs/yr) | Reduction Efficiency (%) | Overall Watershed Loading Rate (lbs/ac/yr) | Efficiency Load Reduction (lbs/yr) | Max Potential Load Reduction (lbs/yr) |
| TN | 240 | 5.965 | 1,429 | 25% | 6.73 | 1,613 | 3,042 |
| TP | 240 | 0.409 | 98 | 50% | 0.63 | 151 | 249 |

### 3.4.2.7 Shoreline Buffer Reforestation

The current vegetative condition of the shoreline riparian buffer (100 feet from shoreline) was analyzed in Chapter 2 of the *Watershed Characterization Report*. Shoreline buffer conditions were classified as impervious, open pervious, or forested areas. Open pervious areas are the best areas to initially target for restoration. Approximately 301 acres of open pervious area were identified within the shoreline buffer zone.

Pollutant reductions for buffer reforestation are calculated based on a land use conversion from pervious urban to forest per BMP performance guidance from CBP (Appendix C). The equation used to estimate total nitrogen (TN) load reductions for shoreline buffer reforestation is expressed as:

$$\text{Land Use Conversion (TN)} = \left[7.255(lbs/ac/yr) - 1.29(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$$

The equation used to estimate total phosphorus (TP) load reductions for shoreline buffer reforestation is expressed as:

$$\text{Land Use Conversion (TP)} = \left[0.429(lbs/ac/yr) - 0.02(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$$

The first expression in brackets in the equations above represents the difference between pervious urban and forest loading rates used in the watershed pollutant loading analysis. This reduction in loading rate is then multiplied by the available open pervious area for reforestation to determine the loads reductions from land use conversion. A summary of shoreline buffer reforestation reduction calculations and results are shown in the table below.

**Table 3-10: Shoreline Buffer Reforestation Load Reductions**

| Pollutant | Open Pervious Area (acres) | Pervious Urban Loading Rate (lbs/ac/yr) | Forest Loading Rate (lbs/ac/yr) | Reduced Loading Rate (lbs/ac/yr) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|---|
| TN | 301 | 7.255 | 1.29 | 5.965 | 1,795 |
| TP | 301 | 0.429 | 0.02 | 0.409 | 123 |

### 3.4.2.8 Pervious Area Reforestation

Nine open pervious areas with reforestation potential were identified in the watershed. Pollutant reductions for pervious area reforestation are calculated based on a 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:

$$\text{Land Use Conversion (TN)} = \left[7.255(lbs/ac/yr) - 1.29(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$$

The equation used to estimate total phosphorus (TP) load reductions for pervious area reforestation is expressed as:

Land Use Conversion (TP) = $\left[0.429(lbs/ac/yr) - 0.02(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$

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 loading analysis, as shown in the first expression in brackets in the equations above. The approximate reduction in pollutant load is then the reduced loading rate multiplied by the open pervious area available for reforestation. A summary of pervious area reforestation reduction calculations and results are shown in the table below.

**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 | 7.255 | 1.29 | 5.965 | 69.64 | 415 |
| TP | 0.429 | 0.02 | 0.409 | 69.64 | 28 |

### 3.4.2.9 Stream Corridor Restoration

Several potential stream restoration sites were identified during the stream corridor assessments (see Appendix D) to address stream stability issues (i.e., significant erosion and channel alterations) and improve water quality. Pollutant load reduction estimates in pounds per linear foot of stream restoration were developed by the County based on a re-analysis of Spring Branch data presented in the NPDES 2006 Annual Report and also used in the Upper Back River SWAP. These were also used to calculate load reductions for proposed stream restoration activities (i.e., restoration lengths [RL]) in the Tidal Back River. The equation used to estimate total nitrogen (TN) load reductions for stream restoration is expressed as:

$$0.202(lbs/ft) \times RL(ft)$$

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

$$0.0107(lbs/ft) \times RL(ft)$$

Significant erosion/channel alteration was noted for approximately 13 percent of the surveyed stream length. Because only a portion of the watershed's streams were surveyed, this percentage was extrapolated to the total watershed stream length (33.1 miles or 174,768 feet) to estimate the total stream length with restoration potential (i.e., 13% x 174,768 feet = 22,720 feet). A summary of stream corridor restoration reduction calculations and results are shown in the table below.

**Table 3-12: Stream Corridor Restoration Load Reductions**

| Pollutant | Reduction in Loading Rate (lbs/ft) | Length of Erosion/ Channel Alteration (ft) | % of Length Surveyed (ft) | Estimated Stream Restoration Length (ft) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|---|
| TN | 0.202 | 7,300 | 13% | 22,720 | 4,589 |
| TP | 0.0107 | 7,300 | 13% | 22,720 | 243 |

### 3.4.2.10 Downspout Disconnection

A total of 35 neighborhoods (out of 46 surveyed) have potential for downspout disconnection. A neighborhood is recommended for disconnection if at least 25 percent of the downspouts are directly and/or indirectly connected to the storm drain system and the average lot has at least 15 feet of pervious area available down gradient from the downspout. During the uplands survey, the percentage of homes with connected downspouts was noted. This percentage was used to determine the rooftop area that could be addressed by disconnection in recommended neighborhoods. This is explained in further detail in Chapter 4 of the *Watershed Characterization Report*.

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

$$\left[14.1(lbs/ac/yr)\times DA(acres)\right]\times 50\%$$

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

$$\left[2.26(lbs/ac/yr)\times DA(acres)\right]\times 70\%$$

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, 14.1 lbs TN/ac/yr and 2.26 lbs TP/ac/yr, are the impervious urban rates used in the pollutant loading analysis. Pollutant removal efficiencies are those reported for infiltration practices, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. A summary of downspout disconnection load reduction calculations and results are shown in the table below.

**Table 3-13: Downspout Disconnection Load Reductions**

| Pollutant | Impervious Urban Loading Rate (lbs/ac/yr) | DA (Rooftop area recommended for downspout disconnect) (acres) | Removal Efficiency (%) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|
| TN | 14.1 | 93 | 50% | 657 |
| TP | 2.26 | 93 | 70% | 147 |

### 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 investigated. 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 400 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:

$$\left[7.255(lbs/ac/yr) - 1.29(lbs/ac/yr)\right] \times \left[\#Trees \cdot \frac{1(acre)}{400(trees)}\right]$$

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

$$\left[0.429(lbs/ac/yr) - 0.02(lbs/ac/yr)\right] \times \left[\#Trees \cdot \frac{1(acre)}{400(trees)}\right]$$

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

**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 for NSAs (#) | New Forested Area (acres) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|---|---|
| TN | 7.255 | 1.29 | 5.965 | 2,125 | 5.3 | 32 |
| TP | 0.429 | 0.02 | 0.409 | 2,125 | 5.3 | 2 |

**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 for ISIs (#) | New Forested Area (acres) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|---|---|
| TN | 7.255 | 1.29 | 5.965 | 1,425 | 3.6 | 21 |
| TP | 0.429 | 0.02 | 0.409 | 1,425 | 3.6 | 1 |

### 3.4.2.12 Urban Nutrient Management

Urban nutrient management refers to educating citizens about environmentally friendly lawn care techniques. This includes the reduction/elimination of fertilizer and pesticide use and reducing the amount of mowed lawn via bayscaping. Neighborhoods targeted for fertilizer reduction/education were those where 20 percent or more of the homes appeared to employ high lawn maintenance practices (15 out of 46 NSAs). Neighborhoods targeted for bayscaping education were those where the typical lot was at least ¼ acre in size, was less than 25 percent landscaped, and where there was sufficient grass area available (21 out of 46 NSAs). The total acres of lawn that could be addressed if both of these urban nutrient management actions were determined based on NSA results which is explained in Chapter 4 of the *Watershed Characterization Report.*

Pollutant reductions for urban nutrient management are calculated based on the pollutant load received from the total lawn drainage area (DA) recommended for fertilizer reduction and bayscaping and removal efficiency. The equation used to estimate total nitrogen (TN) load reductions for urban nutrient management is expressed as:

$$\left[7.255(lbs/ac/yr)\times DA(acres)\right]\times 17\%$$

The equation used to estimate total phosphorus (TP) load reductions for urban nutrient management is expressed as:

$$\left[0.429(lbs/ac/yr)\times DA(acres)\right]\times 22\%$$

The pollutant load received from the lawn area recommended for fertilizer reduction and bayscaping is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 7.255 lbs TN/ac/yr and 0.429 lbs TP/ac/yr, are the pervious urban rates used in the pollutant loading analysis (Table 3.20) since this represents the source of runoff being addressed. Pollutant removal efficiencies are those reported for urban nutrient management, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs. A summary of urban nutrient management reduction calculations and results are shown in the table below.

**Table 3-16: Urban Nutrient Management Load Reductions**

| Pollutant | Pervious Urban Loading Rate (lbs/ac/yr) | High Maintenance Lawns (acres) | Lawn Available for Bayscape (acres) | Total Lawn DA (acres) | Removal Efficiency (%) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|---|---|
| TN | 7.255 | 83 | 104 | 186 | 17% | 230 |
| TP | 0.429 | 83 | 104 | 186 | 22% | 18 |

## 3.4.2.13 Street Sweeping

Ten 10 neighborhoods were recommended for street sweeping in the Tidal Back River watershed and contain approximately 24.5 miles of road. Records from the Department of Public Works (DPW) Street Sweeping Program (NPDES Section 3) showed that 1.24 tons (2,480 lbs) and 1 ton (2,000 lbs) of material were removed per mile of street sweeping in Back River in 2007 and 2008, respectively. Based on the average removal rate, there is potential for approximately 27.4 tons (54,880 lbs) of material to be removed from the proposed roadways in Tidal Back River via street sweeping (i.e., 2,240 lbs/mi/yr x 24.5 miles = 54,880 lbs/yr). The amount of material removed is converted to total nitrogen (TN) load removed using a concentration of 1,825.95 mg/kg, which is expressed by the following equation:

$$54{,}880(lbs/yr) \times 1{,}825.92(mg/kgTN) \times \frac{1(kg)}{1 \cdot 10^{6}(mg)}$$

The amount of material removed is converted to total phosphorus (TP) load removed using a concentration of 707.95 mg/kg, which is expressed by the following equation:

$$54{,}880(lbs/yr) \times 707.95(mg/kgTP) \times \frac{1(kg)}{1 \cdot 10^{6}(mg)}$$

A summary of street sweeping reduction calculations and results are shown in the table below.

**Table 3-17: Street Sweeping Load Reductions**

| Pollutant | Street Sweeping Bulk Removal Rate (lbs/mi/yr) | Proposed Miles of Street Sweeping (miles) | Total Bulk Load (lbs/yr) | Pollutant Concentration (mg/kg) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|---|
| TN | 2,240 | 24.5 | 54,880 | 1,825.92 | 100 |
| TP | 2,240 | 24.5 | 54,880 | 707.95 | 39 |

### 3.4.2.14 Sanitary Sewer Overflows

A total of 25 sanitary sewer overflow (SSO) events were documented between 2000 and 2008 within Tidal Back River. An estimated 223,390 gallons were discharged over this 9-year period. Pollutant loads associated with these SSO events and volume were calculated based on the following assumptions (more detail can be found in Chapter 3.5 of the *Watershed Characterization Report*):

- ***Total Phosphorus (TP):*** A conversion factor of $8.3 \times 10^{-5}$ was used to convert gallons of overflow to pounds of pollutant. This is based on a 10 mg/L TP concentration and a multiplier of $8.3 \times 10^{-6}$ lb·L/mg·gal.

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

Based on these conversion factors, approximately 56 lbs of total nitrogen and 19 lbs of total phosphorus were released over the 9-year period as a result of SSOs. This is equivalent to pollutant reduction capabilities of 6 lbs TN/yr (i.e., 56 lbs TN/9 yrs) and 2 lbs TP/yr (i.e., 19 lbs TP/9 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 (Table 7-6).

### 3.4.2.15 Proposed Shoreline Enhancements

Shoreline enhancement concepts were developed for six different reaches in Tidal Back River as part of DEPRM's Shoreline Feasibility Study (DEPRM 1998). Nutrient reductions associated with proposed shoreline enhancement projects are estimated based on the same equation used for the implemented capital improvement projects (see Chapter 3.4.2.1). Shoreline lengths were estimated from project concept plans in the feasibility study. Average bank heights for the proposed sites are unknown. Therefore, an average of the bank heights estimated for completed shoreline projects throughout the County was used (i.e., 6.6 feet). Erosion rates were obtained from DEPRM's Shoreline Feasibility Study (DEPRM 1998). Eroded volume ($ft^3$) is converted to weight (lbs) using a bulk density, $\rho_b$, of 93.6 lbs/$ft^3$. This weight is converted to tons using the corresponding ratio of 1 ton = 2000 lbs. A summary of potential shoreline enhancement project reduction calculations and results are shown in the table below.

**Table 3-18: Shoreline Enhancement Load Reductions**

| Proposed Project Location | Proposed Length (ft) | Erosion Rate (ft/yr) | Potential Volume Eroded (cf/yr) | Potential Volume Eroded (tons/yr) | Max Potential TN Reduction (lbs/yr) | Max Potential TP Reduction (lbs/yr) |
|---|---|---|---|---|---|---|
| Norris Farm | 1,500 | 1.9 | 18,810 | 880 | 643 | 423 |
| North Point State Park | 2,150 | 0.9 | 12,771 | 598 | 436 | 287 |
| Back River WWTP | 1,500 | 0.8 | 7,920 | 371 | 271 | 178 |
| Essex Sky Park | 1,570 | 0.8 | 8,290 | 388 | 283 | 186 |
| Rocky Point Golf Course | 1,480 | 1.1 | 10,745 | 503 | 367 | 241 |
| Rocky Point Longs Creek | 580 | 1 | 3,828 | 179 | 131 | 86 |
| ***Totals:*** | 8,780 | | 62,363 | 2,919 | ***2,131*** | ***1,401*** |

As discussed in Chapter 3.4.2.1, eroding shorelines are not included as a pollutant source in the watershed pollutant loading analysis summarized in Table 3-1. Therefore, nutrient reductions associated with potential shoreline enhancement projects are not included in the pollutant removal analysis. CBP is currently evaluating pollutant loads from shoreline erosion as well as resuspension of bottom sediments. This component of the restoration strategy will be reevaluated and included when consistent Chesapeake Bay-wide estimates are developed.

### 3.4.2.16 Overall Pollutant Load Reductions

The sum of maximum potential pollutant load reductions calculated for individual BMPs represents the overall pollutant removal capacity for a maximum implementation scenario (i.e., 100% of projects implemented). A practicable pollutant load reduction was estimated for each BMP as the maximum potential load reduction multiplied by a projected participation factor. An overall projected pollutant removal capacity is the sum of practicable pollutant load reductions for individual BMPs. Projected participation factor assumptions are described in the table below.

**Table 3-19: Projected Participation Factors**

| BMP | Projected Participation | Basis of Assumption |
|---|---|---|
| Wet Ponds | 100% | Existing – pond retrofits already implemented |
| Existing SWM | 100% | Existing – BMPs already implemented |
| SWM Conversions | 100% | Complete 2 conversions |
| SW Retrofits | 50% | General estimate to achieve 15% reduction goal |
| ISI Impervious Cover Removal | 50% | General estimate to achieve 15% reduction goal |
| Reforest Stream Buffer | 65% | General estimate to achieve 15% reduction goal |
| Reforest Shoreline Buffer | 60% | General estimate to achieve 15% reduction goal |
| Pervious Area Reforestation | 50% | General estimate to achieve 15% reduction goal |
| Stream Restoration | 75% | General estimate to achieve 15% reduction goal |
| NSA Downspout Disconnection | 33% | 33% willingness factor * |
| NSA Tree Plantings | 33% | 33% willingness factor* |
| ISI Tree Plantings | 60% | 60% of estimated trees located on public lands |
| Urban Nutrient Management | 5% | 10% recall rate (workshop/public meeting) x 54% willingness factor* |
| Street Sweeping | 100% | General estimate to achieve 15% reduction goal |
| SSO Reduction/Elimination | 100% | Consent Decree requirements |

Notes:

* Willingness factors are based on a citizens action survey conducted at a Tidal Back River Stakeholder Meeting held on October 7, 2009 to gage interest in proposed restoration actions.

Table 3-20 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 3-20, will meet the 15 percent reduction of nitrogen and phosphorus loads needed to meet water quality standards for Tidal Back River as specified by the Back River TMDL (Appendix E). There is opportunity to achieve greater reductions if restoration BMPs are implemented to a greater extent than those assumed by projected participation factors. Greater reductions may also be achieved through restoration actions not included in this analysis such as public education/outreach efforts (e.g., watershed trash and recycling campaign, marina environmental education, tours of completed projects and water trails). These types of actions are not included in the pollutant removal analysis because reduction efficiencies are not well known and difficult to estimate.

Completion of the Chesapeake Bay TMDL is anticipated in 2010 which will include an updated urban nutrient load requirement for Back River. The restoration strategy presented in this SWAP will be reevaluated to determine whether it is sufficient to meet the updated nutrient reduction requirements per the Chesapeake Bay TMDL. If the proposed BMPs are not sufficient, the restoration strategy will be modified within one year of TMDL approval to meet these new nutrient reduction requirements.

**Table 3-20: Summary of Pollutant Load Reduction Estimates**

| BMP | How Credited | TN Efficiency | TP Efficiency | Max Potential TN Load Reduction | Max Potential TP Load Reduction | Units Available | | Projected Participation | Projected TN Load Reduction | Projected TP Load Reduction |
|---|---|---|---|---|---|---|---|---|---|---|
| Wet Ponds | Efficiency | 30% | 50% | 202 | 22 | 2 | units | 100% | 202 | 22 |
| Existing SWM | Efficiency | varies | varies | 788 | 100 | 268 | acres | 100% | 788 | 100 |
| SWM Conversions | Efficiency | 50% | 70% | 13 | 1 | 6 | acres | 100% | 13 | 1 |
| SW Retrofits (NSA, ISI, PAA, HSI) | Efficiency | 50% | 70% | 89 | 20 | 13 | acres | 50% | 45 | 10 |
| ISI Impervious Cover Removal | LU Conversion | N/A | N/A | 7 | 2 | 1 | acre | 50% | 3 | 1 |
| Reforest Stream Buffer | LU Conversion + Efficiency | 25% | 50% | 3,042 | 249 | 240 | acres | 65% | 1,977 | 162 |
| Reforest Shoreline Buffer | LU Conversion | 25% | 50% | 1,795 | 123 | 301 | acres | 60% | 1,077 | 74 |
| Pervious Area Reforestation | LU Conversion | N/A | N/A | 415 | 28 | 70 | acres | 50% | 208 | 14 |
| Stream Restoration | Lbs per Ln Ft | 0.202 | 0.0107 | 4,589 | 243 | 22,720 | ft | 75% | 3,442 | 182 |
| NSA Downspout Disconnection | Efficiency | 50% | 70% | 657 | 147 | 93 | acres | 33% | 217 | 49 |
| NSA Tree Plantings | LU Conversion | N/A | N/A | 32 | 2 | 5 | acres | 33% | 10 | 1 |
| ISI Tree Plantings | LU Conversion | N/A | N/A | 21 | 1 | 4 | acres | 60% | 13 | 1 |
| Urban Nutrient Management | Efficiency | 17% | 22% | 230 | 18 | 186 | acres | 5% | 12 | 1 |
| Street Sweeping | Direct Removal | N/A | N/A | 100 | 39 | 25 | miles | 100% | 100 | 39 |
| SSO Reduction/Elimination | Direct Removal | N/A | N/A | 6 | 2 | 223,390 | gal | 100% | 6 | 2 |
| | ***Total Load Reduction (lbs/yr):*** | | | ***11,988*** | ***997*** | | | | ***8,115*** | ***657*** |
| | Total Existing Urban Load (lbs/yr) | | | 43,318 | 4,528 | | | | 43,318 | 4,528 |
| | ***Reduction Achieved:*** | | | ***28%*** | ***22%*** | | | | ***19%*** | ***15%*** |

# CHAPTER 4: SUBWATERSHED MANAGEMENT STRATEGIES

## 4.1 Introduction

This chapter describes the criteria and methodology used to rank the 10 subwatersheds comprising the Tidal Back River watershed (see 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 D.

## 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 60, where 0 denotes the least significant impacts to water quality and 60 corresponds to the greatest water quality improvement potential. The total prioritization score for a subwatershed is comprised of the following ranking criteria:

- Phosphorus and Nitrogen Loads
- Impervious Surfaces
- Neighborhood Restoration Opportunity/Pollution Source Indexes
- Neighborhood Lawn Fertilizer Reduction/Education
- Neighborhood Downspout Disconnection
- Neighborhood Trash Management
- Institutional Site Index
- Pervious Area Restoration
- Municipal Street Sweeping
- Municipal Stormwater Conversions
- Illicit Discharge Data
- Stream Buffer Improvement
- Shoreline Buffer Improvement
- Stream Corridor Restoration

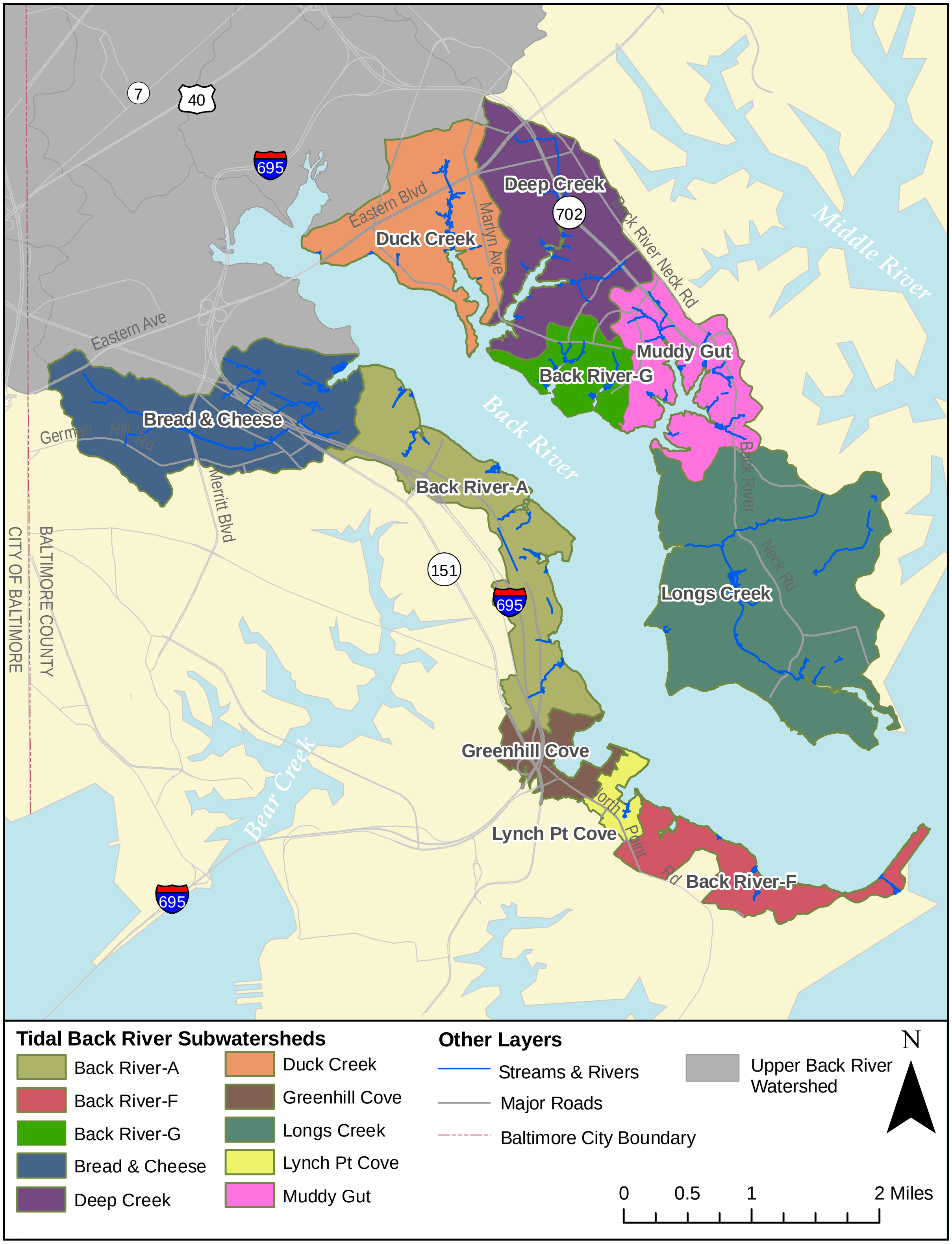


**Figure 4-1: Tidal Back River Subwatersheds**

Each criterion has a maximum possible score of 4. In general, subwatersheds were divided into quartiles based on supporting criterion data to yield an even distribution of the number of watersheds per possible score (i.e., 1, 2, 3, 4). In some cases, criterion data did not support dividing the subwatersheds into four equal parts. Examples include a distribution of data that is too narrow/clustered or cases where zero values were assigned to subwatersheds with 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.

### 4.2.1 Phosphorus and Nitrogen Loads

One of the objectives to improve and maintain water quality and meet TMDLs in Tidal Back River 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 Chesapeake Bay Program (CBP) for various land use types and subwatershed land use distributions. The pollutant loading analysis for Tidal Back River watershed is explained in further detail in the *Watershed Characterization Report* (Appendix D).

For each subwatershed, annual nitrogen and phosphorus loads were divided by the subwatershed's area. This represents pollutant loadings rates (lbs/acre/year) and allows a direct comparison between the 10 subwatersheds since they vary greatly in size. Subwatersheds with higher pollutant loading rates are higher priorities for restoration within the Tidal Back River watershed. Therefore, higher pollutant loading rates are assigned high scores to denote greater water quality impacts and restoration need.

Subwatershed nitrogen loading rates ranged from 3.9 to 9.4 lbs/acre/year. The following point system was used to assign nitrogen load scores to the 10 subwatersheds based on the range and distribution of subwatershed nitrogen loading rates:

- ≥ 8.3 lbs/acres/year = 4 pts
- 6.9 – 8.2 lbs/acre/year = 3 pts
- 6.4 – 6.8 lbs/acre/year = 2 pts
- ≤ 6.3 lbs/acre/year = 1 pt

Subwatershed phosphorus loading rates ranged from 0.2 to 1.0 lbs/acre/year. The following point system was used to assign phosphorus load scores to the 10 subwatersheds based on the range and distribution of subwatershed phosphorus loading rates:

- ≥ 1.0 lbs/acres/year = 4 pts
- 0.8 – 0.9 lbs/acre/year = 3 pts
- 0.6 – 0.7 lbs/acre/year = 2 pts

- ≤ 0.5 lbs/acre/year = 1 pt

Nitrogen and phosphorus loading rates and corresponding scores are summarized in the table below 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 |
|---|---|---|---|---|
| Back River-A | 6.8 | 2 | 0.6 | 2 |
| Back River-F | 6.3 | 1 | 0.5 | 1 |
| Back River-G | 6.8 | 2 | 0.6 | 2 |
| Bread & Cheese | 8.0 | 3 | 0.8 | 3 |
| Deep Creek | 8.8 | 4 | 1.0 | 4 |
| Duck Creek | 9.1 | 4 | 1.0 | 4 |
| Greenhill Cove | 8.2 | 3 | 0.9 | 3 |
| Longs Creek | 3.9 | 1 | 0.2 | 1 |
| Lynch Point Cove | 9.4 | 4 | 1.0 | 4 |
| Muddy Gut | 6.2 | 1 | 0.6 | 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*, 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 was used to assign scores as it allows a direct comparison between the 10 subwatersheds. Subwatersheds with higher percentages of impervious cover are higher priorities for restoration within the Tidal Back River watershed. Therefore, higher percentages of imperviousness are assigned high scores to denote greater water quality impacts and restoration need.

Impervious cover represents about 18 percent of the overall Tidal Back River watershed. Subwatershed percent impervious values range from approximately 3 to 33 percent. The following point system was used to assign percent impervious scores to the 10 subwatershed based on CWP's Impervious Cover model (see Chapter 2.3.3 of Appendix D) and subwatershed impervious surface percentages:

- > 60% = 4 pts

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

Percent impervious values and corresponding scores are summarized in the table below by subwatershed.

**Table 4-2: Percent Impervious Scores**

| SUBWATERSHED | % Impervious | % Impervious Score |
|---|---|---|
| Back River-A | 16 | 2 |
| Back River-F | 11 | 1 |
| Back River-G | 17 | 2 |
| Bread & Cheese | 28 | 3 |
| Deep Creek | 33 | 4 |
| Duck Creek | 33 | 4 |
| Greenhill Cove | 27 | 3 |
| Longs Creek | 3 | 1 |
| Lynch Point Cove | 33 | 4 |
| Muddy Gut | 13 | 2 |

### 4.2.3 Neighborhood Restoration Opportunity/Pollution Source Indexes

As described in the *Watershed Characterization Report*, neighborhood pollution severity and restoration potential were rated during neighborhood source assessments (NSA). The severity of pollution generated by a neighborhood is denoted by the Pollution Severity Index (PSI) and was rated as severe, high, moderate, or none. A neighborhood's potential for residential restoration projects was also rated as high, moderate, or low according to the Restoration Opportunity Index (ROI). Out of the 46 neighborhoods assessed, 8 were rated as high for both PSI and ROI and 14 neighborhoods were rated as a high PSI with a moderate ROI. The remaining 24 neighborhoods assessed were considered as having a moderate PSI with all moderate ROIs with the exception of one neighborhood considered as having a low ROI. Neighborhoods with high PSI and high ROI ratings represent the best areas to initially target for restoration.

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 multiple neighborhoods rated as high for pollution severity and moderate for restoration potential were assigned the third highest score (2 points). Subwatersheds with only moderately rated neighborhoods for both pollution severity and restoration potential were assigned the lowest possible score (1 point). The number of neighborhoods associated with various PSI/ROI ratings and corresponding NSA PSI/ROI scores are summarized in the table below by subwatershed.

**Table 4-3: NSA PSI/ROI Scores**

| SUBWATERSHED | # of NEIGHBORHOODS FOR PSI/ROI RATINGS High/ High | High/ Med | High/ Low | Med/ High | Med/ Med | Med/ Low | NSA PSI/ROI Score |
|---|---|---|---|---|---|---|---|
| Back River-A | - | 2 | - | - | 2 | - | 2 |
| Back River-F | - | - | - | - | 1 | - | 1 |
| Back River-G | 1 | 1 | - | - | 3 | - | 3 |
| Bread & Cheese | 2 | 1 | - | - | 2 | - | 4 |
| Deep Creek | 3 | 3 | - | - | 6 | 1 | 4 |
| Duck Creek | 2 | 5 | - | - | 4 | - | 4 |
| Greenhill Cove | 1 | - | - | - | 1 | - | 3 |
| Longs Creek | - | - | - | - | 3 | - | 1 |
| Lynch Point Cove | 1 | - | - | - | 1 | - | 3 |
| Muddy Gut | - | 4 | - | - | 3 | - | 2 |

### 4.2.4 Neighborhood Lawn Fertilizer Reduction/Education

Lawn maintenance activities often involve over-fertilization, poor pest-management, and over-watering resulting in polluted stormwater runoff to local streams. Lawns with a dense, uniform grass cover or signs designating poisonous lawn care were indicators of high lawn maintenance activities and sources of nutrients originating from lawn fertilizer. Neighborhoods where 20 percent or more of the homes appeared to employ high lawn maintenance practices were recommended for fertilizer reduction/education during the NSAs. This criterion is used for subwatershed prioritization because it has a quantitative pollution reduction efficiency related to nutrient reduction goals.

The acres of lawn addressed if lawn fertilizer reduction/education were initiated in the recommended neighborhoods were calculated in the *Watershed Characterization Report*. The percentage of each subwatershed area addressed by lawn fertilizer reduction/education was also calculated and was used to compare the restoration potential among the 10 subwatersheds. Subwatersheds with the highest percentages of lawn addressed through this action denote greatest restoration potential and therefore, were scored the highest. Percentages of subwatershed areas addressed through lawn fertilizer reduction range from approximately 0 to 3.0 percent. The following point system was used to assign fertilizer reduction scores to the 10 subwatershed based on the distribution and range of percentages of subwatershed area addressed:

- ≥ 2.1% = 4 pts
- 1.6 – 2.0% = 3 pts
- 1.1 – 1.5% = 2 pts
- 0.6 – 1.0% = 1 pt
- ≤ 0.5% = 0 pts

Percentage of area addressed by lawn fertilizer reduction and corresponding scores are summarized in the table below by subwatershed.

**Table 4-4: NSA Lawn Fertilizer Reduction Scores**

| SUBWATERSHED | % Area Addressed | NSA Lawn Fertilizer Reduction Score |
|---|---|---|
| Back River-A | 1.6 | 3 |
| Back River-F | 0 | 0 |
| Back River-G | 3.0 | 4 |
| Bread & Cheese | 0.6 | 1 |
| Deep Creek | 1.6 | 3 |
| Duck Creek | 3.0 | 4 |
| Greenhill Cove | 1.4 | 2 |
| Longs Creek | 0 | 0 |
| Lynch Point Cove | 0 | 0 |
| Muddy Gut | 1.1 | 2 |

### 4.2.5 Neighborhood Downspout Disconnection

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

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

The acres of rooftop addressed if downspout disconnection were initiated in the recommended neighborhoods were calculated in the *Watershed Characterization Report*. The percentage of subwatershed rooftop area addressed was also calculated and was used to compare the restoration potential among the 10 subwatersheds. Subwatersheds with the highest percentages of impervious rooftop acres addressed through downspout disconnection denote the greatest restoration potential and therefore, were scored the highest. Percentages of subwatershed areas addressed through downspout disconnection range from approximately 11 to 37 percent. The following point system was used to assign downspout disconnect scores to the 10 subwatershed based on the distribution and range of percentages of subwatershed rooftop areas addressed:

- ≥ 30% = 4 pts
- 22 – 29% = 3 pts
- 16 – 21% = 2 pts

- ≤15% = 1 pt

Percentage of rooftop area addressed by downspout disconnection and corresponding scores are summarized in the table below by subwatershed.

**Table 4-5: NSA Downspout Disconnect Scores**

| SUBWATERSHED | % Rooftop Area Addressed | NSA Downspout Disconnect Score |
|---|---|---|
| Back River-A | 16 | 2 |
| Back River-F | 14 | 1 |
| Back River-G | 16 | 2 |
| Bread & Cheese | 11 | 1 |
| Deep Creek | 13 | 1 |
| Duck Creek | 29 | 3 |
| Greenhill Cove | 26 | 3 |
| Longs Creek | 21 | 2 |
| Lynch Point Cove | 27 | 3 |
| Muddy Gut | 37 | 4 |

### 4.2.6 Neighborhood Trash Management

Trash is one of the major pollutants of concern in the Tidal Back River watershed. In addition, trash has the potential of becoming a pollutant regulated by USEPA through the TMDL process. For these reasons, NSA results for trash pollution sources and management opportunities were used as a criterion for prioritizing subwatershed. Trash management initiatives involve raising awareness of the trash issue and ways to solve it. Some ways to raise citizen awareness of trash as a problem include community cleanups, trash management education (e.g., presentations about recycling, reuse, and disposal options), storm drain markers, a watershed trash campaign, and/or targeted trash can inspection throughout a neighborhood. Additional strategies to address trash issues within the watershed include end-of-pipe trash collectors and neighborhood cleanups with dumpsters supplied by the County.

Neighborhoods where junk or trash was observed in 25 percent of yards were recommended for trash management initiatives. Neighborhoods with less than 25 percent of yards with junk/trash but had other warning signs such as overflowing dumpsters or dumping in alleys or other common areas were also included as a potential source of trash pollution. The acres of land addressed if trash management was implemented in the recommended neighborhoods was calculated for each subwatershed in the *Watershed Characterization Report*. The percentages of subwatershed areas addressed via neighborhood trash management were also calculated. This was used to directly compare restoration potential among the 10 subwatersheds with respect to addressing trash. Subwatersheds with the highest percentages of area addressed through neighborhood trash management denote the greatest restoration potential and therefore, were scored the highest.

Percentages of subwatershed areas addressed through neighborhood trash management range from approximately 0 to 17 percent. The following point system was used to assign trash management scores to the 10 subwatershed based on the distribution and range of percentages of subwatershed areas addressed:

- ≥ 10% = 4 pts
- 5 – 9% = 3 pts
- 3 – 4% = 2 pts
- 1 – 2% = 1 pt
- < 1% = 0 pts

Percentage of area addressed by neighborhood trash management and corresponding scores are summarized in the table below by subwatershed.

**Table 4-6: NSA Trash Management Scores**

| SUBWATERSHED | % Area Addressed | NSA Trash Management Score |
|---|---|---|
| Back River-A | 0 | 0 |
| Back River-F | 0 | 0 |
| Back River-G | 4 | 2 |
| Bread & Cheese | 11 | 3 |
| Deep Creek | 17 | 4 |
| Duck Creek | 1 | 1 |
| Greenhill Cove | 0 | 0 |
| Longs Creek | 0 | 0 |
| Lynch Point Cove | 0 | 0 |
| Muddy Gut | 7 | 2 |

### 4.2.7 Institutional Site Index

Institutions offer unique opportunities for watershed restoration. Typically, institutional properties encompass considerable portions of land including various natural resources. In addition, they offer the opportunity to engage a wide range of citizens in restoration activities. This raises citizen awareness while also providing water quality improvement benefits in the watershed. A total of 27 community-based facilities were surveyed during Institutional Site Investigations (ISIs) including cemeteries, faith-based facilities, community centers, municipal facilities (e.g, fire and rescue stations), and care centers (e.g., nursing homes). The focus of ISIs is to identify potential restoration opportunities, educate the community and provide water quality benefits. Subwatersheds with more institutional sites present more opportunities for implementing restoration actions (e.g., tree planting, stormwater retrofits, community cleanups, etc.) and encouraging citizen participation. Public institutional sites are good candidates for initial restoration efforts because there are opportunities to make use of and build upon existing partnerships and in many cases, incorporate student projects. While private institutions also have restoration potential, they will require a different approach and the development of new partnerships to implement restoration efforts. For all of these reasons, subwatershed prioritization for this criterion was based on the number of institutions and considering public versus private ownership.

Subwatersheds were first ranked according to the number of public ISIs. Those with the most ISIs under public ownership received the highest score (4 points). Subwatersheds with two publicly-owned institutions received the second highest score (3 points). Subwatersheds with only one public institution received the third highest score (2 points). Subwatersheds with only private institutions received a score of 1 point. The total number of institutions including public versus private ISIs and corresponding institutional site index scores are summarized in the table below by subwatershed.

**Table 4-7: ISI Scores**

| SUBWATERSHED | # Public ISIs | # Private ISIs | Total # ISIs | ISI Score |
|---|---|---|---|---|
| Back River-A | 0 | 0 | 0 | Not Assessed* |
| Back River-F | 0 | 0 | 0 | Not Assessed* |
| Back River-G | 0 | 0 | 0 | Not Assessed* |
| Bread & Cheese | 2 | 7 | 9 | 3 |
| Deep Creek | 4 | 0 | 4 | 4 |
| Duck Creek | 4 | 3 | 7 | 4 |
| Greenhill Cove | 0 | 2 | 2 | 1 |
| Longs Creek | 1 | 0 | 1 | 2 |
| Lynch Point Cove | 2 | 0 | 2 | 3 |
| Muddy Gut | 1 | 1 | 2 | 2 |

*'Not Assessed' denotes institutional site investigations not conducted within subwatershed. Note that Back River-A contains no institutional-related development according to MDP's 2007 Land Use/Land Cover GIS data layer.

### 4.2.8 Pervious Area Restoration

The most likely candidates for successful pervious area restoration 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 restoration was based on the total acres of publicly-owned parks within a subwatershed. Acres of publicly-owned parks were determined based on the parcels identified as recreation and parks in Baltimore County's 'government lands' GIS layer. The subwatershed with the most acres of recreation and park parcels under public ownership received the highest score (4 points). The subwatershed with the second highest acres of publicly-owned pervious area received the second highest score (3 points). Subwatersheds with between 20 and 40 acres of public-owned pervious areas received the third highest score (2 points). Subwatersheds with less than 10 acres of publicly-owned pervious area received a score of 1 point. Finally, subwatersheds with no public lands under recreation and parks received the lowest score (0 points). Public pervious area acreages and corresponding scores are summarized in the table below by subwatershed.

**Table 4-8: Pervious Area Restoration Scores**

| SUBWATERSHED | Acres of Public Pervious Areas* | Pervious Area Restoration Score |
|---|---|---|
| Back River-A | 2.6 | 1 |
| Back River-F | 36.7 | 2 |
| Back River-G | 3.7 | 1 |
| Bread & Cheese | 6.3 | 1 |
| Deep Creek | 28.5 | 2 |
| Duck Creek | 21.5 | 2 |
| Greenhill Cove | 0 | 0 |
| Longs Creek | 337.0 | 4 |
| Lynch Point Cove | 0 | 0 |
| Muddy Gut | 91.1 | 3 |

*Public pervious areas refer to those lands classified under the recreation and parks code in the County's 'government lands' GIS layer.

### 4.2.9 Municipal Street Sweeping

Baltimore County provides street sweeping services throughout their jurisdiction to help remove trash, sediment and other organic matter such as leaves and grass clippings from the curb and gutter system and prevent them from entering the storm drain system and nearby streams. Street sweeping also reduces sediment and other pollutant loads such as oil and metals to the stream system. During the NSAs, neighborhoods where 20 percent or more of the curbs and gutters were covered with excessive trash, sediment, and/or organic matter were recommended for street sweeping. As described in the *Watershed Characterization Report*, the miles of street addressed if street sweeping were implemented in the recommended neighborhoods was estimated by subwatershed. Subwatersheds with more miles of road that could be addressed through street sweeping denote the greatest restoration potential and therefore, were scored the highest. Miles addressed through street sweeping range from 0 to 10.3. The following point system was used to assign street sweeping scores to the 10 subwatershed based on the distribution and range of miles addressed:

- ≥ 10 miles = 4 pts
- 5.0 – 9.9 miles = 3 pts
- 1.0 – 4.9 miles = 2 pts
- 0.1 – 0.9 miles = 1 pt
- < 0.1 miles = 0 pts

Miles addressed by municipal street sweeping and corresponding scores are summarized in the table below by subwatershed.

**Table 4-9: Municipal Street Sweeping Scores**

| SUBWATERSHED | Miles of Road Addressed | Street Sweeping Score |
|---|---|---|
| Back River-A | 0 | 0 |
| Back River-F | 0 | 0 |
| Back River-G | 0.9 | 2 |
| Bread & Cheese | 6.8 | 3 |
| Deep Creek | 10.3 | 4 |
| Duck Creek | 5.0 | 3 |
| Greenhill Cove | 0.3 | 1 |
| Longs Creek | 0 | 0 |
| Lynch Point Cove | 1.2 | 2 |
| Muddy Gut | 0 | 0 |

### 4.2.10 Municipal Stormwater Conversions

Existing dry detention ponds within the Tidal Back River 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 that provides water quality benefits in addition to quantity control such as an extended detention facility. Dry extended detention ponds are designed to capture and retain stormwater runoff from a storm for a minimum duration to allow sediment and pollutants to settle out while also being able to provide flood control.

Four existing dry detention ponds were assessed for their potential to be converted to an extended detention facility. Information collected at each facility included the following: orifice, riser, ponding, debris, vegetation, adjacent land use, physical expansion capabilities, outfall, and downstream conditions. Out of the 4 detention ponds assessed, only two were considered as having the potential for conversion to an extended detention facility. Deep Creek consists of the detention pond considered as having the greatest potential for physical expansion and therefore, was assigned the highest score of 4 points. This detention pond, SWM-07, is located off of Eyring Avenue adjacent to a commercial/industrial building and parking lot from which it receives stormwater runoff. Back River-A contains a detention pond with some potential for physical expansion (e.g., vertical as opposed to lateral) and was assigned the second highest score of 3 points. (Detention pond, SWM-04, is located within the North Point Self Storage property off of North Point Road in subwatershed Back River-A.) Duck Creek and Muddy Gut each contain a detention pond considered as having no physical expansion potential. However, both have maintenance opportunities to maintain or enhance water quality improvement benefits. The detention pond in Duck Creek, SWM-06 located at the end of the cul-de-sac on Urbanwood Court, was recommended for routine inspection and consideration for native vegetation planting. Therefore, Duck Creek was assigned a score of 2 points. The detention pond in Muddy Gut, SWM-12 located off of Turkey Point and Back River Neck Roads in the Cape May Landing residential development, was considered as in good condition and recommended only for proper maintenance and inspection. Therefore, Muddy Gut was assigned a score of 1 point. Remaining subwatersheds without dry detention ponds were given a score of zero to denote no potential for stormwater conversion.

Municipal stormwater conversion scores are summarized in the table below by subwatershed.

**Table 4-10: Municipal Stormwater Conversion Scores**

| SUBWATERSHED | # of Dry Ponds | Expansion Capability | Municipal Stormwater Conversion Score |
|---|---|---|---|
| Back River-A | 1 | Limited | 3 |
| Back River-F | 0 | - | 0 |
| Back River-G | 0 | - | 0 |
| Bread & Cheese | 0 | - | 0 |
| Deep Creek | 1 | Yes | 4 |
| Duck Creek | 1 | No | 2 |
| Greenhill Cove | 0 | - | 0 |
| Longs Creek | 0 | - | 0 |
| Lynch Point Cove | 0 | - | 0 |
| Muddy Gut | 1 | No | 1 |

### 4.2.11 Illicit Discharge Data

Baltimore County tracks illicit discharges through a program of routine outfall screening. Illicit discharges refer to leaking pipes or incorrectly connected pipes. The County has an outfall prioritization system based on data from the outfall screening. Under this system, major outfalls 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 (4 times per year). On the other end of the rating scheme, outfalls that are not prioritized have insufficient data to determine a priority rating. More information regarding the County's outfall screening and prioritization system is included in the *Watershed Characterization Report.*

There are 35 major outfalls in the Tidal Back River watershed. Subwatersheds with the most illicit discharge data and highest prioritization ratings represent the best areas to target for restoration initially. Therefore, subwatersheds with the most major outfalls rated as critical received the highest scores (4 points). Subwatersheds with the most major outfalls rated as high priority received the second highest scores (3 points). Subwatersheds with only low rated major outfalls were assigned the third highest scores (2 points). Subwatersheds with major outfalls only listed as not a priority were assigned a score of 1 point. Finally, subwatersheds with no major outfalls received the lowest score (0 points)

The number of major outfalls associated with various County outfall prioritization ratings and corresponding illicit discharge data scores are summarized in the table below by subwatershed.

**Table 4-11: Illicit Discharge Data Scores**

| | COUNTY OUTFALL PRIORITIZATION RATINGS | | | | Illicit Discharge Data |
|---|---|---|---|---|---|
| SUBWATERSHED | Critical | High | Low | None | Score |
| Back River-A | - | - | - | 2 | 1 |
| Back River-F | - | 1 | - | - | 3 |
| Back River-G | 1 | 1 | - | - | 4 |
| Bread & Cheese | 1 | 3 | 4 | - | 4 |
| Deep Creek | 1 | 5 | 1 | 3 | 4 |
| Duck Creek | - | 5 | 4 | - | 3 |
| Greenhill Cove | - | - | 3 | - | 2 |
| Longs Creek | - | - | - | - | 0 |
| Lynch Point Cove | - | - | - | - | 0 |
| Muddy Gut | - | - | 1 | - | 2 |

### 4.2.12 Stream Buffer Improvements

Forested buffer areas along streams play a crucial role in improving water quality and flood mitigation since they can reduce surface runoff, stabilize stream banks, trap sediment, and provide habitat for various types of terrestrial and aquatic life including fish. They protect water bodies from pollutant loads while also providing bank stabilization and habitat. Maintaining healthy streams and forest buffers are important for reducing nutrient and sediment loadings to the Back River and to the Chesapeake Bay. When stream buffers are converted from forest to developed areas, many of these benefits are lost and stream health declines. Inadequate stream buffers (less than 50 feet wide) were the most commonly observed environmental problem within the Tidal Back River stream corridor assessment area. Riparian buffer zones can be re-established or preserved as a BMP to reduce land use impacts by intercepting and controlling pollutants entering a water body.

In the *Watershed Characterization Report*, the vegetative condition of stream buffer was analyzed based on a 100-foot buffer on either side of the stream system. 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. Therefore, the percentages of open pervious buffer area were used to prioritize restoration potential among subwatersheds. Subwatersheds with greater percentages of open pervious buffer areas denote the greatest potential for stream buffer improvement and were scored the highest.

Open pervious buffer area percentages range from approximately 0 to 91. The following point system was used to assign stream buffer improvement scores to the 10 subwatersheds based on the distribution and range of open pervious buffer area percentages:

- ≥ 80% = 4 pts
- 60 – 79% = 3 pts
- 30 – 59% = 2 pts

- 10 – 29% = 1 pt
- < 10% = 0 pts

Percentages of open pervious stream buffer areas and corresponding scores are summarized in the table below by subwatershed.

**Table 4-12: Stream Buffer Improvement Scores**

| SUBWATERSHED | % Open Pervious Stream Buffer Area | Stream Buffer Improvement Score |
|---|---|---|
| Back River-A | 67 | 3 |
| Back River-F | 82 | 4 |
| Back River-G | 33 | 2 |
| Bread & Cheese | 59 | 2 |
| Deep Creek | 62 | 3 |
| Duck Creek | 57 | 2 |
| Greenhill Cove | 0 | 0 |
| Longs Creek | 10 | 1 |
| Lynch Point Cove | 91 | 4 |
| Muddy Gut | 37 | 2 |

### 4.2.13 Shoreline Buffer Improvements

Similar to stream buffers, forested buffer areas along the shoreline play a crucial role in improving water quality. They protect surface water bodies from watershed pollutant loads while also providing bank stabilization and habitat. Maintaining forest buffers in tidal areas are important for reducing nutrient and sediment loadings to the Back River and to the Chesapeake Bay. Much of the coastal area within the watershed is developed which limits water quality benefits and contributes to surface water degradation. Re-establishing or preserving shoreline buffer areas can be used as a BMP to reduce land use impacts by intercepting and controlling pollutants before they enter the Back River.

In the *Watershed Characterization Report*, the vegetative condition of the shoreline buffer was analyzed based on a 100-foot buffer from the tidal waters. Similar to the stream buffer analysis, three conditions were used to classify stream buffer conditions: impervious, open pervious, or forested. For each subwatershed, acreages and percentages of shoreline buffer area were determined for the three conditions. Since open pervious areas represent the greatest potential for shoreline buffer reforestation, the percentages of open pervious buffer area were used to prioritize restoration potential among subwatersheds. Subwatersheds with greater percentages of open pervious buffer areas denote the greatest potential for shoreline buffer improvement and were scored the highest.

Open pervious buffer area percentages range from approximately 58 to 80. The following point system was used to assign shoreline buffer improvement scores to the 10 subwatersheds based on the distribution and range of open pervious buffer area percentages:

- ≥ 80% = 4 pts

- 70 – 79% = 3 pts
- 60 – 69% = 2 pts
- 50 – 59% = 1 pt

Percentages of open pervious shoreline buffer areas and corresponding scores are summarized in the table below by subwatershed.

**Table 4-13: Shoreline Buffer Improvement Scores**

| SUBWATERSHED | % Open Pervious Shoreline Buffer Area | Shoreline Buffer Improvement Score |
|---|---|---|
| Back River-A | 74 | 3 |
| Back River-F | 72 | 3 |
| Back River-G | 75 | 3 |
| Bread & Cheese | 74 | 3 |
| Deep Creek | 73 | 3 |
| Duck Creek | 71 | 3 |
| Greenhill Cove | 80 | 4 |
| Longs Creek | 66 | 2 |
| Lynch Point Cove | 74 | 3 |
| Muddy Gut | 58 | 1 |

### 4.2.14 Stream Corridor Restoration

Stream Corridor Assessments (SCAs) were conducted based on the Maryland Department of Natural Resources (DNR) survey protocols to quickly assess physical stream conditions and identify common environmental problems in the stream corridor. This included documentation of erosion sites, inadequate stream buffers, fish migration barriers, exposed or discharging pipes, channelized or altered stream sections, trash dumping sites, in or near stream construction, and unusual conditions (e.g., invasive species). SCAs were focused in four subwatersheds with the greatest length of wadeable, non-tidal streams best suited for the survey method and for identifying stream corridor restoration efforts: Bread & Cheese, Duck Creek, Deep Creek, and Muddy Gut. As previously mentioned, maintaining healthy streams is fundamental to improving water quality in the Back River. This criterion relates other watershed goals such as restoring and maintaining fisheries and habitat, reducing trash, and increasing citizen participation with restoration projects (e.g., volunteer stream clean-ups).

Along the 10.7 miles of stream walked in the Tidal Back River watershed, a total of 304 potential environmental problems were observed. The most frequently observed problems were inadequate stream buffers, trash dumping, channel alteration and erosion. Several outfalls and exposed pipe locations were considered as potentially severe or moderately severe water quality problems. Because stream buffer improvement is addressed in a separate criterion, it is not included in the stream corridor restoration ranking criterion. The remaining four frequently observed problems were evaluated/scored separately and then combined to determine an overall stream corridor restoration score. Trash dumping, channel alteration, erosion, and discharging/exposed pipes all relate to multiple watershed goals and are good indicators of restoration need and potential. Each problem category and overall stream corridor restoration criterion scoring are described below.

***Trash Dumping***

Trash dumping sites are places where large amounts of trash have been dumped or have accumulated inside the stream corridor. Identifying these sites helps identify areas where limiting access is necessary to reduce trash dumping and locations suitable for stream clean-ups. Trash dumping sites were a prevalent environmental problem in the streams surveyed. During the SCAs, field teams estimated the number of pick-up truck loads they deemed necessary to remove all trash/debris from a given site. Greater numbers of pick-up truck loads denote greater amounts of trash within a stream and a higher need for restoration. Subwatersheds were ranked according to the total number of estimated pick-up truck loads, where 4 points were assigned to the subwatershed with the most pick-up truck loads and 3 points were assigned to the subwatershed with the second highest amount of pick-up truck loads. Since the remaining two subwatersheds have similar pick-up truck load estimates, these were assigned 2 points. The table below summarizes the total number of pick-up truck loads estimated to remove trash/debris in stream corridors and the corresponding trash dumping sub-criterion scores by subwatershed.

**Table 4-14: SCA Trash Dumping Scores**

| SUBWATERSHED | # TRUCK LOADS | Trash Dumping Score |
|---|---|---|
| Bread & Cheese | 63 | 4 |
| Deep Creek | 27 | 2 |
| Duck Creek | 59 | 3 |
| Muddy Gut | 26 | 2 |

***Channel Alteration***

Sections of stream where the banks or channel have been significantly modified from their naturally occurring structure or condition can have adverse impacts on stream health. This includes channels that have been dredged, widened, straightened, and/or covered with concrete. While often intended to convey more water and prevent flooding, habitat impairments and downstream instabilities may result. During the SCAs, the field team documented channel alteration lengths at each site surveyed. The total length of channel alteration observed and percentage of the total stream length surveyed that is altered were calculated in the *Watershed Characterization Report* by subwatershed. Altered stream length percentages (based on surveyed stream miles) were used to directly compare and rank subwatersheds. A higher percentage of stream length that is significantly altered represents a greater need and potential for stream corridor restoration. Subwatersheds were ranked according to this percentage, where 4 points was assigned to the subwatershed with the highest and 1 point was assigned to the subwatershed with the lowest percentage of altered stream length. Because Bread & Cheese and Duck Creek have similar percentages of altered channel lengths, these were both assigned 2 points. No score of 3 points was assigned since there is such a large gap between the highest and second highest percentages of altered stream lengths. The table below summarizes the percentages of altered stream lengths in surveyed stream corridors and the corresponding channel alteration sub-criterion scores by subwatershed.

**Table 4-15: SCA Channel Alteration Scores**

| SUBWATERSHED | % Altered* | Channel Alteration Score |
|---|---|---|
| Bread & Cheese | 4.2% | 2 |
| Deep Creek | 29.7% | 4 |
| Duck Creek | 3.7% | 2 |
| Muddy Gut | 1.9% | 1 |

* % Altered based on altered length observed in the field divided by total stream length surveyed.

### *Erosion*

Erosion can destabilize stream banks, destroy habitat, and cause sediment pollution problems downstream. Significant erosion problems are often a result of land use changes in a watershed. During the SCAs, the field team documented significant erosion sites and corresponding lengths. The total length of erosion observed and percentage of the total stream length surveyed that is significantly eroded were calculated in the *Watershed Characterization Report* by subwatershed. Eroded stream length percentages (based on surveyed stream miles) were used to directly compare and rank subwatersheds. A higher percentage of stream length that is significantly eroded represents a greater need and potential for stream corridor restoration. Subwatersheds were ranked according to this percentage, where 4 points was assigned to the subwatershed with the highest and 1 point was assigned to the subwatershed with the lowest percentage of significantly eroded stream length. The table below summarizes the percentages of eroded stream lengths in surveyed stream corridors and the corresponding erosion sub-criterion scores by subwatershed.

**Table 4-16: SCA Erosion Scores**

| SUBWATERSHED | % Erosion | Erosion Score |
|---|---|---|
| Bread & Cheese | 4% | 3 |
| Deep Creek | 3% | 2 |
| Duck Creek | 1% | 1 |
| Muddy Gut | 5% | 4 |

* % Erosion based on altered length observed in the field divided by total stream length surveyed.

### *Exposed/Discharging Pipes*

Pipe outfalls refer to storm drain outfalls or small manmade channels that discharge stormwater into a stream corridor. Pipe outfalls are considered a potential water quality problem since they can carry untreated runoff and pollutants such as oil, heavy metals, and nutrients to a stream system. Exposed pipes in a stream corridor are a concern because they can be damaged by debris or during large storm events and leak fluids being carried by the pipeline into the stream system. During the SCAs, the field team documented the pollution severity of pipe outfalls based on discharge presence, color, odor, amount, and downstream impacts. For example, outfalls with a strong discharge relative to the normal stream flow, a distinct color and/or odor, and where discharge was causing significant impacts downstream were considered severe problems.

Exposed pipes include any pipes that were either in the stream or along the immediate banks that could be damaged by a high flow event (e.g., sewer pipes). These include manhole stacks, pipes exposed along the stream banks, pipes exposed that run under the stream bed, and pipes built over a stream but that are low enough to be affecting during high storm flows. Severity of exposed pipes was based on the amount of pipe exposed, location in the stream, structural stability, and leakage presence. Leaking pipes or those with an immediate threat of structural failure were considered severe problems. The total number of severe and moderately severe outfalls and exposed pipes observed during the SCAs were used to rank subwatersheds for this sub-criterion. Subwatersheds with more occurrences of severe to moderately severe exposed and discharging pipes represent a greater need and potential for stream corridor restoration.

Subwatersheds were ranked in order of the total number of severe to moderately severe outfalls and exposed pipes, where 4 points was assigned to the subwatershed with the most and 1 point was assigned to the subwatershed with the least amount. Because Deep Creek and Duck Creek have similar numbers of severe-moderate exposed and discharging pipes, these were both assigned 3 points. No score of 2 points was assigned since there is such a relatively large gap between the subwatersheds assigned 3 points and the subwatershed with the least number of severe-moderate discharging and exposed pipes. The table below summarizes the numbers of severe to moderately severe outfalls and exposed pipes in surveyed stream corridors and the corresponding exposed/discharging pipe sub-criterion scores by subwatershed.

**Table 4-17: SCA Exposed/Discharging Pipes Scores**

| SUBWATERSHED | # Severe-Moderate Outfalls and Exposed Pipe | Exposed/ Discharging Pipes Score |
|---|---|---|
| Bread & Cheese | 16 | 4 |
| Deep Creek | 9 | 3 |
| Duck Creek | 7 | 3 |
| Muddy Gut | 2 | 1 |

***Overall Stream Corridor Restoration Score***

Stream corridor restoration may involve addressing all four environmental problem categories. Therefore, to determine the overall score for the stream corridor restoration criterion, subwatersheds were ranked according to the sum of the sub-criterion scores. The subwatershed with the highest total sub-criteria score received the highest ranking (4 points). The subwatershed with the lowest total sub-criteria score received the lowest ranking for this criterion (1 point). The table below summarized sub-criteria totals and overall stream corridor restoration scores by subwatershed.

**Table 4-18: SCA Stream Corridor Restoration Scores**

| SUBWATERSHED | Total of Sub-Criteria Scores | Overall Stream Corridor Restoration Score |
|---|---|---|
| Bread & Cheese | 13 | 4 |
| Deep Creek | 11 | 3 |
| Duck Creek | 9 | 2 |
| Muddy Gut | 8 | 1 |

### 4.2.15 Subwatershed Prioritization Summary

The 10 subwatersheds comprising the Tidal Back River watershed are ranked according to the total prioritization score (i.e., the sum of prioritization criterion scores). Subwatershed ranking results are summarized in Table 4-19 including criterion scores, total scores, and rankings by subwatershed.

Subwatersheds were placed into one of four priority categories based on ranking results: very high, high, medium, and medium-low. These results are summarized in Table 4-20 and illustrated in Figure 4-2. Subwatersheds with a total prioritization score greater than 30 received a very high priority rating. These three subwatersheds (Deep Creek, Duck Creek, and Bread & Cheese) have scores that are much higher than the remaining subwatersheds. A high rating was assigned to the next logical grouping of subwatersheds with total prioritization scores of 28 and 29 (Lynch Point Cove, Back River-G, and Muddy Gut). A medium rating was assigned to the two subwatersheds with total prioritization scores of 24 and 25 (Greenhill Cove, Back River-A). The remaining two subwatersheds (Back River-F, Longs Creek) with total prioritization scores less than 20 were assigned a medium-low priority rating. Restoration actions will have to occur throughout the entire Tidal Back River watershed in order to meet environmental goals and requirements. However, subwatershed prioritization provides a tool/framework for focusing initial restoration efforts.

**Table 4-19: Subwatershed Ranking Results**

| SUBWATERSHED | Nitrogen Load | Phosphorus Load | % Impervious | NSA PSI/ROI | NSA Lawn Fertilizer Reduction | NSA Downspout Disconnect | NSA Trash Management | ISI Site Index | Pervious Area Restoration | Municipal Street Sweeping | Municipal Stormwater Conversion | Illicit Discharge Data | Stream Buffer Improvement | Shoreline Buffer Improvement | Stream Corridor Restoration | TOTAL SCORE | SUBWATERSHED RANK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Back River-A | 2 | 2 | 2 | 2 | 3 | 2 | 0 | NA | 1 | 0 | 3 | 1 | 3 | 3 | NA | ***24*** | ***7*** |
| Back River-F | 1 | 1 | 2 | 1 | 0 | 1 | 0 | NA | 2 | 0 | 0 | 3 | 4 | 3 | NA | ***18*** | ***8*** |
| Back River-G | 2 | 2 | 2 | 3 | 4 | 2 | 2 | NA | 1 | 1 | 0 | 4 | 2 | 3 | NA | ***28*** | ***5*** |
| Bread & Cheese | 3 | 3 | 3 | 4 | 1 | 1 | 4 | 3 | 1 | 3 | 0 | 4 | 2 | 3 | 4 | ***39*** | ***3*** |
| Deep Creek | 4 | 4 | 3 | 4 | 3 | 1 | 4 | 4 | 2 | 4 | 4 | 4 | 3 | 3 | 3 | ***50*** | ***1*** |
| Duck Creek | 4 | 4 | 3 | 4 | 4 | 3 | 1 | 4 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | ***44*** | ***2*** |
| Greenhill Cove | 3 | 3 | 3 | 3 | 2 | 3 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 4 | NA | ***25*** | ***6*** |
| Longs Creek | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 2 | 4 | 0 | 0 | 0 | 1 | 2 | NA | ***15*** | ***9*** |
| Lynch Point Cove | 4 | 4 | 3 | 3 | 0 | 3 | 0 | 3 | 0 | 2 | 0 | 0 | 4 | 3 | NA | ***29*** | ***4*** |
| Muddy Gut | 1 | 2 | 2 | 2 | 2 | 4 | 3 | 2 | 3 | 0 | 1 | 2 | 2 | 1 | 1 | ***28*** | ***5*** |

* NA denotes that corresponding category 'Not Assessed' within the subwatershed indicated.

**Table 4-20: Subwatershed Prioritization**

| Rank | Subwatershed | Total Score | Prioritization Category |
|---|---|---|---|
| 1 | Deep Creek | 50 | Very High |
| 2 | Duck Creek | 44 | Very High |
| 3 | Bread & Cheese | 39 | Very High |
| 4 | Lynch Point Cove | 29 | High |
| 5 | Back River-G | 28 | High |
| 5 | Muddy Gut | 28 | High |
| 6 | Greenhill Cove | 25 | Medium |
| 7 | Back River-A | 24 | Medium |
| 8 | Back River-F | 18 | Medium-Low |
| 9 | Longs Creek | 15 | Medium-Low |

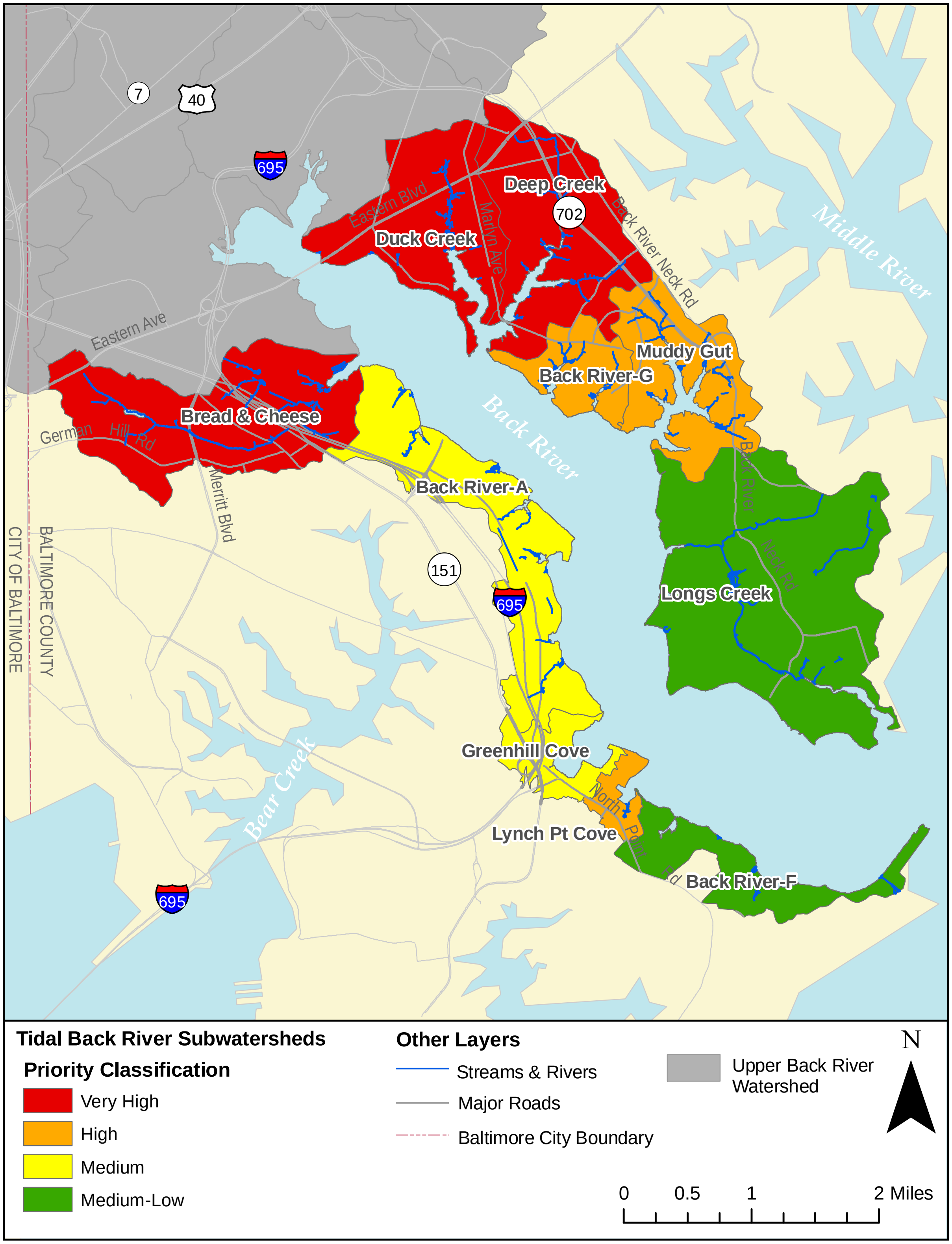


**Figure 4-2: Tidal Back River Subwatershed Prioritization**

## 4.3 Subwatershed Restoration Strategies

Restoration strategies for each subwatershed are presented in the following subsections. Subwatersheds are presented in alphabetical order. A description of key watershed characteristics is presented for each subwatershed including drainage area, stream length, coastline length, population, land use/land cover, impervious cover, soils, and stormwater management (SWM) facilities. Assessment results for neighborhoods, hotspots, institutions, pervious areas, stream corridors, illicit discharges, and stormwater conversions are also summarized for each subwatershed. Finally, a subwatershed management strategy including recommended citizen and municipal actions are presented at the end of each subsection.

Note that because there are numerous operations in the Tidal Back River watershed that qualify as stormwater hotspots, not all could be individually evaluated during the uplands survey. HSIs were focused on unregulated hotspots since access to regulated hotspots was often limited (e.g., private marinas, secured manufacturing plants, other industrial areas, etc.) and because regulated hotspots are previously documented/known pollutant sources. Regulated hotspots are already subject to NPDES permit regulations which normally require strict effluent concentration limits and periodic monitoring. Therefore, ten hotspot site investigations (HSIs) were conducted in areas where urban development/commercial uses are concentrated in the watershed. 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. On a similar note, there are several open pervious areas throughout the watershed with reforestation potential, including over 500 acres of publicly-owned lands for recreation and parks. Ten pervious area assessments (PAAs) were conducted, all of which are large open parcels with minimal site preparation required for reforestation. The total acres of publicly-owned lands with restoration potential is considered in the subwatershed prioritization and discussed in subwatershed descriptions.

### 4.3.1 Back River-A

Back River-A is the fourth largest subwatershed in the Tidal Back River watershed. It encompasses most of the industrial area comprising the watershed. The majority of Back River-A is occupied by urban development (nearly 74%) including industrial, open urban/transportation, and medium density residential uses. Forested areas make up the majority of the remaining subwatershed area. The majority of streams comprising this subwatershed are tidal, marshy areas. The table below summarizes key subwatershed characteristics of Back River-A.

**Table 4-21: Key Subwatershed Characteristics - Back River-A**

| | | |
|---|---|---|
| **Drainage Area** | 973.1 acres (1.52 sq. mi.) | |
| **Stream Length** | 3.9 miles | |
| **Coastline Length** | 5.7 miles | |
| **Population** | 1,469 (2000 Census)<br>1.5 people/acre | |
| **Land Use/Land Cover** | Low Density Residential:<br>Medium Density Residential:<br>High Density Residential:<br>Commercial:<br>Industrial:<br>Institutional:<br>Other Urban:<br>Forest:<br>Agriculture:<br>Water/Wetlands: | 2.1%<br>18.7%<br>0.0%<br>5.3%<br>21.0%<br>0.0%<br>26.5%<br>23.5%<br>0.0%<br>2.9% |
| **Impervious Cover** | 16% of subwatershed | |
| **Soils** | A Soils (low runoff potential):<br>B Soils:<br>C Soils:<br>D Soils (high runoff potential): | 3.3%<br>16.0%<br>51.7%<br>29.0% |
| **SWM Facilities** | 11% of urban land use treated | |
| **Priority Rating** | Medium | |

### *Neighborhoods*

A total of four (4) distinct neighborhoods were identified and assessed within Back River-A during the uplands assessment of Tidal Back River. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, buffer improvement, and public education (i.e., bayscaping, increasing lot tree canopy, lawn care, pet waste management, and pool maintenance). A summary of neighborhood recommended actions is presented in the table below.

**Table 4-22: NSA Recommendations - Back River-A**

| | | RECOMMENDED ACTIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Stencils | Bayscape | Increase Lot Canopy | Fertilizer Reduction | Pet Waste | Buffer Improvement | Notes |
| NSA_E_03 | <1/4 | 50 | X | | | | | | X | X | Pool education |
| NSA_E_04 | 1/2 | 25 | X | X | X | X | X | X | | | Pool education |
| NSA_E_05 | <1/4 | 25 | X | | X | | X | X | | | Community pool, some street trees but < 4 ft |
| NSA_E_32 | Mobile Home | 80 | X | | | X | X | X | | | |

Most of the neighborhoods in Back River-A are recommended for downspout disconnection and public education related to increasing lot tree canopy and proper lawn care and pool maintenance techniques. Because NSA_E_03 is located on the shore of Tidal Back River with most lots consisting of mowed grass up to the shoreline, this neighborhood is recommended for buffer improvement. This may also be achieved through public education about the benefits of providing a shoreline buffer by reducing the amount of mowed lawn through tree and vegetation planting. Several permeable driveways (i.e., porous pavers and/or gravel infill) were observed in NSA_E_05 (see figure below). This neighborhood presents an opportunity to educate other residents about reducing their impervious footprints by providing examples of viable and aesthetically pleasing options currently being used within the watershed.

**Figure 4-3: Permeable Driveways in NSA_E_05**

### *Hotspots*

No hotspot investigations were performed within Back River-A since HSIs were focused in areas where commercial development is concentrated in the watershed (i.e., Bread & Cheese, Deep Creek, and Duck Creek). In addition, Back River-A consists of a considerable portion of industrial areas which are often regulated and/or have limited access. There are currently five NPDES-permitted facilities for industrial stormwater discharges within Back River-A. Compliance with permit requirements should be verified for these facilities. Some auto-related facilities were observed while driving through this subwatershed which should be considered when addressing watershed-wide hotspot operations. Back River-A also includes a marina at the end of Wise Avenue (North Point Cove/Rudy's). This presents an opportunity to encourage and work with the marina owner to implement pollutant prevention practices and become a certified Maryland Clean Marina while also educating marina users.

### *Institutions*

Back River-A does not include institutional related land uses. Therefore, no institutional site assessments were conducted within Back River-A.

### *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 Back River-A: Beachwood Estates Park located off of Greencove Circle. This is a public park, maintained by Baltimore County, with good site access, mostly turf cover (70%), and minimal site preparation required for restoration. Reforestation of this area would also reduce sediment inputs from the considerable amounts of bare soil observed in the park. A summary is provided in the table below.

**Table 4-23: PAA Recommendations - Back River-A**

| Site ID | Location | Description | Acres | Ownership |
|---|---|---|---|---|
| PAA_E_800 | Greencove Circle | Public park in Beachwood Estates | 2.60 | Public |

### *Stream Corridor Assessments*

Stream corridor assessments (SCAs) were not conducted in Back River-A. Streams within this subwatershed are mostly tidal, marshy areas and not appropriate for the walking field survey based on Maryland DNR's SCA Survey Protocols. Therefore, no stream restoration opportunities have been identified in Back River-A.

### *Illicit Discharges*

Baltimore County tracks illicit discharges through a program of routine outfall screening. The County uses a prioritization system based on this data where outfalls are assigned one of the following priority ratings: none (priority 0), low (priority 3), high (priority 2), critical (priority 1). Priority 1 outfalls have major problems that require immediate correction and/or close monitoring, or have recurring problems. These outfalls are sampled four times each year. Priority 2 outfalls have moderate to minor problems with the potential to become more severe. These are sample once a year. There are no priority 1 or 2 outfalls within Back River-A.

Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

### *Stormwater Conversions*

Back River-A contains one detention pond, located within the North Point Self Storage property off of North Point Road. The pond is located on privately-owned property and bounded on three sides by a fence. While lateral expansion capability is limited, there is potential for conversion to an extended detention facility through vertical expansion (i.e., deepening). In addition, there are maintenance opportunities to increase water quality improvement capacity of the pond. One is to replace the current vegetation (patchy grass) with more dense, native vegetation with greater water quality benefits. The outfall should also be cleared of debris, trash, and sediment noted to improve water quality treatment potential. The table below summarizes field survey results.

**Table 4-24: Detention Pond Conversion - Back River-A**

| Site ID | Orifice | Riser | Ponding | Debris | Vege-tation | Adjacent Land | Outfall | Down-stream |
|---|---|---|---|---|---|---|---|---|
| SWM_04 | N/A | Fair | No | Low | Low | Industrial | Bad | Good |

* N/A denotes inability to access site or locate certain features.

### *Shoreline Restoration*

Back River-A has the second longest length of shoreline miles among the 10 subwatersheds comprising Tidal Back River. One reach within Back River-A was assessed previously in DEPRM's Shoreline Enhancement Feasibility Study (1998): Norris Farm Landfill. The Norris Farm Landfill site was determined as a feasible site for shoreline-related habitat enhancement, erosion control, and beneficial use efforts.

### *Subwatershed Management Strategy*

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

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-22.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-22.

3. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as The Growing Home Campaign.

4. Educate citizens about the benefits and importance of proper lawn care and pool maintenance techniques and bayscaping.

5. Educate residents of NSA_E_03 about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments.

6. Educate residents about reducing impervious footprints (e.g., permeable driveway options) such as those used in NSA_E_05.

7. Further investigate the pervious area described in Table 4-23 for tree planting opportunities.

Municipal Actions

1. Work with the North Point Cove Marina to implement appropriate BMPs and become a certified Maryland Clean Marina.

2. Further investigate the conversion potential of the detention pond described in Table 4-24.

3. Evaluate a shoreline enhancement project at the Norris Farm Landfill site identified in DEPRM's Shoreline Feasibility Study.

4. Explore options for wetland restoration and planting along the shoreline.

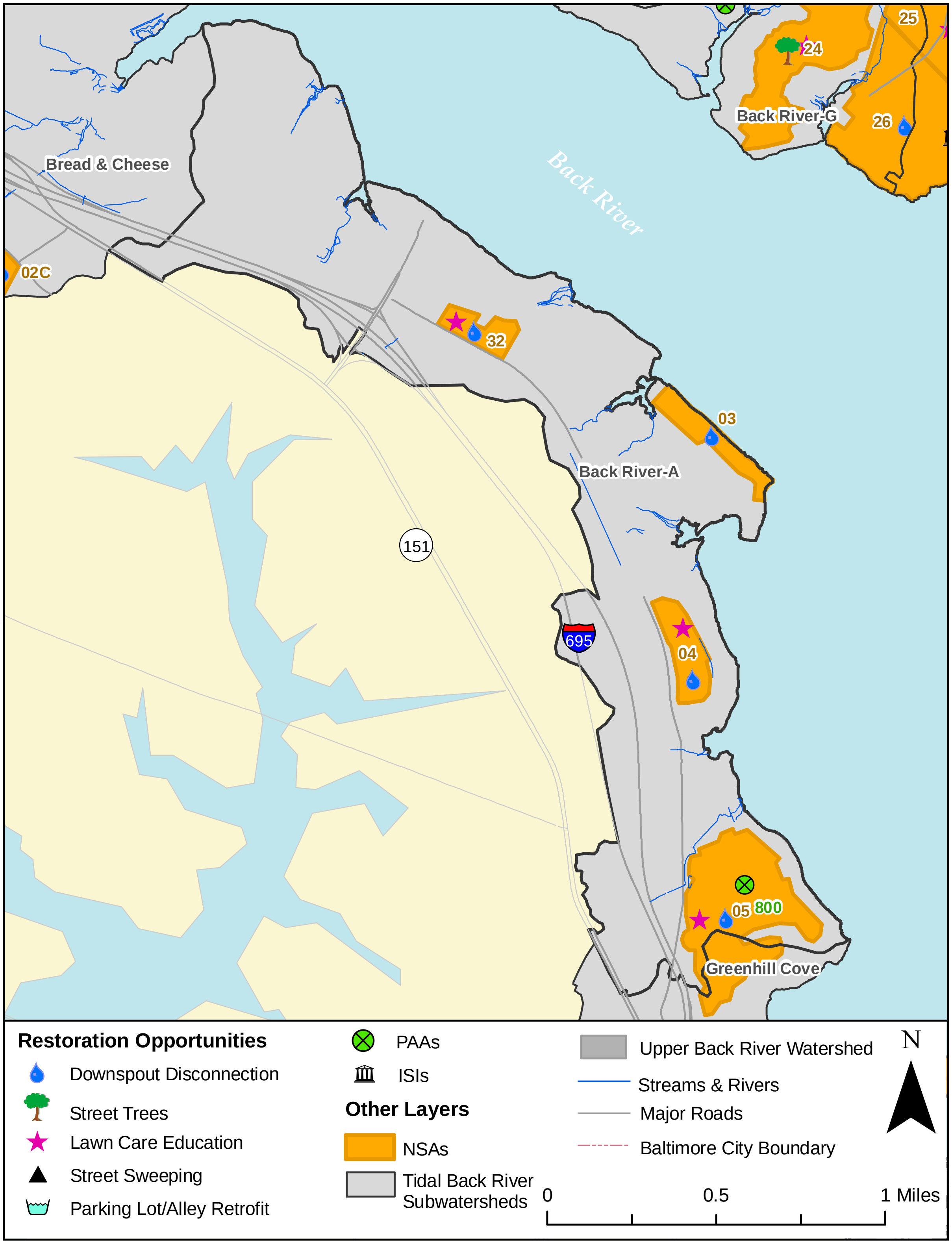


**Figure 4-4: Restoration Opportunities in Back River-A**

### 4.3.2 Back River-F

Back River-F is one of the least developed watersheds with nearly half of its area covered by forest. The majority of forested area is occupied by North Point State Park. Agriculture and medium density residential uses occupy the majority of the remainder of the subwatershed. Similar to Back River-A, the majority of streams comprising this subwatershed are tidal, marshy areas. The table below summarizes key subwatershed characteristics of Back River-F.

**Table 4-25: Key Subwatershed Characteristics - Back River-F**

| | | |
|---|---|---|
| **Drainage Area** | 420.4 acres (0.66 sq. mi.) | |
| **Stream Length** | 1.3 miles | |
| **Coastline Length** | 3.7 miles | |
| **Population** | 1,300 (2000 Census)<br>3.1 people/acre | |
| **Land Use/Land Cover** | Low Density Residential:<br>Medium Density Residential:<br>High Density Residential:<br>Commercial:<br>Industrial:<br>Institutional:<br>Other Urban:<br>Forest:<br>Agriculture:<br>Water/Wetlands: | 0.0%<br>19.4%<br>2.5%<br>2.8%<br>0.0%<br>5.5%<br>0.0%<br>40.0%<br>20.3%<br>9.5% |
| **Impervious Cover** | 11% of subwatershed | |
| **Soils** | A Soils (low runoff potential):<br>B Soils:<br>C Soils:<br>D Soils (high runoff potential): | 0.0%<br>20.5%<br>47.2%<br>29.0% |
| **SWM Facilities** | 3% of urban land use treated | |
| **Priority Rating** | Medium-Low | |

***Neighborhoods***

One (1) distinct neighborhood was identified and assessed within Back River-F during the uplands assessment of Tidal Back River. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection and increasing private lot tree canopy. A summary of neighborhood recommended actions is presented in the table below.

**Table 4-26: NSA Recommendations - Back River-F**

| RECOMMENDED ACTIONS | | | | | |
|---|---|---|---|---|---|
| NSA_ID | LotSize (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Increase Lot Canopy | Notes |
| NSA_E_07 | <1/4 | 35 | X | X | No curb & gutter but sediment issues |

Although NSA_E_07 does not have a curb and gutter system, sediment buildup was observed along many of the streets in this neighborhood (see figure below). This may be partially addressed through efforts to increase tree canopy on private lots.

**Figure 4-5: Sediment Buildup along Streets in NSA_E_07**

### *Hotspots*

No hotspot investigations were performed within Back River-F since HSIs were focused in areas where commercial development is concentrated in the watershed. As previously stated, Back River-F is one of the least developed subwatersheds comprising Tidal Back River and consists of less than three percent of commercial land uses.

### *Institutions*

Back River-F includes a portion of one institutional site surveyed: Sparrows Point Junior and Senior High School. Since the majority of this institution falls within Lynch Point Cove, restoration opportunities for this site are discussed under Lynch Point Cove subwatershed management opportunities.

### *Pervious Areas*

No pervious area assessments were performed within Back River-F. The public park areas within Back River-F (e.g., Triple Union and North Point State Park) are largely forested. However, open pervious (grass) areas, maintained by Baltimore County and with public access to Back River, are located throughout NSA_E_07 such as the one shown in the figure below. These areas may have potential for tree planting and/or bayscaping which could provide some water quality treatment of runoff before entering Back River. This could also be an opportunity to educate residents in NSA_E_07 about appropriate bayscaping and/or tree planting techniques.


**Figure 4-6: Public Parks/Access Points in NSA_E_07**

Back River-F is also part of the County's Coastal Rural Legacy Plan which aims to protect large blocks of forest, wetlands, farms, and other open spaces that are of significant ecological value as habitat for rare, threatened and endangered species and to preserve the environmental benefits that these areas provide to the Chesapeake Bay. The Fort Howard Coastal Rural Legacy Area includes all of Back River-F.

### *Stream Corridor Assessments*

SCAs were not conducted in Back River-F. Streams within this subwatershed are mostly tidal, marshy areas and not appropriate for the walking field survey based on Maryland DNR's SCA Survey Protocols. Therefore, no stream restoration opportunities have been identified in Back River-F.

### *Illicit Discharges*

Back River-F contains one outfall rated as priority 2, which indicates moderate to minor problems with the potential to become more severe. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

### *Stormwater Conversions*

No dry detention ponds are located within Back River-F according to Baltimore County's stormwater management facilities GIS data. Therefore, no stormwater management facility surveys were conducted within this subwatershed.

### *Shoreline Restoration*

Back River-F has a considerable length of shoreline mileage. One reach within Back River-F was assessed previously in DEPRM's Shoreline Enhancement Feasibility Study (1998): North Point State Park. The North Point State Park site was determined as a feasible site for shoreline-related erosion control and beneficial use efforts.

### *Subwatershed Management Strategy*

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhood NSA_E_07.

2. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as The Growing Home Campaign.

Municipal Actions

1. Further investigate the reforestation/bayscaping potential of public parks/access points located throughout neighborhood NSA_E_07.

2. Continue to monitor illicit discharges.

3. Evaluate a shoreline enhancement project at the North Point State Park site identified in DEPRM's Shoreline Feasibility Study.

4. Explore options for wetland restoration and planting along the shoreline.

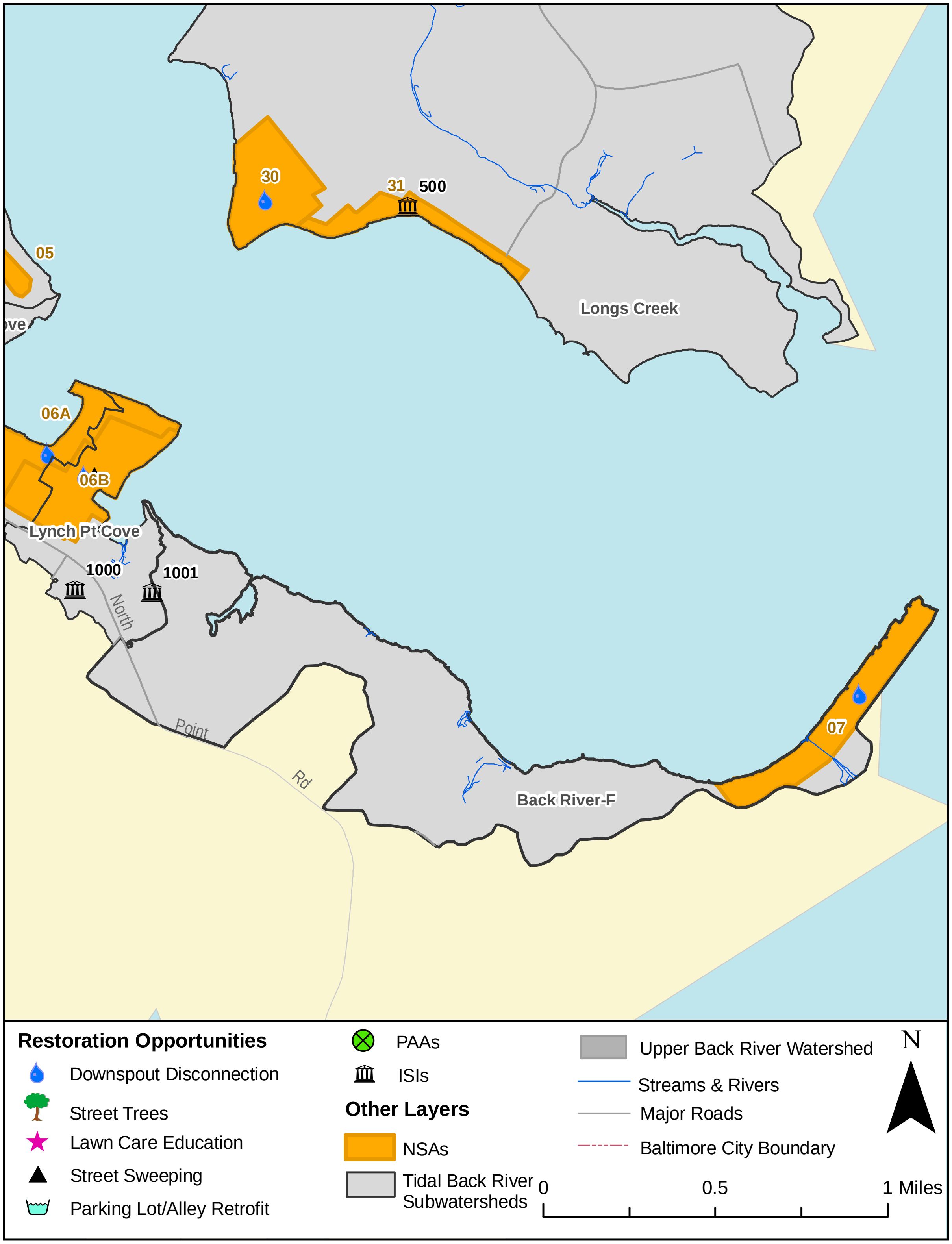


**Figure 4-7: Restoration Opportunities in Back River-F**

### 4.3.3 Back River-G

Back River-G is one of the smallest subwatersheds comprising the Tidal Back River watershed. While it is small in size, it has a relatively high population density which means potential for adverse water quality impacts. Back River-G is largely occupied by residential areas (~65%), most of which is designated as medium density residential area. The remaining subwatershed area mostly consists of forest and some institutional uses.

**Table 4-27: Key Subwatershed Characteristics - Back River-G**

| | | |
|---|---|---|
| **Drainage Area** | 313.4 acres (0.49 sq. mi.) | |
| **Stream Length** | 1.8 miles | |
| **Coastline Length** | 1.9 miles | |
| **Population** | 1,716 (2000 Census)<br>5.5 people/acre | |
| **Land Use/Land Cover** | Low Density Residential:<br>Medium Density Residential:<br>High Density Residential:<br>Commercial:<br>Industrial:<br>Institutional:<br>Other Urban:<br>Forest:<br>Agriculture:<br>Water/Wetlands: | 2.0%<br>51.8%<br>10.8%<br>0.0%<br>0.0%<br>8.2%<br>0.0%<br>21.6%<br>0.0%<br>5.6% |
| **Impervious Cover** | 17% of subwatershed | |
| **Soils** | A Soils (low runoff potential):<br>B Soils:<br>C Soils:<br>D Soils (high runoff potential): | 0.0%<br>11.0%<br>40.6%<br>48.4% |
| **SWM Facilities** | 22% of urban land use treated | |
| **Priority Rating** | High | |

***Neighborhoods***

A total of five (5) distinct neighborhoods were identified and assessed within Back River-G during the uplands assessment of Tidal Back River. Characteristics such as lot size, age, and type were used to delineate neighborhoods rather than subwatershed boundaries. As a result, some neighborhoods overlap multiple subwatersheds. All of the neighborhoods within Back River-G, for example, overlap another subwatershed (either Deep Creek or Muddy Gut) as noted in the table below. Calculations presented in the *Watershed Characterization Report* were based on the fraction of the NSA area within respective watersheds. For the purposes of this report, these five neighborhoods are presented qualitatively only under this subwatershed.

Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, stormwater retrofits, street sweeping, tree planting, and public education (i.e., bayscaping, increasing lot tree canopy, lawn care, pet waste management, and trash management). A summary of neighborhood recommended actions is presented in the table below.

**Table 4-28: NSA Recommendations - Back River-G**

| | | RECOMMENDED ACTIONS | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Stencils | Bayscape | Increase Lot Canopy | Fertilizer Reduction | Pet Waste | Trash Management | Parking Lot/Alley Retrofit | Street Sweeping | # of Street Trees | # of Shade Trees | Notes |
| NSA_E_21* | <1/8 | 50 | X | | X | | | | X | X | X | X | 100 | 0 | Fox Ridge park, outdoor chemical storage, alley dumping |
| NSA_E_22A* | Multi-family | 30 | | | X | X | X | | | | X | | 0 | 75 | Bare soil, concrete channels to inlet & grass areas (standing water and erosion) |
| NSA_E_23* | <1/8 | 50 | | | X | | | | | | | | 100 | 0 | |
| NSA_E_25** | 1/2 | 60 | X | X | | X | X | X | | | | | 0 | 0 | Cheseapeake Bay critical area |
| NSA_E_26** | 1/4 | 60 | X | | | X | X | | | | | | 0 | 5 | Sediment, mechanic |

* Denotes that neighborhood also encompasses a portion of Deep Creek.

** Denotes that neighborhood also encompasses a portion of Muddy Gut.

Most neighborhoods in Back River-G are recommended for downspout disconnection, storm drain marking, bayscaping, and increasing lot tree canopy. NSA_E_22A, an apartment complex, has several opportunities for stormwater retrofits to enhance water quality treatment and reduce pollutant runoff from the subwatershed. Two areas were identified as suitable for parking lot retrofits, meaning implementing BMPs to capture and treat runoff from these impervious surfaces (see figure below). Both sites currently have concrete channels directing runoff from parking lot to a grassy area or directly to a storm drain inlet. These channels should be removed and replaced by a bio-retention area, a depressed area with native plants and filter media, to capture and treat runoff prior to entering the storm drain/stream system.

**Figure 4-8: Potential Parking Lot Retrofit Sites in NSA_E_22A**

Bare soil and a concrete channel conveying runoff directly to a storm drain inlet was also observed in NSA_E_22A, near the playground area. This presents another opportunity to remove the concrete channel and promote native vegetation planting to reduce pollutants and enhance water quality treatment for the neighborhood's impervious surfaces. This neighborhood is also recommended for open space shade tree planting to help increase urban tree canopy.

NSA_E_21 was recommended for several actions including an alley retrofit, street sweeping and trash management. Dumping was observed in the alley as well as outdoor storage of potentially harmful chemicals on impervious driveways. This neighborhood would benefit from public education regarding proper trash disposal and outdoor material storage techniques.

***Hotspots***

No hotspot investigations were performed within Back River-G since HSIs were focused in areas where commercial development is concentrated in the watershed. Urban development in Back River-G consists mostly of residential areas with some institutional uses. There are no commercial or industrial land uses identified within this subwatershed.

***Institutions***

Back River-G includes a portion of one institutional site surveyed: Deep Creek Middle School. Since the majority of this institution falls within Deep Creek, restoration opportunities for this site are discussed under Deep Creek subwatershed management opportunities.

***Pervious Areas***

One pervious area was assessed for restoration potential in Back River-G: Deep Creek Middle School field. This is an open, grass field on the property of Deep Creek Middle School. It appears to be underutilized as suggested by an overgrown baseball field. This area is isolated from other recreational fields on the school property and borders an existing buffer along Back River. By reforesting this area and possibly creating a wetland area, the stream buffer would be enhanced while also connecting forested areas for wildlife habitat and providing an opportunity for student involvement and education. A summary of the site is provided in the table below.

**Table 4-29: PAA Recommendations - Back River-G**

| Site ID | Location | Description | Acres | Ownership |
|---|---|---|---|---|
| PAA_E_200 | Deep Creek Middle | Underutilized athletic field | 2.60 | Public |

***Stream Corridor Assessments***

SCAs were not conducted in Back River-G. Streams within this subwatershed are mostly tidal, marshy areas and not appropriate for the walking field survey based on Maryland DNR's SCA Survey Protocols. Therefore, no stream restoration opportunities have been identified in Back River-G.

***Illicit Discharges***

Back River-G contains one outfall rated as priority 1 which indicates major or reoccurring problems that require either immediate action or close monitoring. This subwatershed also contains one outfall rated as priority 2, which indicates moderate to minor problems with the potential to become more severe. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

***Stormwater Conversions***

No dry detention ponds are located within Back River-G according to Baltimore County's stormwater management facilities GIS data. Therefore, no stormwater management facility surveys were conducted within this subwatershed.

***Subwatershed Management Strategy***

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

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-28.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-28.

3. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as The Growing Home Campaign.

4. Plant street and shade trees. Table 4-28 shows a potential for 200 street trees and 80 open space, shade trees.

5. Educate citizens about the benefits and importance of proper lawn care maintenance, bayscaping, pet waste disposal and trash management.

<u>Municipal Actions</u>

1. Investigate current street sweeping measures in NSA_E_21 and increase frequency or implement program as necessary.

2. Further investigate the stormwater retrofit opportunities for parking lots and alleys identified in Table 4-28.

3. Further investigate the pervious area described in Table 4-29 for tree planting, wetland creation, and educational opportunities.

4. Continue to monitor illicit discharges.

5. Conduct follow-up site inspections of potentially severe to moderately severe discharging and exposed pipes described above and in the *Watershed Characterization Report*.

6. Explore options for wetland restoration and planting along the shoreline.

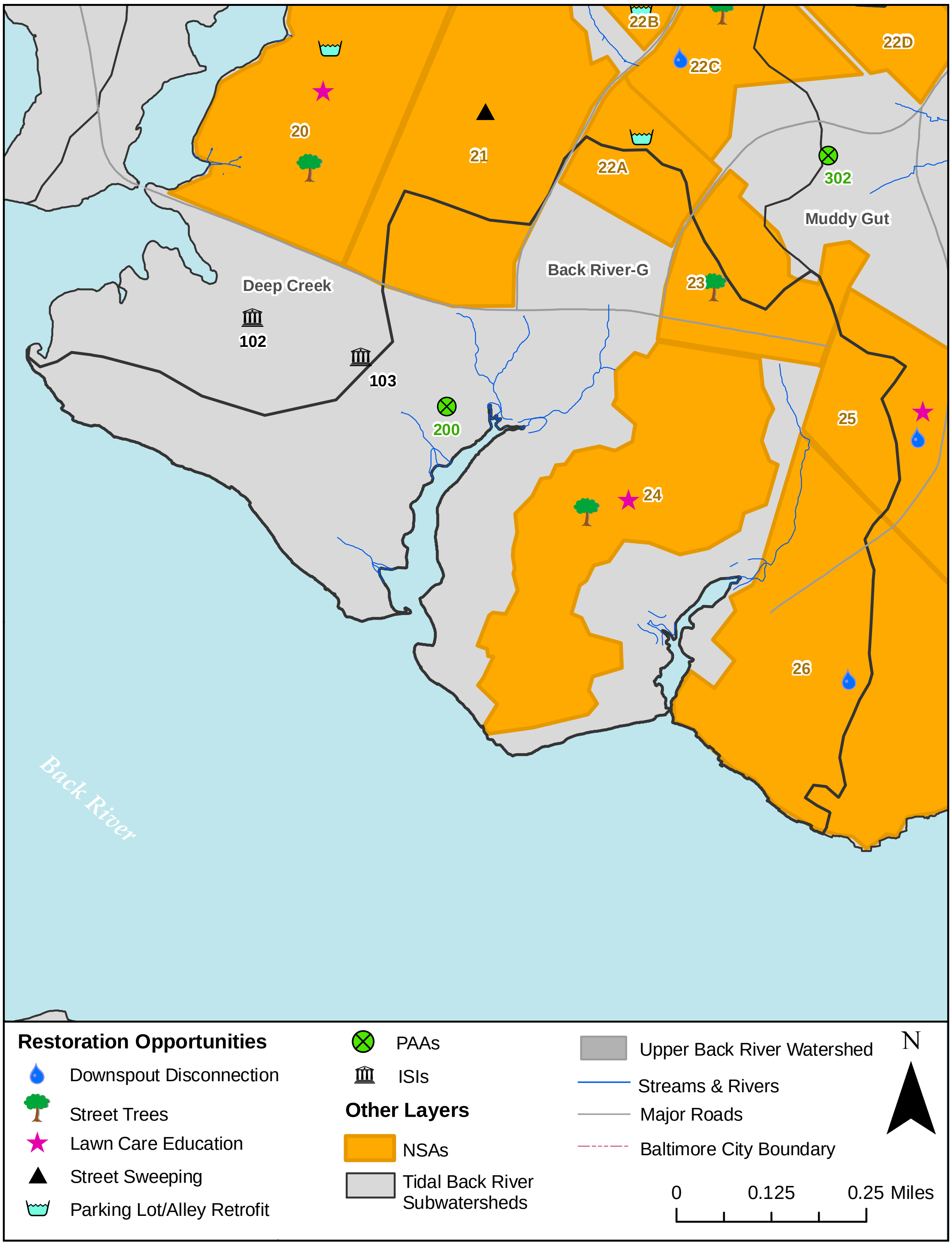


**Figure 4-9: Restoration Opportunities in Back River-G**

### 4.3.4 Bread & Cheese

Bread & Cheese is the second largest and the third most populated subwatershed comprising the Tidal Back River watershed. Bread & Cheese also contains the greatest length of stream miles among the 10 subwatersheds. Bread & Cheese Creek begins just south of Eastern Avenue and continues downstream (east), crossing Merritt Boulevard, North Point Road, and I-695 before discharging to Back River. Bread & Cheese is significantly developed (~80%). Predominant urban land uses include high and medium density residential, commercial and institutional. The Back River WWTP also encompasses a portion of this subwatershed. Key subwatershed characteristics are summarized in the table below.

**Table 4-30: Key Subwatershed Characteristics – Bread & Cheese**

| | | |
|---|---|---|
| **Drainage Area** | 1,183.0 acres (1.85 sq. mi.) | |
| **Stream Length** | 8.5 miles | |
| **Coastline Length** | 0.7 miles | |
| **Population** | 9,038 (2000 Census)<br>7.6 people/acre | |
| **Land Use/Land Cover** | Low Density Residential:<br>Medium Density Residential:<br>High Density Residential:<br>Commercial:<br>Industrial:<br>Institutional:<br>Other Urban:<br>Forest:<br>Agriculture:<br>Water/Wetlands: | 0.0%<br>20.2%<br>10.2%<br>14.0%<br>1.9%<br>11.5%<br>22.5%<br>17.5%<br>0.0%<br>2.2% |
| **Impervious Cover** | 28% of subwatershed | |
| **Soils** | A Soils (low runoff potential):<br>B Soils:<br>C Soils:<br>D Soils (high runoff potential): | 2.1%<br>49.3%<br>18.1%<br>30.5% |
| **SWM Facilities** | 2% of urban land use treated | |
| **Priority Rating** | Very High | |

***Neighborhoods***

A total of five (5) distinct neighborhoods were identified and assessed within Bread & Cheese during the uplands assessment of Tidal Back River. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, buffer improvement, alley retrofit, street sweeping, tree planting and public education (i.e., increasing lot tree canopy, lawn care, and pet waste and trash management). A summary of neighborhood recommended actions is presented in the table below.

**Table 4-31: NSA Recommendations – Bread & Cheese**

| RECOMMENDED ACTIONS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NSA_ID** | **Lot Size (acres)** | **% Opportunity for Downspout Disconnection** | **Rain Barrels** | **Storm Drain Stencils** | **Increase Lot Canopy** | **Fertilizer Reduction** | **Pet Waste** | **Trash Management** | **Buffer Improvement** | **Alley Retrofit** | **Street Sweeping** | **# of Street Trees** | **Notes** |
| NSA_E_01A | <1/8 | 65 | X | X | | | X | X | X | X | X | 100 | Long-term car parking, cars parked near stream along buffer, trash |
| NSA_E_01B | <1/4 | 80 | X | | X | | | X | X | | | 0 | Trash/junk in several yards, outdoor chemical storage |
| NSA_E_02A | <1/4 | 70 | X | X | X | X | | | X | | | 100 | Pool education |
| NSA_E_02B | <1/4 | 60 | X | X | X | | | | | | | 0 | |
| NSA_E_02C | <1/4 | 60 | X | X | X | | | | X | | | 100 | |

All neighborhoods assessed in Bread & Cheese are good candidates for downspout disconnection. Due to limited space (small lot sizes), redirection and rain barrels are the most viable options for disconnecting downspouts in these neighborhoods. Stream buffer impacts were noted for all neighborhoods assessed in Bread & Cheese. This is because most private residences along the creek consist of mowed lawn adjacent to the stream corridor rather than dense vegetation or forested buffer which provides more water quality treatment of runoff. In NSA_E_01A, the field team observed cars parked immediately adjacent to the stream corridor. These neighborhoods present a good opportunity to educate residents about the benefits and importance of planting and maintaining a riparian stream buffer for aesthetic and water quality purposes. Several neighborhoods were also recommended for storm drain marking and street tree planting (see figure below). Community tree and buffer plantings and storm drain marking are good ways to engage citizens in these neighborhoods and raise awareness.

**Figure 4-10: Potential Street Tree Planting Site in NSA_E_01A**

Also noted in several neighborhoods assessed were trash in yards and along streets and improper storage of outdoor chemicals. Public education and outreach regarding proper trash management and outdoor chemical storage would help address these issues in Bread & Cheese as well as Tidal Back River (e.g., community cleanups and education about the County's household hazardous waste collection events).

Street sweeping was recommended for NSA_E_01A to address excessive accumulation of trash and organics along curbs & gutters in this neighborhood. An open pervious area located in the southwestern portion of NSA_E_01 through which Bread & Cheese Creek traverses, was identified as a potential site for an alley retrofit in NSA_E_01A (see figure below). A BMP such as bio-retention could be incorporated to treat runoff from adjacent impervious alleys before entering Bread & Cheese Creek. This could also be used to educate citizens and raise awareness about water quality treatment methods.

**Figure 4-11: Potential Alley Retrofit Site in NSA_E_01A**

### *Hotspots*

A total of four (4) hotspots were investigated in Bread & Cheese during the uplands assessment of Tidal Back River. This included commercial shopping centers and a garden center with multiple potential sources of pollution. The table below summarizes hotspot investigation results for sites assessed in Bread & Cheese.

**Table 4-32: HSI Results Summary – Bread & Cheese**

| | | | POTENTIAL POLLUTION SOURCES | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Site_ID** | **HSI Status*** | **Description** | **Vehicle Operations** | **Outdoor Materials** | **Waste Management** | **Physical Plant** | **Storm Water** | **Comments** |
| HSI_E_700 | Severe | Shopping Center | | | X | X | X | Dumping, leaks from pool store/dumpster stains to stream |
| HSI_E_701 | Confirmed | Bowling | | | X | | | Dumping, overflowing dumpsters |
| HSI_E_703 | Confirmed | Flea Market | | | X | | X | Unlabeled drums (some sideways) & trash in fenced area |
| HSI_E_704 | Severe | Shopping Center | X | X | | | X | Tire/service & garden center drain to inlets, housekeeping reminders |
| HSI_E_705 | Confirmed | Garden Center | | X | | X | X | Plants stored outside & uncovered, no inlets |

*Notes:
Confirmed – pollution observed, many potential sources
Severe – multiple polluting activities observed

Similar to neighborhoods, trash management issues were observed at the hotspots surveyed and other commercial properties in general. Public education and outreach regarding proper trash management and outdoor chemical storage would help address these issues in Bread & Cheese as well as Tidal Back River.

In addition, there are currently four NPDES-permitted facilities for industrial stormwater discharges within Bread & Cheese. Compliance with permit requirements should be verified for these facilities.

### *Institutions*

A total of nine (9) institutions were assessed for retrofit opportunities in Bread & Cheese during the uplands assessment of Tidal Back River. This includes two public schools and seven private, community-based facilities. The table below summarizes recommendations for institutional sites assessed in Bread & Cheese.

**Table 4-33: ISI Recommendations – Bread & Cheese**

| | | | RECOMMENDATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Site ID | Name | Public/ Private | Storm Drain Marking | #Trees for Planting | Downspout Disconnection | Stormwater Retrofit | Impervious Cover Removal | Buffer Improvement | Trash Management | Notes |
| ISI_E_700 | Eastwood Center | Public | X | 30 | | X | X | | X | Retrofit inlets (bare soil), New playgrd construction - sediment to inlets |
| ISI_E_701 | Oak Lawn Cemetery | Private | X | 100 | | | | X | X | Buffer improvement, woven metal trash cans w/ no lining & overflowing |
| ISI_E_702 | Berkshire Elementary | Public | X | 75 | | X | X | | | Parking lot retrofit |
| ISI_E_703 | Holy Cross Cemetery | Private | | 0 | | | | | | Pervious pavement? |
| ISI_E_704 | Freedom Baptist | Private | | 50 | X | | | | | |
| ISI_E_705 | Heritage Center | Private | X | 0 | | X | | | | Inlet retrofit, pervious pavement? |
| ISI_E_706 | Calvary Baptist | Private | X | 75 | | X | | X | | Buffer improvement, erosion & dumping in stream, ponding, owners concerned w/ losing fields; prkg lot retrofit |
| ISI_E_707 | The Arc of Baltimore | Private | X | 15 | X | | | | | Clearing next to stream (bare soil) |
| ISI_E_708 | Dundalk Assembly of God | Private | | 50 | | X | | | | Previously disconnected downspouts, owners concerned w/ undergrd pipes in front property; prkg lot retrofit |

Most of the institutional sites assessed are recommended for storm drain marking and tree planting which are both good opportunities to engage citizens while raising awareness and providing water quality benefits. Several sites also have the potential for implementing stormwater retrofits. Runoff from a parking lot at ISI_E_702, for example, is currently directed to an open, grassy area but has some ponding and erosion issues (see figure below). A portion of this area could be converted to a BMP (e.g., bio-retention) to capture and treat runoff from the parking lot and address erosion/ponding issues. Teachers and students could also assist with vegetation planting and maintenance as a school project.

**Figure 4-12: Potential Parking Lot Retrofit Site in ISI_E_702**

Impervious cover removal was recommended for both of the public school sites assessed. This is also another opportunity to engage students with tree or vegetation planting while providing education about the importance of filtration for water quality benefits. An impervious surface behind the building at ISI_E_700, for example, is in poor condition with several areas breaking up indicating underutilization and inadequate maintenance. These surfaces are good candidates for removal (in between sidewalks) and grass/vegetation planting to provide more infiltration of runoff from adjacent impervious surfaces.

**Figure 4-13: Potential Impervious Cover Removal Site at ISI_E_700**

***Pervious Areas***

One pervious area was assessed for restoration potential in Bread & Cheese: Harbor View Park. This is a public park located off of Woodrow Avenue. This is a public park, maintained by Baltimore County, with good site access, mostly turf cover (70%), and minimal site preparation required for restoration. Reforestation of this area would not interfere with use of the baseball field or basketball court areas and the limited flat pervious areas. An opportunity for stormwater retrofit to treat runoff from the small impervious parking area was also noted. This may involve filtering/filtration practices to treat runoff and address bare soil before entering the storm drain inlets on site. A summary is provided in the table below.

**Table 4-34: PAA Recommendations – Bread & Cheese**

| Site ID | Location | Description | Acres | Ownership |
|---|---|---|---|---|
| PAA_E_700 | Harbor View Park | Public park | 4.20 | Public |

***Stream Corridor Assessments***

Field crews walked 3.73 miles of stream (44% of total stream miles) within Bread & Cheese to identify water quality problems and restoration opportunities. This included a survey of all wadeable and accessible portions of Bread & Cheese Creek. A total of 105 potential environmental problems were identified in Bread & Cheese Creek. The most predominant water quality issues included inadequate buffer, trash dumping, channel alteration and erosion. Several unusual conditions were noted which mostly include invasive species, atypical discharge, and stream destruction due to sources such as bike trails and construction. The table below summarizes the results of the SCA survey and restoration opportunities.

**Table 4-35: Summary of Stream Conditions – Bread & Cheese**

| OPPORTUNITIES (# of ENVIRONMENTAL PROBLEM SITES) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Inadequate Buffer | Trash Dumping | Channel Alteration | Erosion | Pipe Outfalls | Exposed Pipe | Fish Barrier | In/Near Stream Construction | Unusual Conditions | Totals |
| 16 | 16 | 10 | 10 | 29 | 4 | 5 | 2 | 13 | ***105*** |

| Length of Inadequate Buffer (ft) | Length of Channel Alteration (ft) | Length of Erosion (ft) | # of Truckloads for Trash Dumping Sites |
|---|---|---|---|
| 16,905 | 830 | 755 | 63 |

***Illicit Discharges***

Bread & Cheese contains one outfall rated as priority 1 which indicates major or reoccuring problems that require either immediate action or close monitoring. This subwatershed also contains three outfalls rated as priority 2, which indicates moderate to minor problems with the potential to become more severe. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

Potentially severe to moderate water quality issues were also identified during the stream corridor assessments due to discharging and exposed pipes. In Bread & Cheese, 15 outfalls and one exposed pipe were rated as severe to moderately severe water quality problems.

### *Stormwater Conversions*

No dry detention ponds are located within Bread & Cheese according to Baltimore County's stormwater management facilities GIS data. Therefore, no stormwater management facility surveys were conducted within this subwatershed.

### *Shoreline Restoration*

One reach within Bread & Cheese was assessed previously in DEPRM's Shoreline Enhancement Feasibility Study (1998): Back River WWTP. The Back River WWTP site was determined as a feasible site for shoreline-related habitat enhancement, erosion control, and beneficial use efforts.

### *Subwatershed Management Strategy*

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

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-31.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-31, as piloted in the Berkshire neighborhood.

3. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as The Growing Home Campaign.

4. Plant street trees. Table 4-31 shows a potential for 300 street trees.

5. Educate citizens about the benefits and importance of proper lawn care maintenance, pet waste disposal and trash management.

6. Encourage community cleanups in neighborhoods recommended for trash management in Table 4-31.

7. Educate residents of neighborhoods identified in Table 4-31 about the importance of stream buffers and encourage more environmentally friendly stream bank treatments.

8. Engage institutional sites listed in Table 4-33 in recommended restoration actions.

9. Investigate the pervious area described in Table 4-34 for potential tree planting.

10. Encourage stream cleanups such as that conducted between Merritt Boulevard and Plainfield Road.

<u>Municipal Actions</u>

1. Investigate current street sweeping measures in NSA_E_01A and increase frequency or implement program as necessary.

2. Further investigate alley stormwater retrofit opportunities identified in NSA_E_01A.

3. Educate commercial property owners about the importance of proper trash management and outdoor material storage techniques at hotspot sites similar to those identified in Table 4-32.

4. Post no dumping signs in problem areas identified and enforce no dumping (e.g., Merritt Manor Shopping Center, AMF Bowling, North Point Plaza, etc.)

5. Investigate potential for stormwater retrofits at the public schools identified in Table 4-33.

6. Further investigate the pervious area described in Table 4-34 for stormwater retrofit opportunity.

7. Investigate stream restoration potential at sites listed in Table 4-35 and described in the *Watershed Characterization Report*.

8. Continue to monitor illicit discharges.

9. Conduct follow-up site inspections of potentially severe to moderately severe discharging and exposed pipes described above and in the *Watershed Characterization Report*.

10. Evaluate a shoreline enhancement project at the Back River WWTP site identified in DEPRM's Shoreline Feasibility Study.

11. Explore options for wetland restoration and planting along the shoreline.

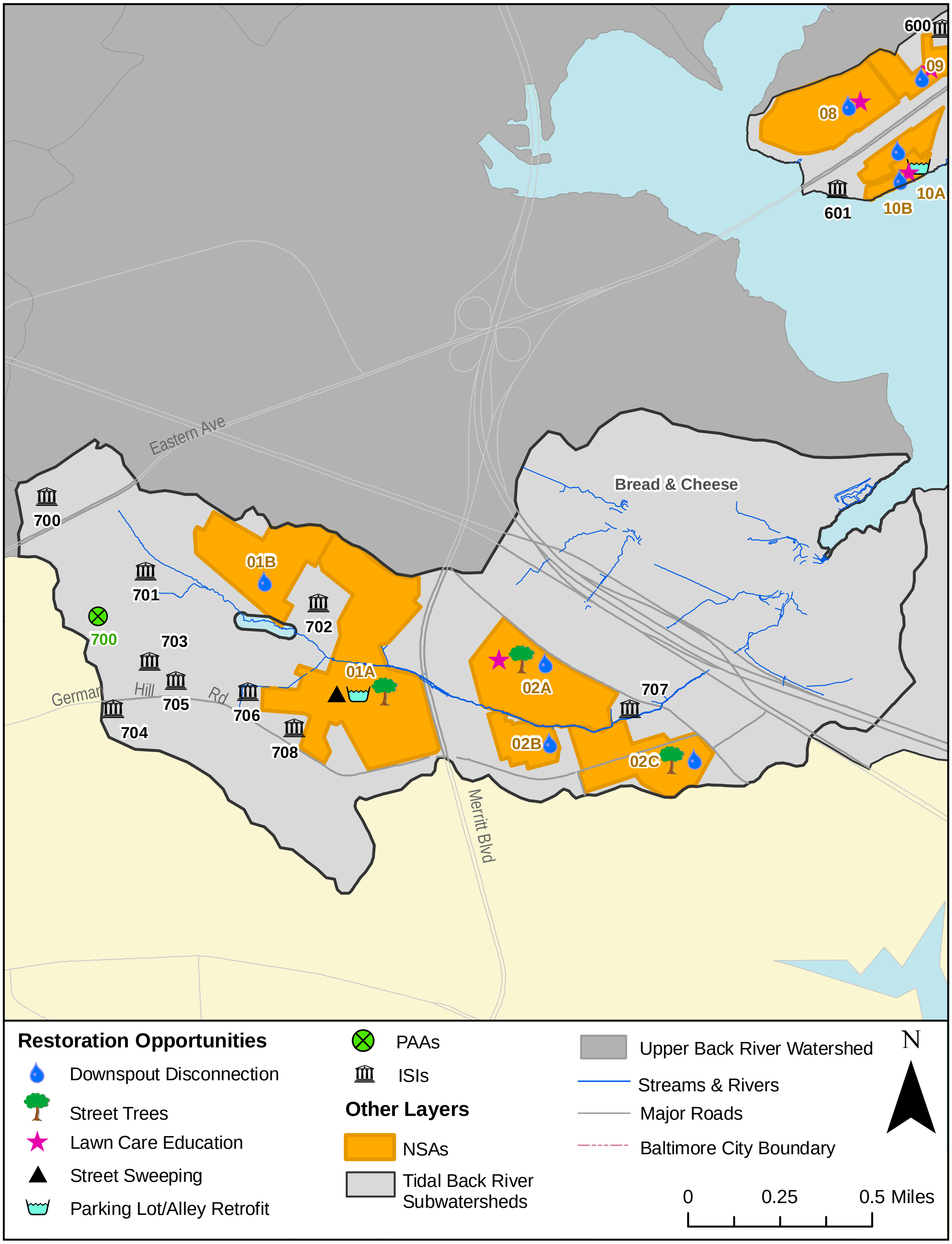


**Figure 4-14: Restoration Opportunities in Bread & Cheese**

### 4.3.5 Deep Creek

Deep Creek is the third largest subwatershed comprising the Tidal Back River watershed and is the most populated. Over half of the subwatershed area is occupied by high and medium density residential areas (~62%) and one-third of the subwatershed is covered by impervious surfaces. The main tributary to Deep Creek begins south of Eastern Boulevard and continues downstream (south), crossing Old Eastern Avenue and Southeast Boulevard before discharging into the tidal portion of Deep Creek. Another tributary begins between Back River Neck Road and Southeast Boulevard and flows southwest to the tidal portion of Deep Creek. Key watershed characteristics are summarized in the table below.

**Table 4-36: Key Subwatershed Characteristics – Deep Creek**

| | | |
|---|---|---|
| **Drainage Area** | 989.5 acres (1.55 sq. mi.) | |
| **Stream Length** | 3.9 miles | |
| **Coastline Length** | 3.2 miles | |
| **Population** | 16,126 (2000 Census)<br>16.3 people/acre | |
| **Land Use/Land Cover** | Low Density Residential:<br>Medium Density Residential:<br>High Density Residential:<br>Commercial:<br>Industrial:<br>Institutional:<br>Other Urban:<br>Forest:<br>Agriculture:<br>Water/Wetlands: | 0.0%<br>20.1%<br>42.3%<br>13.0%<br>0.0%<br>6.4%<br>5.7%<br>10.6%<br>0.0%<br>1.9% |
| **Impervious Cover** | 33% of subwatershed | |
| **Soils** | A Soils (low runoff potential):<br>B Soils:<br>C Soils:<br>D Soils (high runoff potential): | 1.5%<br>47.4%<br>33.5%<br>17.6% |
| **SWM Facilities** | 1% of urban land use treated | |
| **Priority Rating** | Very High | |

***Neighborhoods***

A total of 15 distinct neighborhoods were identified and assessed within Deep Creek during the uplands assessment of Tidal Back River. Characteristics such as lot size, age, and type were used to delineate neighborhoods rather than subwatershed boundaries. As a result, some neighborhoods overlap multiple subwatersheds. Five of the neighborhoods within Deep Creek overlap other subwatersheds. NSA_E_21, NSA_E_22A, and NSA_E_23 overlap Back River-G and were described previously in Section 4.3.3 for this subwatershed. NSA_E_15 and NSA_E16A also encompass portions of Duck Creek and are described in the next section. NSA_E_22C and NSA_E_22D overlap with Muddy Gut. Qualitative descriptions of these neighborhoods and recommendations are included within this section. While descriptions are not repeated for neighborhoods overlapping multiple subwatersheds, calculations presented in the *Watershed Characterization Report* were based on the fraction of the NSA area within respective watersheds.

Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, buffer improvement, alley/parking lot retrofit, street sweeping, tree planting and public education (i.e., bayscaping, increasing lot tree canopy, lawn care, and pet waste and trash management). A summary of neighborhood recommended actions is presented in the table below.

**Table 4-37: NSA Recommendations – Deep Creek**

| | | RECOMMENDED ACTIONS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marks | Bayscape | Increase Lot Canopy | Fertilizer Reduction | Pet Waste | Trash Management | Buffer Improvement | Alley/Parking Lot Retrofit | Street Sweeping | # of Street Trees | # of Shade Trees | Notes |
| NSA_E_16B | <1/4 | 40 | X | | | | X | | | | | | | 0 | 0 | |
| NSA_E_17 | <1/8 | 50 | X | | X | | | | X | X | X | X | X | 100 | 0 | Dumping in backyards, pool education |
| NSA_E_18A | Multi-family | 30 | | X | X | X | X | | | | | X | X | 0 | 50 | Potential bioretention; significant open space for trees |
| NSA_E_18B | Multi-family | 70 | X | X | X | X | X | | | X | | X | | 0 | 75 | Lids open on most dumpsters, trash on ground and animals in dumpsters |
| NSA_E_19A | Multi-family | 75 | X | | X | X | X | X | | | X | X | | 0 | 50 | Curb cuts & riprap channel direct runoff to river |
| NSA_E_19B | Multi-family | 25 | | | X | X | X | | | | X | | | 0 | 100 | |
| NSA_E_20 | Multi-family | 70 | | | X | X | X | X | | | X | X | | 100 | 75 | Community pool, buffer planting, playgrd/storage area retrofit, bare soil |

| | | RECOMMENDED ACTIONS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marks | Bayscape | Increase Lot Canopy | Fertilizer Reduction | Pet Waste | Trash Management | Buffer Improvement | Alley/Parking Lot Retrofit | Street Sweeping | # of Street Trees | # of Shade Trees | Notes |
| NSA_E_22B | Multi-family | 60 | | | X | X | X | | | X | X | X | X | 40 | 100 | Bare soil, buffer planting, educate to keep dumpster lids closed, cigarette receptacles |
| NSA_E_22C | Multi-family | 70 | X | | X | X | X | | | X | | | | 50 | 75 | Overflowing dumpsters, pollen & grass clippings on sidewalks & parking lot |
| NSA_E_22D | Multi-family | 80 | X | | X | X | X | | | X | X | X | | 10 | 100 | Overturned dumpster near stream, pollen & grass clippings on sidewalks |

All neighborhoods assessed in Deep Creek are good candidates for downspout disconnection. Stream buffer impacts were noted for many of the neighborhoods assessed in Deep Creek. Similar to Bread & Cheese, many residential properties consist of mowed lawn adjacent to the stream corridor rather than dense vegetation or forested buffer which provides more water quality treatment of runoff. These neighborhoods present a good opportunity to educate residents about the benefits and importance of planting and maintaining a riparian stream buffer for aesthetic and water quality purposes. Several neighborhoods were also recommended for storm drain marking and street tree planting (see figure below). Community tree and buffer plantings and storm drain marking are good ways to engage citizens in these neighborhoods and raise awareness.

Most of the neighborhoods assessed in Deep Creek are multi-family developments (e.g., apartments, condos, etc.). Several of these are good candidates for stormwater retrofits to treat runoff from impervious parking lots and for open space shade tree plantings. For example, a large, open grassy area in NSA_E_18A was identified as a potential site for a stormwater retrofit to treat runoff from the adjacent parking lot. The area and existing grading appear to be amendable to a filtration type BMP (see figure below).

**Figure 4-15: Potential Stormwater Retrofit Site in NSA_E_18A**

Trash management issues (e.g., overflowing dumpsters, bulk dumping) and accumulation of organics along curbs and sidewalks was also noted in several of the multi-family neighborhoods assessed in Deep Creek. Public education and outreach regarding proper trash and lawn/property management would help address these issues in Deep Creek as well as Tidal Back River. Multi-family neighborhoods are also good candidates for bayscaping and planting open space shade trees to improve water quality benefits and aesthetic value and engage citizens.

### *Hotspots*

A total of two (2) hotspots were investigated in Deep Creek during the uplands assessment of Tidal Back River. This included a commercial shopping center and auto/tire repair shop with potential sources of pollution. The table below summarizes hotspot investigation results for sites assessed in Deep Creek.

**Table 4-38: HSI Results Summary – Deep Creek**

| | | | POTENTIAL POLLUTION SOURCES | | | | | |
|---|---|---|---|---|---|---|---|---|
| Site_ID | HSI Status* | Description | Vehicle Operations | Outdoor Materials | Waste Management | Physical Plant | Storm Water | Notes |
| HSI_E_100 | Confirmed | Shopping Center | | | X | | X | Dumpster overflowing to stream, potential parking lot retrofit |
| HSI_E_101 | Potential | Auto-related | X | X | | | | Tire service center, tires stored on asphalt near stream |

*Notes:

Potential – no observed pollution, some potential sources present

Confirmed – pollution observed, many potential sources

Trash management issues and improper storage of outdoor materials was noted at some of the hotspots assessed in Deep Creek. Public education and outreach regarding proper trash management and outdoor material storage at these and similar sites would help address these issues in Deep Creek as well as Tidal Back River.

There are currently two NPDES-permitted facilities for general stormwater discharges within Deep Creek. Compliance with permit requirements should be verified for these facilities. Deep Creek also includes a marina off of Sandalwood Road (Essex Yacht). This presents an opportunity to encourage and work with the marina owner to implement pollutant prevention practices and become a certified Maryland Clean Marina while also educating marina users.

### *Institutions*

A total of four (4) institutions were assessed for retrofit opportunities in Deep Creek during the uplands assessment of Tidal Back River. This includes four public schools (3 elementary schools, 1 middle school). The table below summarizes recommendations for institutional sites assessed in Deep Creek.

**Table 4-39: ISI Recommendations – Deep Creek**

| | | | RECOMMENDATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Site ID** | **Name** | **Public/ Private** | **Storm Drain Marking** | **#Trees for Planting** | **Stormwater Retrofit** | **Impervious Cover Removal** | **Pervious Area Restoration** | **Buffer Improvement** | **Trash Management** | **Notes** |
| ISI_E_100 | Mars Elementary | Public | X | 100 | | X | | X | | Buffer improvement, algae in outfall discharge |
| ISI_E_101 | Deep Creek Elementary | Public | X | 30 | X | X | | | | Convert existing grassed det pond to wetland planting; inlet & downspout planting |
| ISI_E_102 | Sandalwood Elementary | Public | X | 100 | | | | | X | Community cleanup of wetland/habitat project, leaking dumpster |
| ISI_E_103 | Deep Creek Middle | Public | X | 100 | X | X | X | | X | Dumping, bare soil to inlets, Wetland creation/education opportunity |

Public schools represent unique opportunities to combine water quality improvement measures with student education/outreach. All of the schools assessed are recommended for tree planting and storm drain marking which are both ways to engage teachers and students. Impervious cover removal was recommended for both of the public school sites assessed. Three out of the four schools assessed have potential for impervious cover removal. As discussed in the previous section, this is another opportunity to engage students with tree or vegetation planting while providing education about the importance of filtration for water quality benefits.

Two of the schools have potential for stormwater retrofits. In particular, ISI_E_101 (Deep Creek Elementary) is recommended for conversion of an existing detention pond. Currently, the pond is a mowed grass area bordered by a fence (see figure below). Water quality treatment capabilities of this facility could be enhanced by incorporating more dense and native vegetation which would provide water quality, wildlife, and aesthetic benefits while requiring less maintenance than the current facility. It is another way to educate students about water quality and stormwater management.

**Figure 4-16: Potential Stormwater Retrofit Site in ISI_E_101**

Trash and dumping was observed in the vicinity of a wildlife habitat project at ISI_E_102 (Sandalwood Elementary). This is an opportunity to engage students and teachers in a community cleanup to repair the habitat project while also educating the community about the importance of proper trash disposal.

Stream buffer improvement was recommended for ISI_E_100 (Mars Elementary). A stream runs parallel to the property edge at this site. Currently, the buffer consists of mowed grass. There is sufficient room to plant trees to provide stream protection without interfering with the nearby baseball field (see figure below). Algae growth was observed in the outfall from this site to the adjacent stream. This indicates an opportunity to educate property owner about proper nutrient management practices. In addition, the stream bed is a concrete channel which could be removed to restore natural stream functions and used as an educational tool for the elementary school.

**Figure 4-17: Potential Buffer and Stream Restoration Site at ISI_E_100**

### *Pervious Areas*

Two pervious areas were assessed for restoration potential in Deep Creek: Martindale and Fox Ridge Parks. Martindale Park is a public park located at the end of Homberg Avenue. Fox Ridge Park is a public park located between Deep Creek and the alley behind Foxwood Lane. Both parks are maintained by Baltimore County and are mostly covered by turf. Both sites are also good candidates for reforestation, with good site access, full sun exposure and requiring minimal site preparation. A summary is provided in the table below.

**Table 4-40: PAA Recommendations – Deep Creek**

| Site ID | Location | Description | Acres | Ownership |
|---|---|---|---|---|
| PAA_E_100 | Martindale | Public park | 3.20 | Public |
| PAA_E_101 | Fox Ridge | Public park | 1.50 | Public |

### *Stream Corridor Assessments*

Field crews walked 2.43 miles of stream (63% of total stream miles) within Deep Creek to identify water quality problems and restoration opportunities. This included a survey of all wadeable and accessible portions of Deep Creek. A total of 97 potential environmental problems were identified in Deep Creek. The most predominant water quality issues included inadequate buffer, trash dumping, channel alteration and erosion. Several unusual conditions were noted which mostly include invasive species and atypical discharges. The table below summarizes the results of the SCA survey and restoration opportunities.

**Table 4-41: Summary of Stream Conditions – Deep Creek**

| OPPORTUNITIES (# of ENVIRONMENTAL PROBLEM SITES) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Inadequate Buffer | Trash Dumping | Channel Alteration | Erosion | Pipe Outfalls | Exposed Pipe | Fish Barrier | In/Near Stream Construction | Unusual Conditions | Totals |
| 15 | 14 | 9 | 8 | 37 | 2 | 4 | 1 | 7 | ***97*** |

| Length of Inadequate Buffer (ft) | Length of Channel Alteration (ft) | Length of Erosion (ft) | # of Truckloads for Trash Dumping Sites |
|---|---|---|---|
| 12,565 | 3,814 | 440 | 27 |

### *Illicit Discharges*

Deep Creek contains one outfall rated as priority 1 which indicates major or reoccuring problems that require either immediate action or close monitoring. This subwatershed also contains five outfalls rated as priority 2, which indicates moderate to minor problems with the potential to become more severe. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

Potentially severe to moderate water quality issues were also identified during the stream corridor assessments due to discharging and exposed pipes. In Deep Creek, eight outfalls and one exposed pipe were rated as severe to moderately severe water quality problems.

### *Stormwater Conversions*

Deep Creek contains one detention pond, located in an industrial complex off of Eyring Avenue. The pond is located on privately-owned property and bounded by a large grassy area which presents potential for conversion to an extended detention facility. In addition, there is a maintenance opportunity to increase water quality improvement capacity of the pond by replacing the current vegetation (patchy grass) with more dense, native vegetation. The outfall should also be cleared of debris, trash, and sediment noted to improve water quality treatment potential. The table below summarizes field survey results.

**Table 4-42: Detention Pond Conversion – Deep Creek**

| Site ID | Orifice | Riser | Ponding | Debris | Vege-tation | Adjacent Land | Outfall | Down-stream |
|---|---|---|---|---|---|---|---|---|
| SWM_07 | Good | Fair | No | Low | Low | Forest, Industrial | N/A | N/A |

* N/A denotes inability to access site or locate certain features.

***Subwatershed Management Strategy***

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-37.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-37.

3. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as The Growing Home Campaign.

4. Plant street and shade trees. Table 4-37 shows a potential for 300 street trees and 625 shade trees.

5. Educate citizens about the benefits and importance of bayscaping, proper lawn care maintenance, pet waste disposal and trash management.

6. Encourage community cleanups in neighborhoods recommended for trash management in Table 4-37.

7. Educate residents about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments.

8. Engage institutional sites listed in Table 4-39 in recommended restoration actions.

9. Investigate the pervious areas described in Table 4-40 for potential tree planting.

Municipal Actions

1. Investigate current street sweeping measures in recommended neighborhoods listed in Table 4-37 and increase frequency or implement program as necessary.

2. Further investigate parking lot/alley stormwater retrofit opportunities identified in neighborhoods listed in Table 4-37.

3. Educate commercial property owners about the importance of proper trash management and outdoor material storage techniques at hotspot sites similar to those identified in Table 4-38.

4. Work with the Essex Yacht Marina to implement appropriate BMPs and become a certified Maryland Clean Marina.

5. Investigate potential for stormwater retrofits at the public schools identified in Table 4-39.

6. Investigate stream restoration potential at sites listed in Table 4-41 and described in the *Watershed Characterization Report*.

7. Continue to monitor illicit discharges.

8. Conduct follow-up site inspections of potentially severe to moderately severe discharging and exposed pipes described above and in the *Watershed Characterization Report*.

9. Further investigate the conversion potential of the detention pond described in Table 4-42.

10. Explore options for wetland restoration and planting along the shoreline.

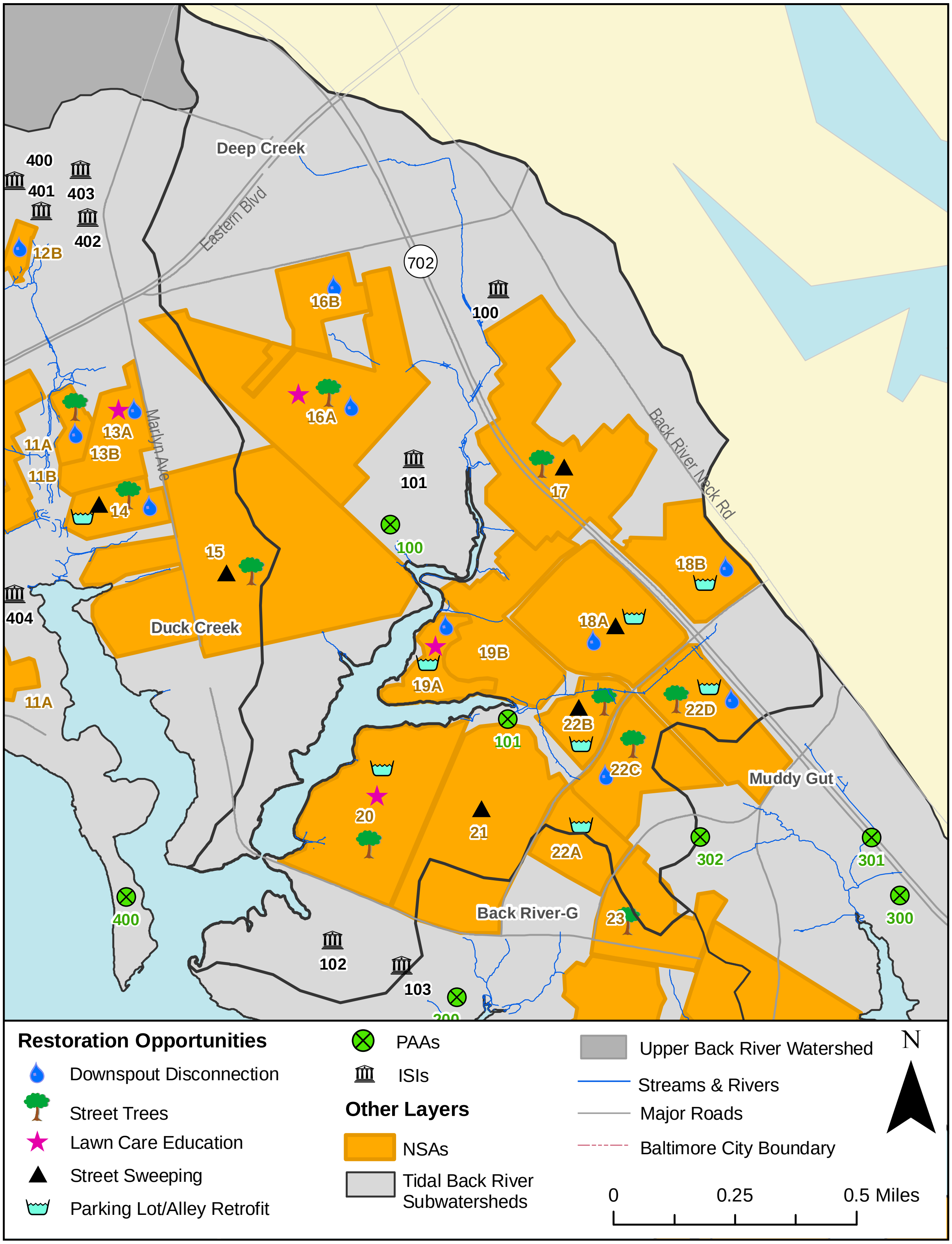


**Figure 4-18: Restoration Opportunities in Deep Creek**

### 4.3.6 Duck Creek

Duck Creek is the fifth largest subwatershed comprising the Tidal Back River watershed and the second most populated after Deep Creek. Duck Creek is largely occupied by residential land uses (~69%) with some considerable portions of commercial and institutional areas. About one-third of the total subwatershed area is covered by impervious surfaces. The majority tributary beings north of Eastern Boulevard and continues downstream (south) to the tidal portion of Duck Creek before discharging into Back River. Key subwatershed characteristics are summarized in the table below.

**Table 4-43: Key Subwatershed Characteristics – Duck Creek**

| | | |
|---|---|---|
| **Drainage Area** | 825.0 acres (1.29 sq. mi.) | |
| **Stream Length** | 3.1 miles | |
| **Coastline Length** | 4.4 miles | |
| **Population** | 9,080 (2000 Census)<br>11.0 people/acre | |
| **Land Use/Land Cover** | Low Density Residential:<br>Medium Density Residential:<br>High Density Residential:<br>Commercial:<br>Industrial:<br>Institutional:<br>Other Urban:<br>Forest:<br>Agriculture:<br>Water/Wetlands: | 0.0%<br>63.2%<br>5.6%<br>15.7%<br>0.0%<br>5.5%<br>2.2%<br>5.0%<br>0.0%<br>2.8% |
| **Impervious Cover** | 33% of subwatershed | |
| **Soils** | A Soils (low runoff potential):<br>B Soils:<br>C Soils:<br>D Soils (high runoff potential): | 0.0%<br>73.3%<br>18.9%<br>7.8% |
| **SWM Facilities** | 2% of urban land use treated | |
| **Priority Rating** | Very High | |

***Neighborhoods***

A total of 13 distinct neighborhoods were identified and assessed within Deep Creek during the uplands assessment of Tidal Back River. Characteristics such as lot size, age, and type were used to delineate neighborhoods rather than subwatershed boundaries. As a result, some neighborhoods overlap multiple subwatersheds. Two of the neighborhoods within Duck Creek overlap Deep Creek (NSA_E_15 and NSA_E_16A). Qualitative descriptions of these neighborhoods and recommendations are included within this section. While descriptions are not repeated for neighborhoods overlapping multiple subwatersheds, calculations presented in the *Watershed Characterization Report* were based on the fraction of the NSA area within respective watersheds.

Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, buffer improvement, parking lot retrofit, street sweeping, tree planting and public education (i.e., bayscaping, increasing lot tree canopy, lawn care, and pet waste and trash management). A summary of neighborhood recommended actions is presented in the table below.

**Table 4-44: NSA Recommendations – Duck Creek**

| | | RECOMMENDED ACTIONS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marks | Bayscape | Increase Lot Canopy | Fertilizer Reduction | Pet Waste | Trash Management | Buffer Improvement | Parking Lot Retrofit | Street Sweeping | # of Street Trees | # of Shade Trees | Notes |
| NSA_E_08 | <1/4 | 60 | X | | X | | | X | X | | | | | 0 | 0 | |
| NSA_E_09 | <1/8 | 75 | X | | X | | X | X | | | | | | 0 | 0 | |
| NSA_E_10A | <1/4 | 70 | X | | X | | | | | | | | | 0 | 0 | |
| NSA_E_10B | <1/8 | 70 | X | | X | | X | X | | | X | X | | 0 | 15 | Runoff (e.g., car washing) from backyard and parking lot straight into Back River |
| NSA_E_11A | <1/4 | 70 | X | | X | | X | X | | | | | | 100 | 0 | |
| NSA_E_11B | <1/8 | 70 | X | X | X | | | | | | | | X | 50 | 0 | Curb & gutter sediment |
| NSA_E_12A | <1/4 | 40 | X | | X | | X | X | | | | | X | 100 | 0 | Pool education, long-term car parking |
| NSA_E_12B | <1/4 | 60 | X | | X | | X | | | | X | | | 0 | 0 | SWM pond |
| NSA_E_13A | <1/4 | 40 | X | | X | | X | X | | | X | | | 0 | 0 | Pool education, no curb but inlets adjacent to lawns - sediment |
| NSA_E_13B | <1/4 | 60 | X | | X | | X | | | | X | | | 30 | 0 | Pool education |
| NSA_E_14 | Multifamily | 90 | X | X | X | X | X | | | X | X | X | X | 40 | 30 | Curb & gutter org matter, bulk trash dumping in parking lot |

| | | RECOMMENDED ACTIONS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marks | Bayscape | Increase Lot Canopy | Fertilizer Reduction | Pet Waste | Trash Management | Buffer Improvement | Parking Lot Retrofit | Street Sweeping | # of Street Trees | # of Shade Trees | Notes |
| NSA_E_15 | <1/4 | 35 | X | | X | | X | | | | | | X | 100 | 0 | Pool education, long-term car parking |
| NSA_E_16A | 1/4 | 60 | X | | X | X | X | X | | | | | | 75 | 0 | Pool ed. |

Unlike Deep Creek, most of the neighborhoods in Duck Creek consist of single-family detached homes. All of the neighborhoods assessed are good candidates for downspout disconnection and storm drain marking. Several neighborhoods are also recommended for education related to proper lawn care, increasing private lot tree canopy, and pool maintenance. Some neighborhoods consist of mowed lawn adjacent to the stream corridor rather than dense vegetation or forested buffer which provides more water quality treatment of runoff. These neighborhoods present a good opportunity to educate residents about the benefits and importance of planting and maintaining a riparian stream buffer for aesthetic and water quality purposes. Several neighborhoods also have the potential for street and/or open space, shade trees. Community tree and buffer plantings and storm drain marking are good ways to engage citizens in these neighborhoods and raise awareness.

***Hotspots***

A total of three (3) hotspots were investigated in Duck Creek during the uplands assessment of Tidal Back River. This included a park and ride, auto-related commercial store, and a private residence with potential sources of pollution. The table below summarizes hotspot investigation results for sites assessed in Duck Creek.

**Table 4-45: HSI Results Summary – Duck Creek**

| Site_ID | HSI Status* | Description | POTENTIAL POLLUTION SOURCES: Vehicle Operations | Outdoor Materials | Waste Management | Physical Plant | Stormwater | Notes |
|---|---|---|---|---|---|---|---|---|
| HSI_E_400 | Confirmed | Park & Ride | X | | X | X | X | Trash dumping on east side of parking lot into stream |
| HSI_E_401 | Confirmed | Residence | | X | | | | Heavy machinery/construction materials stored adj to stream on residential property |
| HSI_E_600 | Confirmed | Auto-related | X | | X | | X | |

*Notes:
Confirmed – pollution observed, many potential sources

Trash management issues and improper storage of outdoor materials was noted at some of the hotspots assessed in Duck Creek. Public education and outreach regarding proper trash management and outdoor material storage at these and similar sites would help address these issues in Duck Creek as well as Tidal Back River.

There are currently two NPDES-permitted facilities for general stormwater discharges within Duck Creek. Compliance with permit requirements should be verified for these facilities. Deep Creek also includes two certified Maryland Clean Marinas: Weaver's and Riverside. There is an opportunity to locally emphasize (e.g., local newspapers) the efforts of these marinas to voluntarily implement pollution prevention practices while also educating citizens and marine users about water quality measures. This is also an opportunity to encourage marina owners to continue to implement BMPs to address runoff from their facilities.

***Institutions***

A total of seven (7) institutions were assessed for retrofit opportunities in Duck Creek during the uplands assessment of Tidal Back River. This includes four public facilities and three private facilities. The table below summarizes recommendations for institutional sites assessed in Deep Creek.

**Table 4-46: ISI Recommendations – Duck Creek**

| | | | RECOMMENDATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Site ID** | **Name** | **Public/ Private** | **Storm Drain Marking** | **#Trees for Planting** | **Dwnspout Disconnection** | **Stormwater Retrofit** | **Impervious Cover Removal** | **Buffer Improvement** | **Trash Management** | **Notes** |
| ISI_E_400 | St. Clare Parish | Private | X | 50 | X | X | X | | | Partial SW retrofit - front of Madonna Center |
| ISI_E_401 | Essex Fire Station | Public | | 15 | | | X | | | Car washing to drain, concrete channel removal |
| ISI_E_402 | Apostolic Life Center | Private | | 10 | X | X | | | | Parking lot retrofit |
| ISI_E_403 | Balt. Co. Precinct 11 | Public | X | 75 | | X | | | X | Sediment & org matter build-up in parking lot, inlet retrofit |
| ISI_E_404 | Sussex Elementary | Public | X | 100 | | X | | X | | Grass clippings to drain, parking lot retrofit |
| ISI_E_600 | Essex Elementary | Public | X | 50 | | | | | | |
| ISI_E_601 | Riverview Care Center | Private | X | 40 | | X | | X | X | Trash near dumpsters & dumping at rivers edge adjacent to Eastern Blvd); parking lot retrofits |

All of the institutions surveyed have potential for tree plantings. Most also are recommended for storm drain marking and stormwater retrofits to address runoff from impervious surfaces (e.g., parking lots). Some of the institutions were also considered good candidates for impervious cover removal, downspout disconnection, and buffer improvement.

### *Pervious Areas*

One pervious area was assessed for restoration potential in Duck Creek: Cox's Point Park. Cox's Point Park is a public park located at the end of Riverside Drive. It is maintained by Baltimore County and about half of the property is covered by turf. This site was considered as a good candidate for reforestation, requiring minimal site preparation. An opportunity for stormwater retrofit to treat runoff from one of the parking lot areas also noted. This may involve filtering/filtration practices to treat runoff and address bare soil before entering the Back River. A summary is provided in the table below.

**Table 4-47: PAA Recommendations – Duck Creek**

| Site ID | Location | Description | Acres | Ownership |
|---|---|---|---|---|
| PAA_E_400 | Cox's Point | Public park | 18.50 | Public |

### *Stream Corridor Assessments*

Field crews walked 1.62 miles of stream (52% of total stream miles) within Duck Creek to identify water quality problems and restoration opportunities. This included a survey of all wadeable and accessible portions of Duck Creek. A total of 52 potential environmental problems were identified in Duck Creek. The most predominant water quality issues included inadequate buffer and trash dumping. The table below summarizes the results of the SCA survey and restoration opportunities.

**Table 4-48: Summary of Stream Conditions – Duck Creek**

| OPPORTUNITIES (# of ENVIRONMENTAL PROBLEM SITES) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Inadequate Buffer | Trash Dumping | Channel Alteration | Erosion | Pipe Outfalls | Exposed Pipe | Fish Barrier | In/Near Stream Construction | Unusual Conditions | Totals |
| 13 | 11 | 4 | 2 | 14 | 1 | 2 | 0 | 5 | ***52*** |

| Length of Inadequate Buffer (ft) | Length of Channel Alteration (ft) | Length of Erosion (ft) | # of Truckloads for Trash Dumping Sites |
|---|---|---|---|
| 4,995 | 315 | 66 | 59 |

### *Illicit Discharges*

Duck Creek contains five outfalls rated as priority 2, which indicates moderate to minor problems with the potential to become more severe. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

Potentially severe to moderate water quality issues were also identified during the stream corridor assessments due to discharging and exposed pipes. In Duck Creek, six outfalls and one exposed pipe were rated as severe to moderately severe water quality problems.

### *Stormwater Conversions*

Duck Creek contains one detention pond, located in a residential neighborhood off of Urbanwood Court. The pond is bounded by private residential properties which limits the potential for physical expansion. Therefore, this facility is not recommended for conversion to an extended detention facility. Because the pond is considered to be in good condition, recommendations are only to monitor the condition of the inlet and riser and make sure maintenance of the pond continues to ensure proper function. This pond could be considered for planting of native vegetation that requires low maintenance while providing some water quality benefit.

***Subwatershed Management Strategy***

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-44.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-44.

3. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as The Growing Home Campaign.

4. Plant street and shade trees. Table 4-44 shows a potential for 495 street trees and 45 shade trees.

5. Educate citizens about the benefits and importance of bayscaping, proper lawn care and pool maintenance, pet waste disposal and trash management.

6. Encourage community cleanups in neighborhoods recommended for trash management in Table 4-44.

7. Educate residents about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments.

8. Engage institutional sites listed in Table 4-46 in recommended restoration actions.

9. Investigate the pervious areas described in Table 4-47 for potential tree planting.

Municipal Actions

1. Investigate current street sweeping measures in recommended neighborhoods listed in Table 4-44 and increase frequency or implement program as necessary.

2. Further investigate parking lot stormwater retrofit opportunities identified in neighborhoods listed in Table 4-44.

3. Educate commercial property owners about the importance of proper trash management and outdoor material storage techniques at hotspot sites similar to those identified in Table 4-45.

4. Encourage Weaver's and Riverside Marinas to continue to implement BMPs and maintain the Maryland Clean Marina certification.

5. Investigate stormwater retrofit and shoreline project opportunities at the Essex Park and Ride.

6. Investigate potential for stormwater retrofits at the institutions identified in Table 4-46.

7. Investigate stream restoration potential at sites listed in Table 4-48 and described in the *Watershed Characterization Report*.

8. Continue to monitor illicit discharges.

9. Conduct follow-up site inspections of potentially severe to moderately severe discharging and exposed pipes described above and in the *Watershed Characterization Report*.

10. Explore options for wetland restoration and planting along the shoreline.

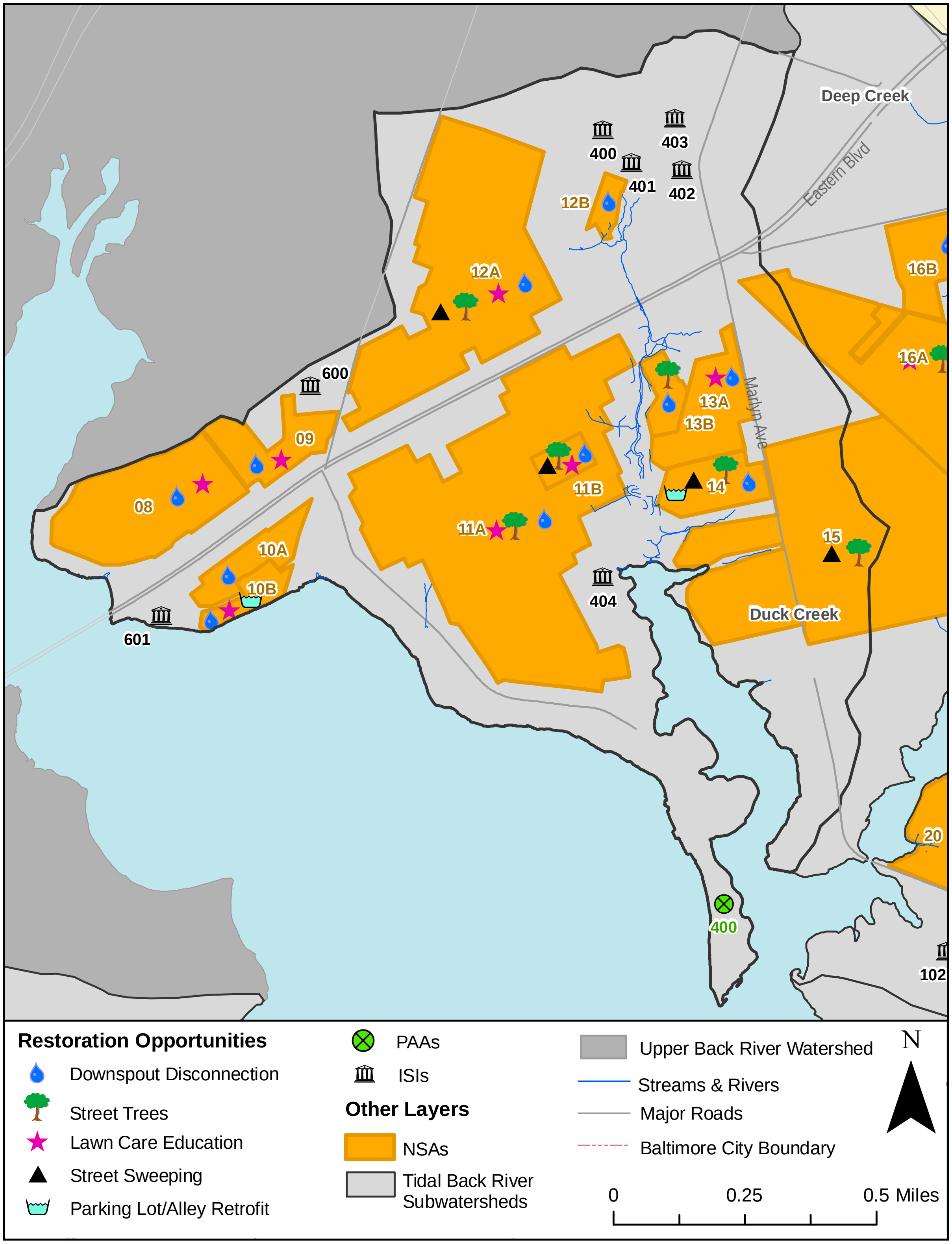


**Figure 4-19: Restoration Opportunities in Duck Creek**

### 4.3.7 Greenhill Cove

Greenhill Cove is the second smallest subwatershed comprising the Tidal Back River watershed. Nevertheless, it has a relatively high population density since over 80 percent of the subwatershed is developed. This subwatershed consists only of the cove which connects to Back River rather than upland, riverine streams. A summary of key subwatershed characteristics is presented in the table below.

**Table 4-49: Key Subwatershed Characteristics – Greenhill Cove**

| | | |
|---|---|---|
| **Drainage Area** | 221.6 acres (0.35 sq. mi.) | |
| **Stream Length** | 0 miles | |
| **Coastline Length** | 1.6 miles | |
| **Population** | 1,066 (2000 Census)<br>4.8 people/acre | |
| **Land Use/Land Cover** | Low Density Residential:<br>Medium Density Residential:<br>High Density Residential:<br>Commercial:<br>Industrial:<br>Institutional:<br>Other Urban:<br>Forest:<br>Agriculture:<br>Water/Wetlands: | 0.0%<br>33.1%<br>3.2%<br>3.7%<br>16.4%<br>3.3%<br>23.8%<br>14.8%<br>0.0%<br>1.7% |
| **Impervious Cover** | 27% of subwatershed | |
| **Soils** | A Soils (low runoff potential):<br>B Soils:<br>C Soils:<br>D Soils (high runoff potential): | 2.5%<br>63.6%<br>26.0%<br>7.9% |
| **SWM Facilities** | 28% of urban land use treated | |
| **Priority Rating** | Medium | |

***Neighborhoods***

A total of two (2) distinct neighborhoods were identified and assessed within Greenhill Cove during the uplands assessment of Tidal Back River. Characteristics such as lot size, age, and type were used to delineate neighborhoods rather than subwatershed boundaries. As a result, some neighborhoods overlap multiple subwatersheds. Both of the neighborhoods assessed within Greenhill Cove encompass portions of Lynch Point Cove. Qualitative descriptions of these neighborhoods and recommendations are included within this section. While descriptions are not repeated for neighborhoods overlapping multiple subwatersheds, calculations presented in the *Watershed Characterization Report* were based on the fraction of the NSA area within respective watersheds.

Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, buffer improvement, street sweeping, tree planting and public education (i.e., bayscaping, increasing lot tree canopy, lawn care and trash management). A summary of neighborhood recommended actions is presented in the table below.

**Table 4-50: NSA Recommendations – Greenhill Cove**

| | | RECOMMENDED ACTIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **NSA_ID** | **Lot Size (acres)** | **% Opportunity for Downspout Disconnection** | **Rain Barrels** | **Storm Drain Marks** | **Bayscape** | **Increase Lot Canopy** | **Fertilizer Reduction** | **Buffer Improvement** | **Street Sweeping** | **# of Shade Trees** | **Notes** |
| NSA_E_06A | <1/4 | 65 | X | X | X | X | | X | | 10 | Community park, standing water in streets |
| NSA_E_06B | <1/4 | 55 | X | X | | X | X | X | X | 20 | Strong fertilizer odor, mostly organic matter along curb, pool education, long-term parking |

Both neighborhoods assessed are good candidates for downspout disconnection. Due to limited space (small lot sizes), redirection and/or rain barrels are the most suitable options for disconnection. There is also potential for storm drain marking and tree planting in both neighborhoods which is a great way to engage citizens and raise awareness about water quality issues and improvement techniques. Similar to the properties observed in other shorefront areas, the shoreline buffer has been impacted by residential development. In both neighborhoods, the buffer consists of mowed lawns rather than dense vegetation or forested areas. This presents an opportunity to educate residents about the importance of maintaining a shoreline buffer by encouraging them to increase tree canopy and bayscaping on their lots. This would provide water quality benefits in addition to aesthetic value.

### *Hotspots*

No hotspot investigations were performed within Greenhill Cove since HSIs were focused in areas where commercial development is concentrated in the watershed. Less than four percent of Greenhill Cove is comprised by commercial areas. There is currently one NPDES-permitted facility for surface industrial discharge within Greenhill Cove. Compliance with permit requirements should be verified for this facility.

### *Institutions*

A total of two (2) institutions were assessed for retrofit opportunities in Greenhill Cove during the uplands assessment of Tidal Back River. This includes one private facility and one public facility. The table below summarizes recommendations for institutional sites assessed in Greenhill Cove.

**Table 4-51: ISI Recommendations – Greenhill Cove**

| Site ID | Name | Type | Public/ Private | Storm Drain Marking | #Trees for Planting | Dwnspout Disconnection | Stormwater Retrofit | Buffer Improvement | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | | | RECOMMENDATIONS | | | | | |
| ISI_E_900 | VFW Post 2678 | Community Center | Private | | 60 | | X | | Parking lot retrofit |
| ISI_E_901 | Edgemere Senior Center | Care Center | Public | X | 10 | X | | X | Nearly no pervious space, discharge goes directly to river, pervious pavement? |

Both institutions have opportunities for tree plantings which is a great way to get the community involved in water quality improvement measures while also raising awareness. ISI_E_900 was considered as a good candidate for a parking lot retrofit(s) since there are small, open grassy areas available adjacent to impervious parking lot areas (see figure below). This would provide aesthetic value for the community facility and require less maintenance than the grass while also treating runoff before entering the storm drain system.

**Figure 4-20: Potential Parking Lot Retrofit Sites at ISI_E_900**

ISI_E_901 is a senior center operated by Baltimore County Department of Aging and located off of North Point Road. The property is located on the shorefront of Greenhill Cove and is predominantly occupied by impervious surfaces (parking lot and building). As a result, runoff from the impervious surfaces is discharged directly to Back River either through inlets within the parking lot or over the bulkhead. While pervious space is limited at this site, there is potential to improve the buffer along the bulkhead by converting a portion of the existing grass area to native vegetation and/or trees. This is an opportunity to engage families (citizens of all ages) with vegetation/tree plantings and/or education about the water quality project. Additional options for treating more of the impervious surface runoff at this facility include use of permeable pavement, incorporating bio-retention areas in the parking lot rather than solely grass areas, and proprietary BMP devices such as filters for the parking lot inlets. The figure below shows potential restoration sites at this facility.

**Figure 4-21: Potential Restoration Sites at ISI_E_901**

### *Pervious Areas*

No pervious area assessments were performed within Greenhill Cove. Most of this subwatershed is developed. The small portion that is undeveloped is already forested. There is little to no potential for pervious area restoration within Greenhill Cove

### *Stream Corridor Assessments*

SCAs were not conducted in Greenhill Cove since there are no riverine streams within this subwatershed. Therefore, no stream restoration opportunities have been identified in Greenhill Cove.

### *Illicit Discharges*

Greenhill Cove does not contain any outfalls rated as priority 1 or priority 2. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

### *Stormwater Conversions*

No dry detention ponds are located within Greenhill Cove according to Baltimore County's stormwater management facilities GIS data. Therefore, no stormwater management facility surveys were conducted within this subwatershed.

***Subwatershed Management Strategy***

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-50.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-50.

3. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as The Growing Home Campaign.

4. Plant shade trees. Table 4-50 shows a potential for 30 open space, shade trees.

5. Educate citizens about the benefits and importance of proper lawn care maintenance and bayscaping.

6. Educate residents about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments in the neighborhoods indicated in Table 4-50.

7. Engage institutional sites listed in Table 4-51 in recommended restoration actions.

Municipal Actions

1. Investigate current street sweeping measures in NSA_E_06B and increase frequency or implement program as necessary.

2. Further investigate the stormwater retrofit opportunities at institution sites identified in Table 4-51.

3. Explore options for wetland restoration and planting along the shoreline.

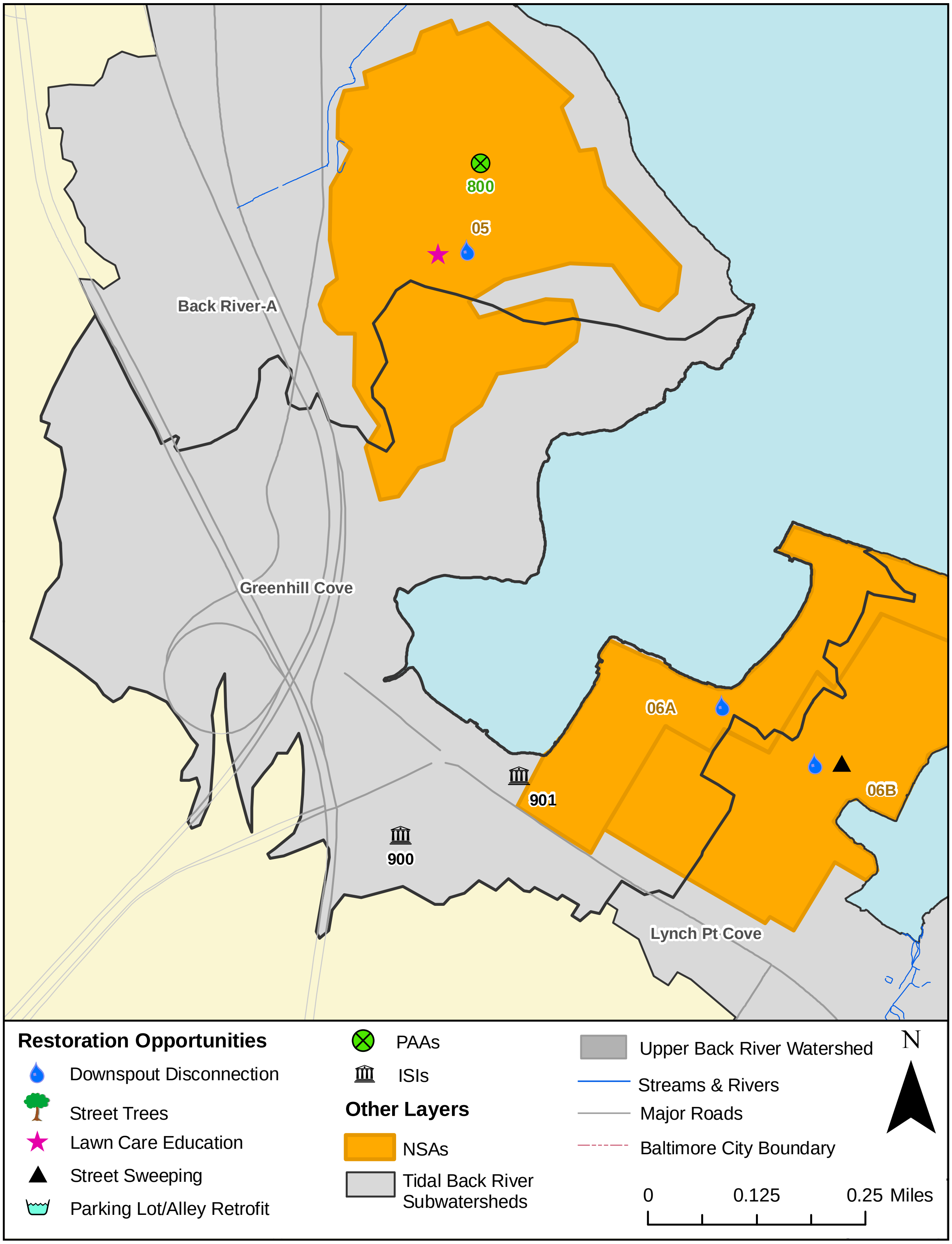


**Figure 4-22: Restoration Opportunities in Greenhill Cove**

### 4.3.8 Longs Creek

Longs Creek is the largest subwatershed comprising Tidal Back River. It is also the least developed and least populated subwatershed with over half of its area occupied by forested area (~67%). One tributary within Longs Creek begins south of Holly Neck Road and flows downstream (west), crossing Back River Neck Road before discharging into Back River. A second tributary flows parallel to Back River Neck Road in a southeast direction until discharging into the tidal portion of Longs Creek at the southern end of the subwatershed. Key subwatershed characteristics are summarized in the table below.

**Table 4-52: Key Subwatershed Characteristics – Longs Creek**

| | | |
|---|---|---|
| **Drainage Area** | 2,028.0 acres (3.17 sq. mi.) | |
| **Stream Length** | 6.4 miles | |
| **Coastline Length** | 6.9 miles | |
| **Population** | 803 (2000 Census)<br>0.4 people/acre | |
| **Land Use/Land Cover** | Low Density Residential:<br>Medium Density Residential:<br>High Density Residential:<br>Commercial:<br>Industrial:<br>Institutional:<br>Other Urban:<br>Forest:<br>Agriculture:<br>Water/Wetlands: | 2.5%<br>5.2%<br>0.0%<br>1.6%<br>0.0%<br>0.2%<br>11.1%<br>67.2%<br>10.3%<br>1.9% |
| **Impervious Cover** | 3% of subwatershed | |
| **Soils** | A Soils (low runoff potential):<br>B Soils:<br>C Soils:<br>D Soils (high runoff potential): | 2.0%<br>17.1%<br>53.2%<br>27.7% |
| **SWM Facilities** | 0% of urban land use treated | |
| **Priority Rating** | Medium-Low | |

***Neighborhoods***

A total of three (3) distinct neighborhoods were identified and assessed within Longs Creek during the uplands assessment of Tidal Back River. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, buffer improvement, street sweeping, tree planting and public education (i.e., bayscaping, increasing lot tree canopy, lawn care and trash management). A summary of neighborhood recommended actions is presented in the table below.

**Table 4-53: NSA Recommendations – Longs Creek**

| RECOMMENDED ACTIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Bayscape | Increase Lot Canopy | Buffer Improvement | Notes |
| NSA_E_29 | 1/4 | 60 | X | X | X | X | X | No curbs, standing water, some junk in yards |
| NSA_E_30 | 1/4 | 30 | X | X | X | X | X | No curbs, standing water & erosion, bare soil in several yards |
| NSA_E_31 | < 1/2 | 30 | X | X | X | X | X | |

All neighborhoods assessed within Longs Creek are good candidates for downspout disconnection. Because the private lot sizes are larger than those in other subwatersheds, redirection, rain barrels, and rain gardens are all viable options for disconnection. The relatively large lot sizes also offer an opportunity to encourage bayscaping and increasing lot tree canopy through public education/outreach efforts. All of the neighborhoods assessed within Longs Creek are located along the shorefront of Back River. Similar to several other subwatersheds comprising Tidal Back River, shoreline buffer impacts were noted as a result of residential development (i.e., mowed grass up to the shore rather than forested buffer area). Educating citizens about the importance and benefits of maintaining a riparian shoreline buffer would help address this potential water quality issue while also adding to the aesthetic value of the shorefront properties. The recommended actions would also help address standing water and bare soil noted in the neighborhoods assessed.

### *Hotspots*

No hotspot investigations were conducted within Longs Creek since HSIs were focused in areas where commercial development is concentrated in the watershed. Longs Creek consists of very little commercial areas (less than 2 percent) and no industrial land uses. In addition, there are currently no NPDES-permitted facilities located within Longs Creek.

### *Institutions*

One (1) institution site was assessed for retrofit opportunities in Longs Creek during the uplands assessment of Tidal Back River. This includes one public facility. The table below summarizes recommendations for the institutional site assessed in Longs Creek.

**Table 4-54: ISI Recommendations – Longs Creek**

| | | | | RECOMMENDATIONS | | | |
|---|---|---|---|---|---|---|---|
| Site ID | Name | Type | Public/ Private | #Trees for Planting | Buffer Improvement | Trash Management | Notes |
| ISI_E_500 | Maryland Environmental Services | Municipal | Public | 10 | X | X | Buffer Improvement, dumpster next to river |

ISI_E_500 is a docking site for Maryland Environmental Services (MES). It includes a gravel parking area for cars and boats. It also includes a docking area and trailer for equipment. There is some opportunity to plant trees in open grass areas on the property and along the shorefront to enhance the shoreline buffer. Another recommendation for this site is to address waste management operations, particularly relocating the dumpster away from the shoreline or creating a diversion to prevent dumpster runoff from entering the Back River.

**Figure 4-23: Potential Restoration Sites at ISI_E_500**

### *Pervious Areas*

No pervious area assessments were conducted within Longs Creek. This is because previous studies have been conducted within this subwatershed. Also, Longs Creek is part of the County's Coastal Rural Legacy Plan which aims to protect large blocks of forest, wetlands, farms, and other open spaces that are of significant ecological value as habitat for rare, threatened and endangered species and to preserve the environmental benefits that these areas provide to the Chesapeake Bay. The Back River/Holly Neck Coastal Rural Legacy Area includes all of Longs Creek and a portion of Muddy Gut.

### *Stream Corridor Assessments*

Longs Creek was not included in the SCA since a previous study has been conducted. Therefore, no stream restoration opportunities have been identified in Longs Creek.

***Illicit Discharges***

Longs Creek does not contain any outfalls rated as priority 1 or priority 2. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

***Stormwater Conversions***

No dry detention ponds are located within Longs Creek according to Baltimore County's stormwater management facilities GIS data. Therefore, no stormwater management facility surveys were conducted within this subwatershed.

***Shoreline Restoration***

Longs Creek is the subwatershed with the greatest length of coastline suitable for preservation, reforestation and/or shoreline enhancement projects. Two reaches within Longs Creek were assessed previously in DEPRM's Shoreline Enhancement Feasibility Study (1998): Essex Sky Park and Rocky Point Park. Essex Sky Park was determined as a feasible site for shoreline-related erosion control and beneficial use efforts. Rocky Point Park was determined as a feasible site for erosion control, habitat enhancement and expansion of existing shoreline projects.

***Subwatershed Management Strategy***

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

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-53.

2. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as The Growing Home Campaign.

3. Educate citizens about the benefits and importance of bayscaping.

4. Educate residents about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments.

5. Engage institutional sites listed in Table 4-54 in recommended restoration actions.

<u>Municipal Actions</u>

1. Evaluate a shoreline enhancement project at the Essex Sky Park and Rocky Point Park (including the golf course) sites identified in DEPRM's Shoreline Feasibility Study.

2. Explore options for wetland restoration and planting along shoreline reaches identified.

3. Continue to designate forested area as resource conservation and limit development in this subwatershed.

4. Continue to preserve the Back River/Holly Neck area through the County's Coastal Rural Legacy Program.

5. Implement actions identified in the Forest Health Assessment of Lower Back River Neck.

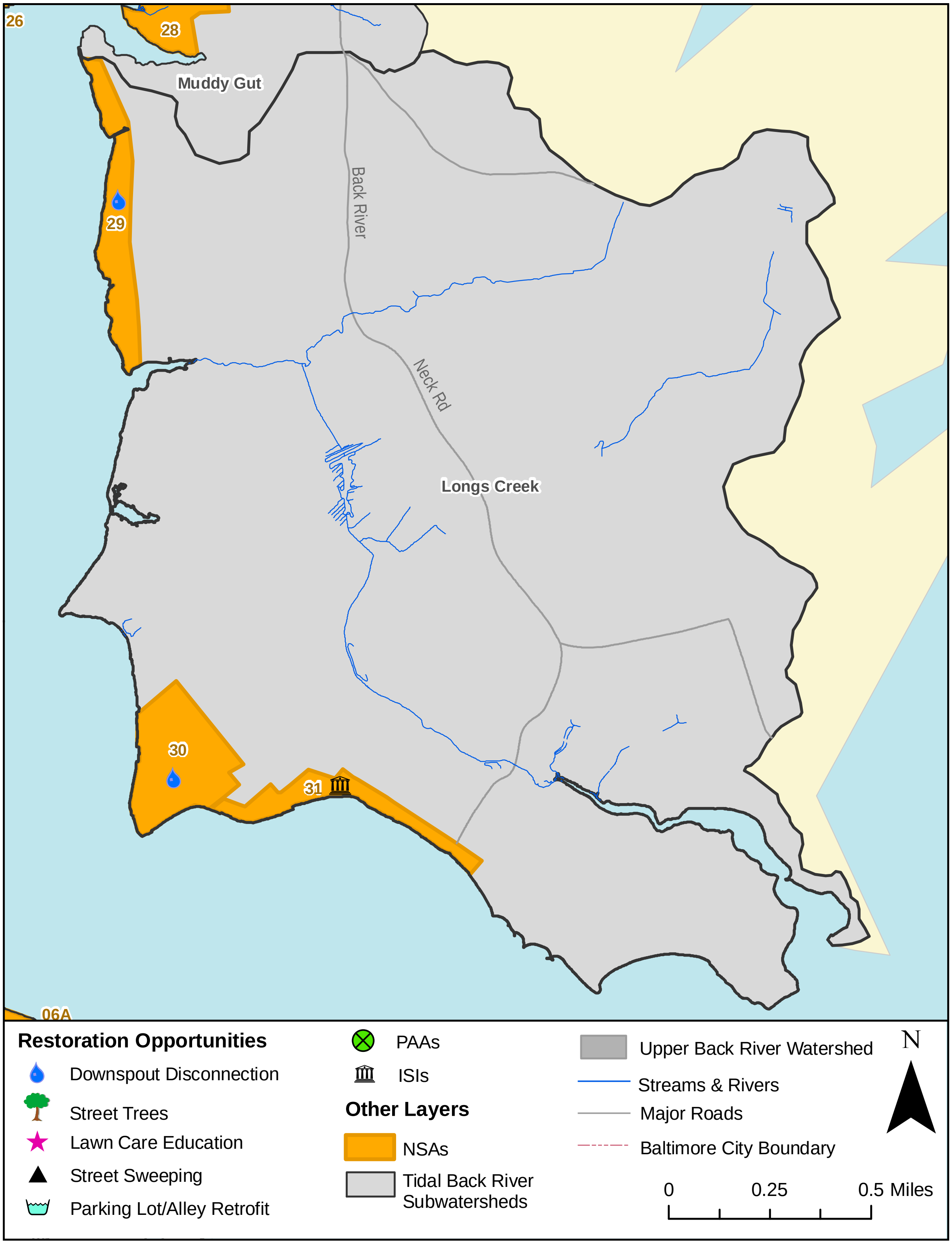


**Figure 4-24: Restoration Opportunities in Longs Creek**

### 4.3.9 Lynch Point Cove

Lynch Point Cove is the smallest subwatershed comprising the Tidal Back River watershed. Nevertheless, it has a relatively high population density since nearly 95 percent of the subwatershed is developed. Predominant urban land uses are residential and institutional. Lynch Point Cove consists of a very small stream network. Lynch Point Cove is the main water feature of this subwatershed which connects to Back River. A summary of key subwatershed characteristics is presented in the table below.

**Table 4-55: Key Subwatershed Characteristics – Lynch Point Cove**

| | | |
|---|---|---|
| **Drainage Area** | 113.2 acres (0.18 sq. mi.) | |
| **Stream Length** | 0.4 miles | |
| **Coastline Length** | 1.0 miles | |
| **Population** | 971 (2000 Census) | |
| **Land Use/Land Cover** | Low Density Residential:<br>Medium Density Residential:<br>High Density Residential:<br>Commercial:<br>Industrial:<br>Institutional:<br>Other Urban:<br>Forest:<br>Agriculture:<br>Water/Wetlands: | 0.0%<br>61.5%<br>0.0%<br>12.3%<br>0.0%<br>21.0%<br>0.0%<br>2.8%<br>0.0%<br>2.4% |
| **Impervious Cover** | 33% of subwatershed | |
| **Soils** | A Soils (low runoff potential):<br>B Soils:<br>C Soils:<br>D Soils (high runoff potential): | 0.0%<br>59.3%<br>34.0%<br>6.7% |
| **SWM Facilities** | 26% of urban land use treated | |
| **Priority Rating** | High | |

***Neighborhoods***

A total of two (2) distinct neighborhoods were identified and assessed within Lynch Point Cove during the uplands assessment of Tidal Back River. Characteristics such as lot size, age, and type were used to delineate neighborhoods rather than subwatershed boundaries. As a result, both neighborhoods encompass portions of Lynch Point Cove and Greenhill Cove. Qualitative descriptions of these neighborhoods (NSA_E_06A and NSA_E_06B) and recommendations are included in Section 4.3.7 (Greenhill Cove). While descriptions are not repeated for neighborhoods overlapping multiple subwatersheds, calculations presented in the *Watershed Characterization Report* were based on the fraction of the NSA area within respective watersheds.

### *Hotspots*

No hotspot site investigations were conducted within Lynch Point Cove since HSIs were focused in areas where commercial development is concentrated in the watershed (i.e., northern portion of the watershed).

### *Institutions*

Two (2) institutional sites were assessed for retrofit opportunities in Lynch Point Cove during the uplands assessment of Tidal Back River. This includes two public schools. The table below summarizes recommendations for the institutional sites assessed in Lynch Point Cove.

**Table 4-56: ISI Recommendations – Lynch Point Cove**

| | | | RECOMMENDATIONS | | | |
|---|---|---|---|---|---|---|
| Site ID | Name | Public/ Private | Storm Drain Marking | #Trees for Planting | Stormwater Retrofit | Notes |
| ISI_E_1000 | Edgemere Elementary | Public | X | 50 | | |
| ISI_E_1001 | Sparrows Point Jr & Sr High | Public | X | 100 | X | Outdoor storage area w/ greenhouse (soil, garden matls, canoes, etc), near Lynch Point SW Improvement Project |

Both schools are good candidates for storm drain marking and tree planting efforts. These are both ways to engage teachers and students in restoration activities while providing an education about water quality issues and improvement methods.

An opportunity for stormwater retrofit was also identified at ISI_E_1001 (Sparrows Point Junior and Senior High School). An open pervious area and existing grading are considered amenable to install a BMP (e.g., bio-retention) to treat runoff from the adjacent impervious parking lot while also addressing bare soil and standing water observed (see figure below). There is an opportunity to engage the school community in the installation, maintenance, and/or monitoring of the BMP. This site also includes an outdoor storage area for garden materials and recreational equipment. At the time of the investigation, top soil and mulch piles were being stored on an impervious surface without underlying or overlying cover. This is a good opportunity to encourage the school to cover these materials and store them on pallets or in containers to preserve the materials and prevent washoff of sediment into nearby storm drains.

**Figure 4-25: Potential Restoration Sites at ISI_E_1001**

### *Pervious Areas*

No pervious area assessments were performed within Greenhill Cove. However, visual observation of a privately maintained community park in NSA_E_06A revealed restoration potential. Lynch Point Community Park is located on the shorefront of Back River and encompasses portions of Greenhill Cove and Lynch Point Cove. The park is well maintained and indicates that restoration activities might be well received and maintained by the community. This site is a good candidate to incorporate bayscaping and/or tree plantings for water quality treatment and buffer enhancement purposes. Since this park is centrally located in the community, it can be used to engage residents in restoration activities and serve as an example of techniques residents can apply on their own properties to improve water quality in their community.


**Figure 4-26: Potential Restoration Site at Lynch Point Community Park**

### *Stream Corridor Assessments*

SCAs were not conducted in Lynch Point Cove. Stream mileage is very limited within this subwatershed and streams are mostly tidal, marshy areas. These are not appropriate for the walking field survey based on Maryland DNR's SCA Survey Protocols. Therefore, no stream restoration opportunities have been identified in Lynch Point Cove.

### *Illicit Discharges*

Lynch Point Cove does not contain any outfalls rated as priority 1 or priority 2. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

### *Stormwater Conversions*

No dry detention ponds are located within Lynch Point Cove according to Baltimore County's stormwater management facilities GIS data. Therefore, no stormwater management facility surveys were conducted within this subwatershed. A pond retrofit was completed previously in Lynch Point Cove.

### *Subwatershed Management Strategy*

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-50.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-50.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as The Growing Home Campaign.
4. Plant shade trees. Table 4-50 shows a potential for 30 open space, shade trees.
5. Educate citizens about the benefits and importance of proper lawn care maintenance and bayscaping.
6. Educate residents about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments in the neighborhoods indicated in Table 4-50.
7. Engage institutional sites listed in Table 4-56 in recommended restoration actions.
8. Engage community in restoration activities recommended for the community park located in NSA_E_06A.

Municipal Actions

1. Further investigate stormwater retrofit opportunity described for the public school listed in Table 4-56.

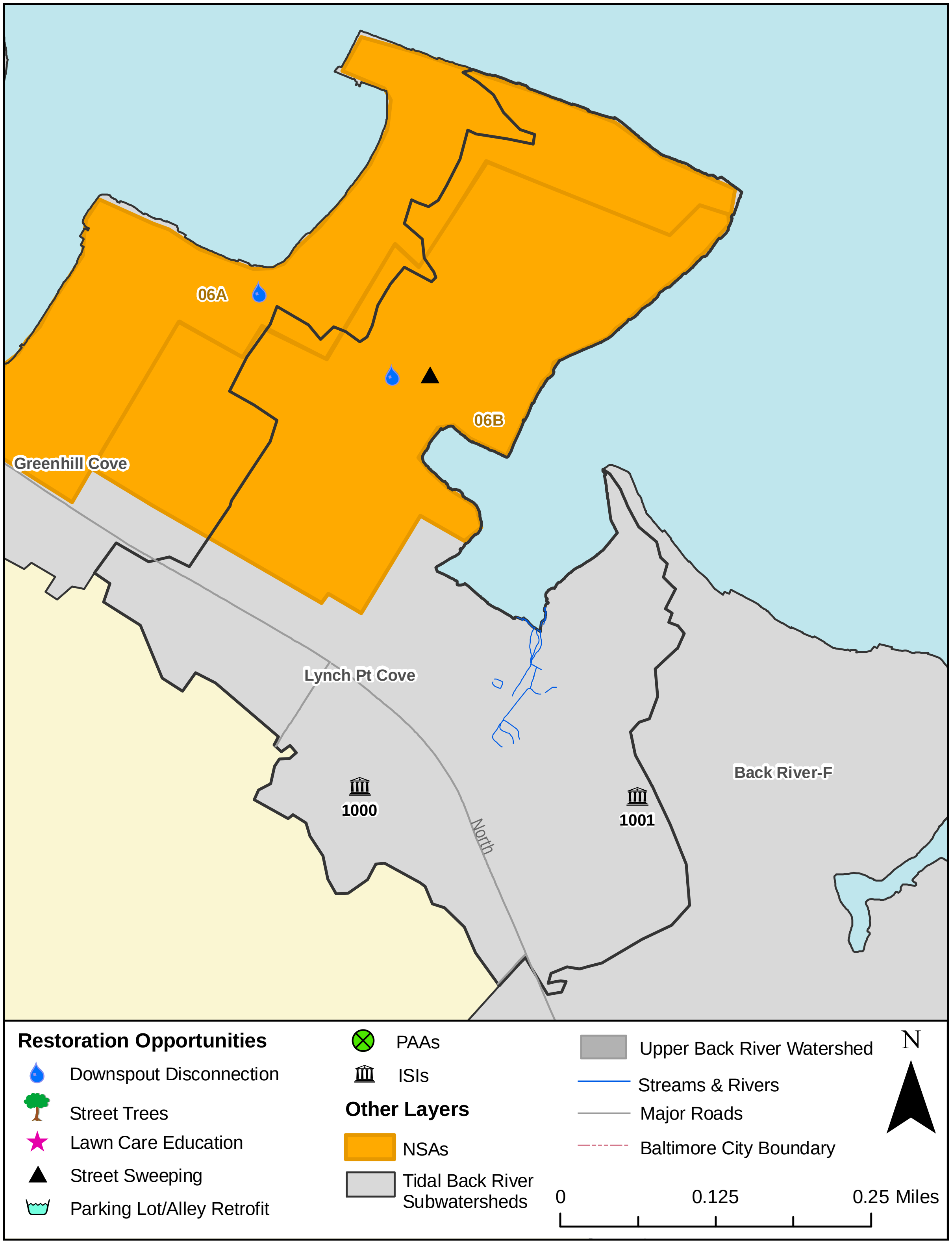


**Figure 4-27: Restoration Opportunities in Lynch Point Cove**

### 4.3.10 Muddy Gut

Muddy Gut is the sixth largest subwatershed comprising the Tidal Back River watershed and the fourth most populated. Muddy Gut consists of a considerable portion of forested area (~40%) which is mostly located in the vicinity of stream corridors. The remainder of the watershed is largely occupied by low and medium density residential developments. Several new developments (including both commercial and residential) are being established in this subwatershed. Existing forested areas and buffers are important features to preserve during future development. Several tributaries contribute to the tidal portion of Muddy Gut and Back River. Most begin in the vicinity of Back River Neck Road or Southeast Boulevard. Key subwatershed characteristics are summarized in the table below.

**Table 4-57: Key Subwatershed Characteristics – Muddy Gut**

| | | |
|---|---|---|
| **Drainage Area** | 653.0 acres (1.02 sq. mi.) | |
| **Stream Length** | 4.0 miles | |
| **Coastline Length** | 4.7 miles | |
| **Population** | 2,455 (2000 Census)<br>3.8 people/acre | |
| **Land Use/Land Cover** | Low Density Residential:<br>Medium Density Residential:<br>High Density Residential:<br>Commercial:<br>Industrial:<br>Institutional:<br>Other Urban:<br>Forest:<br>Agriculture:<br>Water/Wetlands: | 17.0%<br>21.7%<br>3.6%<br>2.4%<br>0.5%<br>1.7%<br>1.0%<br>40.5%<br>7.5%<br>4.1% |
| **Impervious Cover** | 13% of subwatershed | |
| **Soils** | A Soils (low runoff potential):<br>B Soils:<br>C Soils:<br>D Soils (high runoff potential): | 0.0%<br>0.7%<br>67.6%<br>31.7% |
| **SWM Facilities** | 5% of urban land use treated | |
| **Priority Rating** | High | |

***Neighborhoods***

A total of five (5) distinct neighborhoods were identified and assessed within Muddy Gut during the uplands assessment of Tidal Back River. Characteristics such as lot size, age, and type were used to delineate neighborhoods rather than subwatershed boundaries. As a result, two neighborhoods also encompass portions of Back River-G (NSA_E_25 and NSA_E_26). Qualitative descriptions of these neighborhoods and recommendations are included in Section 4.3.3 (Back River-G). While descriptions are not repeated for neighborhoods overlapping multiple subwatersheds, calculations presented in the *Watershed Characterization Report* were based on the fraction of the NSA area within respective watersheds.

Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, buffer improvement, parking lot retrofit, tree planting and public education (i.e., bayscaping, increasing lot tree canopy, lawn care, and trash management). A summary of neighborhood recommended actions is presented in the table below.

**Table 4-58: NSA Recommendations – Muddy Gut**

| | | RECOMMENDED ACTIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Storm Drain Marks | Bayscape | Increase Lot Canopy | Fertilizer Reduction | Trash Management | Buffer Improvement | # of Street Trees | Notes |
| NSA_E_24 | 1/4 | 0 | | X | X | X | X | | | 50 | Several SWM ponds, 2 locations w/ curb cut & swale |
| NSA_E_27 | <1/4 | 70 | X | X | | X | | | | 0 | |
| NSA_E_28 | 1/4 | 30 | X | | X | X | | X | X | 0 | Junk in most yards, most have a boat |

Similar to Longs Creek, residential lot sizes are relatively large in this subwatershed as compared to more developed areas in the watershed. This presents an opportunity to encourage residents to implement bayscaping and tree canopy on their private lots for aesthetic and water quality benefits. Downspout disconnection is recommended for two out of the three neighborhoods shown with redirection and rain barrels as the most viable options for disconnection. Storm drain marking is also recommended for two of the neighborhoods listed which is a great way to engage citizens and raise awareness of water quality issues.

NSA_E_24 is a relatively new residential development with multiple stormwater management features in good condition (e.g., detention facilities). There is an opportunity to plant street trees in this neighborhood which would enhance water quality treatment capabilities and aesthetics and engage the residents (see figure below).

**Figure 4-28: Street Planting Opportunity in NSA_E_24**

Public education/outreach opportunities are available for addressing potential water quality issues noted in NSA_E_28 including outdoor boat storage, trash management, and buffer impacts.

### *Hotspots*

No hotspot investigations were included in Muddy Gut since HSIs were focused in areas where commercial development is concentrated in the watershed. Muddy Gut consists of little commercial development (less than 3 percent). There is currently one NPDES-permitted facility for general stormwater discharge within Muddy Gut. Compliance with permit requirements should be verified for this facility. Muddy Gut also includes one certified Maryland Clean Marina: West Shore Yacht Center. There is an opportunity to locally emphasize (e.g., local newspapers) the efforts of this marina to voluntarily implement pollution prevention practices while also educating citizens and marine users about water quality measures. This is also an opportunity to encourage the marina owner to continue to implement BMPs to address runoff from their facility.

### *Institutions*

Two (2) institutional sites were assessed for retrofit opportunities in Muddy Gut during the uplands assessment of Tidal Back River. This includes one public facility and one private facility. The table below summarizes recommendations for the institutional sites assessed in Muddy Gut.

**Table 4-59: ISI Recommendations – Muddy Gut**

| | | | | RECOMMENDATIONS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Site ID** | **Name** | **Type** | **Ownership** | **Storm Drain Marking** | **#Trees for Planting** | **Dwnspout Disconnection** | **Stormwater Retrofit** | **Impervious Cover Removal** | **Trash Management** | **Notes** |
| ISI_E_300 | Hyde Park VFD | Municipal | Public | | 30 | | | | | |
| ISI_E_301 | Back River Community Center | Community Center | Private | X | 100 | X | X | X | X | Dumpster lids open, pervious pavement?, YMCA and daycare center, parking lot retrofit |

Both institutions assessed in Muddy Gut have tree planting opportunities. This is a good opportunity to engage citizens while raising awareness of water quality issues and improvement methods.

Several restoration opportunities were noted for ISI_E_301 (Back River Community Center) including storm drain marking, downspout disconnection, stormwater retrofit, impervious cover removal and trash management education. Restoration activities at this site have the potential to engage and educate citizens of all ages since it is a community center and daycare center. A potential stormwater retrofit site was identified for treating runoff from one of the impervious parking lot areas before entering inlets (see figure below). This would help address the bare soil and standing water observed at the time of investigation. An opportunity for impervious cover removal was also noted. A patch of impervious cover next to an athletic court appeared to be in poor condition suggesting that it is underutilized and not maintained.

**Figure 4-29: Restoration Opportunities at ISI_E_301**

### *Pervious Areas*

Three (3) pervious areas were assessed for restoration potential in Muddy Gut: Julio Bros. propert, Daro Land Holding property and Route 702 median. A summary is provided in the table below.

**Table 4-60: PAA Recommendations – Muddy Gut**

| Site ID | Location | Description | Acres | Ownership |
|---|---|---|---|---|
| PAA_E_300 | Southeast Blvd | Vacant land | 3.60 | Private |
| PAA_E_301 | Rte 702 | Grassed median (right of way) | 0.94 | Public |
| PAA_E_302 | S. Marlyn Ave. | Vacant land | 32.50 | Private |

The Julio Bros. property is a privately-owned vacant property located off of Southeast Boulevard (Route 72). The Daro Land Holding property is a privately-owned, vacant property located off of S. Marlyn Avenue. Both properties have potential for reforestation and connecting existing forested areas. Public lands, however, are better candidates for successful pervious area restoration efforts since private lands are often planned for future development.

The median on Southeast Boulevard (Rt. 702) between Hyde Park Road and Turkey Point Road is 100 percent turf coverage and a good candidate for reforestation with minimal site preparation required. Because this site is along a Maryland state route, it may be eligible for the SHA's Partnership Planting Program. Through this program, SHA partners with local government and community organizations to beautify highways and improve the environment through projects such as streetscapes and reforestation plantings. Some organizations participate in the partnership program by helping with planting costs and/or by providing volunteers to do the work. SHA may also seek long-term support to maintain the project. Providing volunteers to help plant trees or landscape materials provided by SHA would be a good opportunity for community involvement and education. Public sites are also eligible for tree planting through DNR's "Tree-mendous Maryland" program and are good opportunities for volunteer or community projects.

### *Stream Corridor Assessments*

Field crews walked 2.91miles of stream (73% of total stream miles) within Muddy Gut to identify water quality problems and restoration opportunities. This included a survey of all wadeable and accessible portions of Muddy Gut. A total of 50 potential environmental problems were identified in Muddy Gut. The most predominant water quality issue was inadequate buffers. Several unusual conditions were also noted which mostly involved atypical discharges (ferric oxide) stream destruction as a result of all-terrain vehicles. The table below summarizes the results of the SCA survey and restoration opportunities.

**Table 4-61: Summary of Stream Conditions – Muddy Gut**

| OPPORTUNITIES (# of ENVIRONMENTAL PROBLEM SITES) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Inadequate Buffer | Trash Dumping | Channel Alteration | Erosion | Pipe Outfalls | Exposed Pipe | Fish Barrier | In/Near Stream Construction | Unusual Conditions | Totals |
| 11 | 2 | 5 | 6 | 7 | 0 | 3 | 1 | 15 | ***50*** |

| Length of Inadequate Buffer (ft) | Length of Channel Alteration (ft) | Length of Erosion (ft) | # of Truckloads for Trash Dumping Sites |
|---|---|---|---|
| 7,465 | 295 | 785 | 26 |

### *Illicit Discharges*

Muddy Gut does not contain any outfalls rated as priority 1 or priority 2. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

Potentially severe to moderate water quality issues were also identified during the stream corridor assessments due to discharging and exposed pipes. In Muddy Gut, two outfalls were rated as severe to moderately severe water quality problems.

### *Stormwater Conversions*

Muddy Gut contains one detention pond, located in a residential neighborhood off of Cape May Road. The pond is bounded by private residential properties which limits the potential for physical expansion. Therefore, this facility is not recommended for conversion to an extended detention facility. Since the condition of the existing detention pond is good, proper maintenance and inspection is the main recommendation.

### *Subwatershed Management Strategy*

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

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-58.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-58.

3. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as The Growing Home Campaign.

4. Plant street trees. Table 4-58 shows a potential for 50 street trees.

5. Educate citizens about the benefits and importance of riparian buffers, bayscaping, proper lawn care and trash management.

6. Encourage community cleanups in neighborhoods recommended for trash management in Table 4-58.

7. Educate residents in NSA_E_28 about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments.

8. Engage institutional sites listed in Table 4-59 in recommended restoration actions.

9. Investigate the pervious areas described in Table 4-60 for potential tree planting and the SHA Partnership Planting Program.

Municipal Actions

1. Encourage West Shore Yacht Center to continue to implement BMPs and maintain the Maryland Clean Marina certification.

2. Investigate potential for stormwater retrofits at the institution identified in Table 4-59.

3. Investigate stream restoration potential at sites listed in Table 4-61 and described in the *Watershed Characterization Report*.

4. Conduct follow-up site inspections of potentially severe to moderately severe discharging and exposed pipes described above and in the *Watershed Characterization Report*.

5. Explore options for wetland restoration and planting along the shoreline.

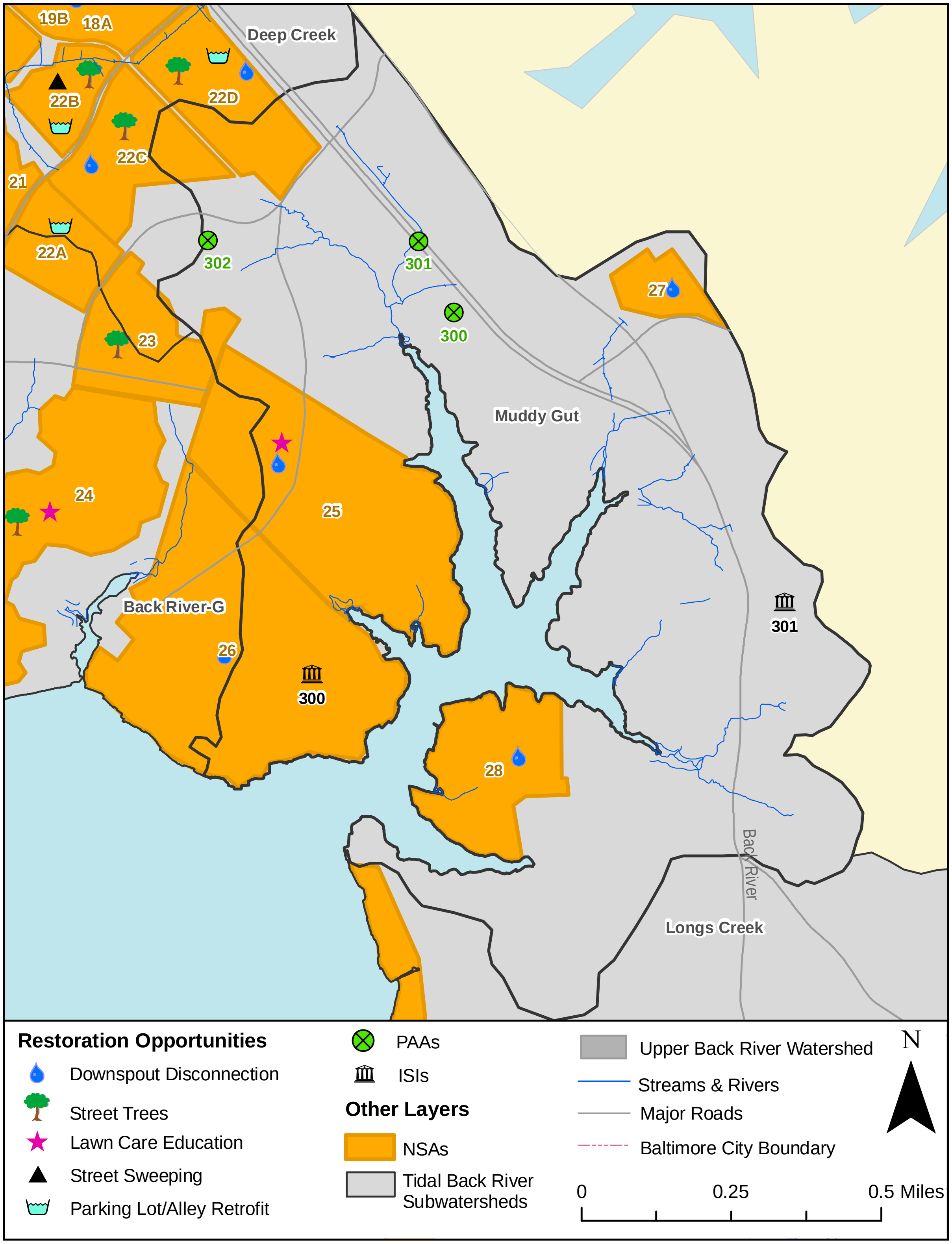


**Figure 4-30: Restoration Opportunities in Muddy Gut**

## 4.4 Tidal Basin Strategies

Some of the action strategies described in Chapter 3 and Appendix A apply to tidal areas of the watershed and were not be included under specific subwatershed management strategies. Tidal basin strategies are intended to benefit the watershed as a whole in order to be effective and help achieve restoration goals and objectives. One tidal basin strategy includes marking and maintaining navigation channels in Back River to help keep a balance between encouraging recreational boat use and submerged aquatic vegetation (SAV) growth. Mudflat restoration is another tidal basin strategy. Community cleanups of mudflat areas in the watershed have already taken place. Restoring these areas present good opportunities for wetland plantings, which provide water quality benefits and habitat. Installation of a trash boom/collector device downstream of the beltway is also a tidal basin strategy.

## 4.5 Watershed-Wide Strategies

Some of the action strategies described in Chapter 3 and Appendix A apply to the entire watershed and were not be included under 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.

***Municipal Strategies:*** One example of a municipal action is developing and implementing trash and recycling campaigns for the watershed. Trash-related water quality concerns were observed throughout the watershed and therefore, this action is recommended for all subwatersheds. This may also involve the development of a trash treaty to engage institutions, neighborhoods, and patrons of public properties throughout the watershed by raising awareness and seeking support to address the trash problem. Examples of other municipal, watershed-based actions include the installation of a trash collector device downstream of the I-695 beltway and navigation channel markers in Back River. Both of these would involve and contribute to the water quality of the entire 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 Back River and be effective at meeting water quality goals and objectives. Examples of watershed-wide citizen actions include conducting tours of completed water quality BMP and shoreline enhancement projects and encouraging safe and recreational public access through water trail tours and/or brochures.

# CHAPTER 5: PLAN EVALUATION

## 5.1 Introduction

The Tidal Back River SWAP is based on a 10-year implementation schedule (2020 endpoint). This timeframe is necessary to implement restoration measures and meet the Back River nutrient TMDL. The ability to implement this plan within the 10-year timeframe is dependent upon the availability of staff and sufficient funding. The Tidal Back River 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. If additional TMDLs are developed, such as the Chesapeake Bay TMDL anticipated in 2010, or if other water quality issues arise, the Tidal Back River SWAP Implementation Committee will initiate a revision of the plan within six months of TMDL approval or when a water quality issue arises.

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

## 5.2 Interim Measurable Milestones

Performance measures have been developed for each action listed in Appendix A and will be used to gage the progress and success of proposed restoration strategies. The progress and success of actions in Appendix A will be evaluated 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 approved by the Chesapeake Bay Program (CBP) for various nonpoint source BMPs. These pollutant removal efficiencies will continue to be used to measure progress in meeting the nutrient TMDL reduction goal (i.e., 15% reduction in total nitrogen and total phosphorus loads from urban stormwater discharges.) CBP-approved BMP removal efficiencies are summarized in the tables included as Appendix C. 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

An implementation tracking tool that accounts for all restoration activities is being developed in conjunction with the Baltimore Watershed Agreement to produce a consistent tracking system for use by Baltimore City and Baltimore County governments and local watershed organizations as part of the Upper Back River SWAP. This tracking tool will also be used by the Tidal Back River SWAP Implementation Committee to assess annual progress through a comparison between completed restoration activities and the performance measures detailed in Appendix A. The tracking tool will also provide information regarding pollutant load reductions that have been accomplished through implementation of various restoration projects.

## 5.5 Monitoring

Baltimore County currently conducts water quality monitoring programs within the Tidal Back River watershed. Additional monitoring is anticipated to assess the effectiveness of restoration projects and progress in meeting nutrient TMDL reductions.

***Existing Monitoring***

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

- County Recreational Water Sampling Program - 7 sampling locations in the tidal portion of Back River to measure levels of bacteria, suspended solids, nutrients, metals, and chloride

- County Baseflow Monitoring Program – 1 sampling location, on Bread and Cheese Creek, measure baseflows, suspended solids, nutrients, metals, and chloride

- County Biological Monitoring Program – Randomly selected locations in the Tidal Back River watershed using characteristics of benthic macroinvertebrates as a water quality indicator

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

- Tidal Benthic Community Monitoring – A tidal benthic community monitoring program is currently being assessed. Ten sampling locations throughout Tidal Back River were sample once in 2009 and additional sampling is planned for 2010. Initial samples confirm presence of an extensive midge community and further benthic sample identification continues.

***SWAP Implementation Monitoring***

SWAP implementation monitoring activities will focus on project specific monitoring and targeted subwatershed monitoring. Project specific monitoring will be indentified as restoration progresses. It will not be possible to monitor all restoration projects due to the number of actions proposed. Project specific monitoring will target activities with limited data regarding removal efficiencies such as 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. There is potential to coordinate a citizen-based stream watch program since there existing water quality monitoring stations are limited in non-tidal portions of the Tidal Back River watershed. Monitoring activities will be coordinated among SWAP participants (Baltimore County and BRRC) through participation in the Tidal Back River SWAP Implementation Committee.

# CHAPTER 6: REFERENCES

Baltimore County Department of Environmental Protection and Management (DEPRM). April 1998. *Shoreline Enhancement Feasibility Study.* Volumes 1 and 2. Prepared by Bay Land Consultants and Designers, Inc. Hanover, Maryland.

Ibison, N.A., J.C. Baumer, C.L. Hill, J.E. Frye, N.H. Burger. 1992. *Eroding Bank Nutrient Verification Study for the Lower Chesapeake Bay*. Virginia Division of Soil and Water Conservation. Gloucester Point, Virginia.

Center of Watershed Protection (CWP) and Maryland Department of the Environment (MDE). 2000. *2000 Maryland Stormwater Design Manual*. Website:

http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp

# APPENDIX A:

## Tidal Back River Action Strategies

# Tidal Back River Action Strategies

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

***Action***

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

- Restoration Actions
    - Nutrient Reduction
    - Stormwater Management
    - Urban Tree Canopy
    - Trash Management
    - Tidal Waters
    - Stream Corridor Restoration
- 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).

***Responsible Party***

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

1. Baltimore County
2. Baltimore City
3. Back River Restoration Committee (BRRC)
4. Tidal Back River SWAP Implementation Committee

Table A-1: Tidal Back River Action Strategies

| | Action | Basis for Performance Measure | Timeline | Performance Measure | Unit Cost | Respons. Party* |
|---|---|---|---|---|---|---|
| **RESTORATION ACTIONS** | | | | | | |
| | ***Nutrient Reduction*** | | | | | |
| **1** | Construct Enhanced Nutrient Removal (ENR) upgrade for the WWTP. | Improvements scheduled for completed in 2015 | 5 years | Improvements completed | $460 million / upgrade | 2 |
| **2** | Reduce fertilizer use on residential high maintenance lawns in the 15 recommended neighborhoods by implementing a lawn education program. | Conduct 5 lawn care education events targeting 3 recommended neighborhoods per event = 15 neighborhoods (83 acres of high maintenance lawn identified x 5% participation rate = 4 acres) | 5 years | 1 event per year | $300 / event | 1, 3 |
| **3** | Reduce lawns and plant bayscapes in the 21 neighborhoods identified. | Conduct 5 bayscaping education events targeting 4 neighborhoods per event (104 acres of lawn identified for bayscaping x 5% participation rate = 5 acres) | 5 years | 1 event per year | $300 / event | 1, 3 |
| **4** | Continue municipal road maintenance street sweeping activities. Investigate the 10 neighborhoods recommended for street sweeping to implement activities and/or adjust frequency as needed. | 25 miles of road identified and reported to Baltimore County DPW; Existing Operations - bulk removal rates reported | On-going | Pounds removed | Existing Operations | 1 |
| **5** | Continue to meet the requirements of consent decree for the elimination of sanitary sewer overflows. | Status report | On-going | Status Report | Existing Staff | 1, 2 |
| | ***Stormwater Management*** | | | | | |
| **6** | Investigate and convert the 2 existing dry detention ponds identified for enhanced water quality treatment. | 2 out of 4 existing detention ponds identified as having physical expansion capability x 100% projected participation = 2 conversions | 10 years | 1 conversion per 5 years | $75,000 / pond | 1 |
| **7** | Investigate the feasibility of implementing stormwater retrofits to treat runoff from impervious surfaces (parking lots, alleys) in the 10 neighborhoods identified. | 10 potential neighborhood sites identified | 2 years | Feasible retrofit sites identified | Existing Staff | 1 |
| **8** | Investigate the feasibility of implementing stormwater retrofits for parking lots and/or inlets at the 15 institutional sites identified (7 public, 8 private). | 15 potential institution sites identified | 2 years | Feasible retrofit sites identified | Existing Staff | 1 |
| **9** | Investigate the feasibility of implementing stormwater retrofits to treat runoff from impervious surfaces (parking lots) at the 7 hotspots identified (1 public, 6 private). | 7 potential hotspot sites identified | 2 years | Feasible retrofit sites identified | Existing Staff | 1 |
| **10** | Design and implement stormwater retrofits at feasible sites. | 10 neighborhoods + 15 institutions + 7 hotspots = 32 sites identified x 50% participation rate = 16 stormwater retrofits | 8 years | 2 retrofits per year | $50,000 / retrofit | 1 |
| **11** | Work with institutional partners to reduce impervious cover at the 8 institutional sites identified (6 public schools, 2 private). | Maximum potential of 1 acre of impervious cover removal identified x 50% participation rate; Work with institutions to remove impervious cover and meet 0.5 acres needed | 10 years | 1 institution per year | $25,000 / acre | 1, 3, 4 |
| **12** | Develop and implement a downspout disconnection program. Use rainbarrels, rain gardens, and/or redirection for downspout disconnection in the 35 recommended neighborhoods. | 93 acres of impervious rooftop identified x 13% participation rate = 12 acres | 10 years | Address 1.2 rooftop acres per year | $150 / house | 1, 3 |
| **13** | Inspect and maintain stormwater conversions and retrofits. | 2 conversions + 16 retrofits = 18 projects | 9 years | 2 inspections per year | Existing Staff | 1, 3, 4 |
| | ***Urban Tree Canopy*** | | | | | |
| **14** | Investigate the feasibility of planting riparian stream buffers on open pervious land. | 240 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 |
| **15** | Investigate the feasibility of planting riparian shoreline buffers on open pervious land. | 301 acres of open pervious land identified within the 100-foot shoreline buffer through GIS analysis | 2 years | Feasible buffer planting sites identified | Existing Staff | 1 |
| **16** | Reforest stream buffer at feasbile sites with a minimum width of 35 feet. | 240 acres of open pervious stream buffer identified in the GIS analysis x 65% participation rate = 156 acres (This represents about 37 miles of buffer based on 35-foot minimum width) | 10 years | Reforest 15.6 acres per year | $15,000 / acre | 1, 3, 4 |
| **17** | Reforest shoreline buffer at feasbile sites with a minimum width of 35 feet. | 301 acres of open pervious shoreline buffer identified in the GIS analysis x 60% participation rate = 181 acres (This represents about 43 miles of buffer based on 35-foot minimum width) | 10 years | Reforest 18.1 acres per year | $15,000 / acre | 1, 2, 3, 4 |

*Responsible Parties
1 – Baltimore County, 2 – Baltimore City, 3 – BRRC, 4 – SWAP Implementation Committee

Table A-1: Tidal Back River Action Strategies

| | Action | Basis for Performance Measure | Timeline | Performance Measure | Unit Cost | Respons. Party* |
|---|---|---|---|---|---|---|
| 18 | Plant trees on PAA sites, focusing efforts on sites identified as mostly open pervious cover type and requiring minimal site preparation. (This includes working with MD SHA to plant trees in suitable medians and rights-of-way.) | 70 acres of PAA sites with open pervious cover & minimal site prep required x 50% participation rate = 35 acres | 10 years | Reforest 3.5 acres per year | $6,000 / acre | 3 |
| 19 | Encourage street and shade tree planting in the 27 recommended neighborhoods. | Maximum potential of 2,125 trees x (1 acre/400 trees) = 5.3 acres x 33% participation rate = 1.75 acres (or 700 trees) | 10 years | Plant 70 trees per year | $175 / tree | 3 |
| 20 | Encourage institutions to plant trees on available open space at the 25 sites identified. | Maximum potential of 1,425 trees x (1 acre/400 trees) = 3.5 acres x 60% participation rate = 2.1 acres (or 840 trees) | 10 years | Plant 84 trees per year | $175 / tree | 1, 3, 4 |
| 21 | 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 |
| 22 | Maintain trees planted at reforestation/tree planting sites. | Tree maintenance (watering, mowing, weeding, etc.) is required for the first 5 years to ensure successful growth; projected number of acres to be reforested/planted: 156+181+35+1.75+2.1 = 376 acres (max 620 acres) | 5 years | Maintain 75.2 acres per year | $1,300 / acre | 1, 3, 4 |
| | ***Trash Management*** | | | | | |
| 23 | Install trash boom/collector device downstream of the beltway. | Trash boom installed | 1 year | Trash boom installed | $150,000 / installation | 1 |
| 24 | Maintain trash boom/collective device downstream of the beltway. | Annual maintenance | 10 years | Trash boom maintained | $50,000 / year | 1 |
| 25 | Post no dumping signs in problem areas identified and enforce no dumping. | Signs posted; Upland sites identified with trash management/dumping issues: 10 neighborhoods + 6 hotspots + 8 institutions = 24 sites | 2 years | Post 12 signs per year | $40 / sign | 1 |
| 26 | Identify areas where additional trash cans, covered receptacles, and/or better maintenance measures are needed (particularly at bus stops and the Essex Park and Ride). | Bus stops and park and ride evaluated and receptacles/maintenance improved as needed | 5 years | Problem sites identified and addressed | Existing Staff | 1 |
| 27 | Implement recycling and add separate receptacles for recycling on public properties such as parks and the Essex Park and Ride. | Add recycling receptacles at public parks and the Essex Park and Ride | 5 years | Recycling implemented at feasible sites | Existing Staff | 1 |
| | ***Tidal Waters*** | | | | | |
| 28 | Install and maintain navigation channel markers to prevent encroachment of SAV and habitat areas. | Add markers from Riverside Marina to the mouth of Back River | 10 years | Markers installed | $5,000 / year | 1 |
| 29 | Post shallow water signs on the bridge support near the mudflats. | Signs posted; 4 total | 2 years | Signs posted | $40 / sign | 1 |
| 30 | Explore options for wetland restoration and planting. | Identify feasible tidal areas (including mudflats) and plant species | 3 years | Feasible planting sites identified | Existing Staff | 1 |
| 31 | Implement wetland plantings at feasible sites. | Complete 3 wetland plantings in Tidal Back River; 0.25 acres (1,210 sq yd) per planting site x 3 sites = 0.75 acres (3,630 sq yd) | 9 years | 1 planting per 3 years | $11 / sq yd | 1, 3, 4 |
| 32 | Evaluate shoreline enhancement project potential of the six sites identified in Tidal Back River as part of DEPRM's Shoreline Feasibility Study. | 6 potential shoreline enhancement sites identified in the Shoreline Feasibility Study | 2 years | Feasible shoreline sites identified | Existing Staff | 1 |
| 33 | Implement shoreline enhancement projects at feasible sites. | Maximum potential of 8,780 feet of shoreline restoration (at 6 locations); Complete 2 shoreline enhancement projects | 10 years | 1 shoreline project per 5 years | $1,000,000 / project | 1 |
| | ***Stream Corridor Restoration*** | | | | | |
| 34 | Conduct a follow up inspection of the outfalls and exposed pipe locations rated as potentially severe or severe-moderate issues during the stream corridor assessments. | 31 outfalls and 3 exposed pipe locations rated as potentially severe or severe-moderate issues = 34 locations total | 5 years | 7 inspections per year | Existing Staff | 1 |

*Responsible Parties
1 – Baltimore County, 2 – Baltimore City, 3 – BRRC, 4 – SWAP Implementation Committee

| | Action | Basis for Performance Measure | Timeline | Performance Measure | Unit Cost | Respons. Party* |
|---|---|---|---|---|---|---|
| 35 | Evaluate the restoration potential and feasibility of restoring eroded stream banks and channel alterations identified in the stream corridor assessments. | 2,046 feet of eroded stream banks and 5,254 feet of channel alterations identified | 2 years | Feasible stream restoration sites identified | Existing Staff | 1 |
| 36 | Complete stream restoration projects at feasible sites. | Maximum restoration length of 4,589 ft x 75% participation rate = 3,442 ft; Restore at least 1,200 feet every 3 years | 9 years | Restore 1,200 feet of stream per 3 years | $350 / ln ft | 1 |
| **OUTREACH & AWARENESS** | | | | | | |
| 37 | Distribute pollution prevention information to facilities falling within hotspot categories identified in the watershed and provide guidance/workshops. Include working with business partners to cut off stream access in areas with dumping issues and encourage them to keep parking lots free of trash and debris. | 10 hotspot sites assessed; Categories identified: shopping centers, auto-related facilities, garden centers, and marinas; Conduct 2 workshops and distribute outreach material | 6 years | 1 workshop every 3 years | $300 / workshop | 1, 3, 4 |
| 38 | Locally recognize the 3 marinas that are certified Maryland Clean Marinas and encourage the remaining 2 marinas to participate in the Clean Marina Initiative. | Advertise Clean Marina Initiative and participating marinas in local newspapers | 10 years | 1 advertisement per year | Existing Staff | 1, 3, 4 |
| 39 | Form partnerships with community groups and discuss the BMP recommendations from the neighborhood assessments and implementation options. | 46 neighborhoods assessed - target at least 2 neighborhoods per informational meeting | 10 years | 2 neighborhood meetings per year | $300 / meeting | 1, 3, 4 |
| 40 | Form partnerships with institutions and discuss the BMP recommendations from the institutional assessments and implementation options. Include implementing/enhancing recycling programs on their properties. | 27 institutions assessed | 9 years | 3 institution meetings per year | Existing Staff | 1, 3, 4 |
| 41 | Work with community groups to install storm drain markers in the 35 recommended neighborhoods. | Install markers in 35 neighborhoods identified | 10 years | 4 neighborhoods per year | $11 / event (site) | 1, 3, 4 |
| 42 | Work with institutional sites to install storm drain markers at the 19 recommended sites. | Install markers in 19 institutional sites identified | 10 years | 2 institutions per year | $11 / event (site) | 1, 3, 4 |
| 43 | Develop and implement signs and educational material for the trash campaign in the watershed. | Develop signs and post throughout watershed; work on funding and cost to post a billboard (~ 3 years); post a billboard for 1 year (billboard ~$750/month x 12 months = $9,000) | 1 year | Develop material, post signs | $9,000 / year | 1, 3, 4 |
| 44 | 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, 4 |
| 45 | Develop a trash treaty for institutions, public properties and neighorhoods. | Develop trash treaties that target specific areas (e.g., neighborhoods, schools, parks, park and ride, etc.) | 3 years | Develop treaty | Existing Staff | 1, 3, 4 |
| 46 | Encourage institional partners, community groups, and patrons of public properties to sign and support a trash treaty. | Have sign-up events | 10 years | 1 sign-up event per year | Existing Staff | 1, 3, 4 |
| 47 | Encourage and support community cleanups in neighborhoods. | 10 neighborhoods identified as having trash management issues | 10 years | 1 community cleanup per year | Existing Staff | 1, 3, 4 |
| 48 | Encourage and support waterway cleanups in streams and tidal areas. | Conduct at least one waterway cleanup per year (e.g., local streams or mudflats) ; cost includes supplies and tire removal | 10 years | 1 waterway cleanup per year | $1,000 / cleanup | 1, 3, 4 |
| 49 | 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, shoreline enhancement project) | 10 years | 1 tour per 5 years | Existing Staff | 1 |
| 50 | Develop and distribute a brochure advertising and encouraging public access points to Tidal Back River. | Develop and distribute material; consider working with marinas to produce brochures & include marina locations/advertisements | 3 years | Develop material, distribute | Existing Staff | 1, 3, 4 |
| 51 | Conduct water trail tours for community groups including description of public access points, navigation channel markings, shoreline/wetland enhancement project(s), etc. | Conduct annual tours; consider distributing brochures with public access points to tour participants | 10 years | 1 tour per year | Existing Staff | 1, 3, 4 |

*Responsible Parties
1 – Baltimore County, 2 – Baltimore City, 3 – BRRC, 4 – SWAP Implementation Committee

Table A-1: Tidal Back River Action Strategies

| | Action | Basis for Performance Measure | Timeline | Performance Measure | Unit Cost | Respons. Party* |
|---|---|---|---|---|---|---|
| **MONITORING** | | | | | | |
| **52** | Continue to remove illicit connections when discovered through Illicit Connect Program | NPDES permit | On-going | Reported annually in NDPES permits | Existing Staff | 1, 2 |
| **53** | Continue the illicit connection monitoring at the major outfalls in the watershed and complete one inspection at each of the minor outfalls. | 35 major outfalls + 50 minor outfalls = 85 outfall inspections | 5 years | 17 outfalls per year | Existing Staff | 1 |
| **54** | Implement a Stream Watch program, a citizen-based program to increase the ability to monitor/identify sources of water quality and habitat degradation. | Implement a program based on number of stream miles adopted by citizen groups | 10 years | # of stream miles adopted | Existing Staff | 1, 3, 4 |
| **55** | Conduct periodic inspection of implemented BMPs and provide on-going maintence. | Assure continued function of BMPs | 10 years | Inspections completed | Existing Staff | 1, 3, 4 |
| **56** | Continue probabilistic biological monitoring program. | Biological monitoring stations in Back River are monitored in even numbered years - report produced | Even number years | Stations monitored, report produced | Existing Staff | 1 |
| **57** | Work with teachers to develop water quality monitoring activities for students at Baltimore County public schools. | 2 public schools identified as having education opportunities for BMP monitoring | 10 years | Monitoring activities implemented | Existing Staff | 1, 3, 4 |
| **58** | Continue to address/research issues related to midges through the midge subcomittee and Secchi disk monitoring. | Sampling completed in 2009 and activities proposed for 2010 | 1 year | Sampling activities completed | Existing Staff | 1, 3, 4 |
| **FUNDING** | | | | | | |
| **59** | Coordinate grant funding requests to secure funding and implement restoration projects to meet TMDL nutrient reductions requirements. | Seek a minimum of 1 grant per year to meet nutrient TMDL requirements within 10 years | 10 years | 1 grant proposal per year | Existing Staff | 1, 3, 4 |
| **60** | Increase applications for the Baltimore County - Green Building Tax Credit Program as a model. | Provide incentive for landowners to install BMPs to address water quality and habitat | 5 years | # of applications | Existing Staff | 1, 3, 4 |
| **REPORTING** | | | | | | |
| **61** | Tidal Back River 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 | 4 |
| **62** | Coordinate restoration activities between and among Baltimore County and the Back River Restoration Committee. | NPDES annual report | On-going | NPDES annual report | Existing Staff | 4 |
| **63** | Designated 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 |
| **64** | Produce a water quality monitoring report in conjunction with the Baltimore Watershed Agreement. | Report is produced bi-ennially | 10 years | Report produced every 2 years | $34,000 / 2 years | 1 |
| **65** | Develop a unified restoration tracking system to track progress toward meeting TMDL reduction requirements. | Tracking system currently being developed for similar SWAPs (e.g., Upper Back River, Jones Falls) | 2 years | Tracking system developed | Existing Staff | 4 |
| **66** | Update the status of citizen-based restoration projects and BMPs. | Provide update of progress made in annual NPDES report | 10 years | NPDES annual report | Existing Staff | 1, 3 |
| **67** | Continue to update status of County capital budget restoration projects and BMPs | Provide update of progress made in annual NPDES report | 10 years | NPDES annual report | Existing Staff | 1, 2 |

*Responsible Parties
1 – Baltimore County, 2 – Baltimore City, 3 – BRRC, 4 – SWAP Implementation Committee

Table A-1: Tidal Back River Action Strategies - Goal Objective Matrix

| Action | Goal 1 | | | | | | Goal 2 | | | | | | Goal 3 | | | Goal 4 | | | | | | | Goal 5 | | | | Goal 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 1 | 2 |
| **RESTORATION ACTIONS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ***Nutrient Reduction*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** Construct Enhanced Nutrient Removal (ENR) upgrade for the WWTP. | X | | X | X | X | X | | | | | | | | X | | | | | | | | X | | | X | | | |
| **2** Reduce fertilizer use on residential high maintenance lawns in the 15 recommended neighborhoods by implementing a lawn education program. | | X | X | X | | X | | | | | | | X | X | | | | | | | | | | | | | | |
| **3** Reduce lawns and plant bayscapes in the 21 neighborhoods identified. | | X | X | X | | X | | | | | | | X | X | | | | | | | | | | | | | | |
| **4** Continue municipal road maintenance street sweeping activities. Investigate the 10 neighborhoods recommended for street sweeping to implement activities and/or adjust frequency as needed. | | X | X | X | | X | | | | | | | | X | | | | | | | | | | | | | | |
| **5** Continue to meet the requirements of consent decree for the elimination of sanitary sewer overflows. | X | X | X | X | X | X | | | | | | | | X | | | | | | | | X | | | X | | | |
| ***Stormwater Management*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **6** Investigate and convert the 2 existing dry detention ponds identified for enhanced water quality treatment. | | X | X | X | | X | | | | | | | | X | | | | | | | | | | | | | | |
| **7** Investigate the feasibility of implementing stormwater retrofits to treat runoff from impervious surfaces (parking lots, alleys) in the 10 neighborhoods identified. | | X | X | X | | X | | | | | | | | X | | | | | | | | | | | | | | |
| **8** Investigate the feasibility of implementing stormwater retrofits for parking lots and/or inlets at the 15 institutional sites identified (7 public, 8 private). | | X | X | X | | X | | | | | | | | X | | | | | | | | | | | | | | |
| **9** Investigate the feasibility of implementing stormwater retrofits to treat runoff from impervious surfaces (parking lots) at the 7 hotspots identified (1 public, 6 private). | | X | X | X | | X | | | | | | | | X | | | | | | | | | | | | | | |
| **10** Design and implement stormwater retrofits at feasible sites. | | X | X | X | | X | | | | | | | | X | | | | | | | | | | | | | | |
| **11** Work with institutional partners to reduce impervious cover at the 8 institutional sites identified (6 public schools, 2 private). | | X | X | X | | X | | | | | | | X | X | | | | | | | | | | | | | X | X |
| **12** Develop and implement a downspout disconnection program. Use rainbarrels, rain gardens, and/or redirection for downspout disconnection in the 35 recommended neighborhoods. | | X | X | X | | X | | | | | | | X | X | | | | | | | | | | | | | | |
| **13** Inspect and maintain stormwater conversions and retrofits. | | X | X | X | | X | | | | | | | | X | | | | | | | | | | | | | | |
| ***Urban Tree Canopy*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **14** Investigate the feasibility of planting riparian stream buffers on open pervious land. | | X | X | X | | | | | | | | | X | X | | X | | | X | | | X | | | | | X | |
| **15** Investigate the feasibility of planting riparian shoreline buffers on open pervious land. | | X | X | X | | | | | | | | | X | X | | X | | | X | | | X | | | X | | X | |
| **16** Reforest stream buffer at feasbile sites with a minimum width of 35 feet. | | X | X | X | | | | | | | | | X | X | | X | | | X | | | X | | | | | X | |
| **17** Reforest shoreline buffer at feasbile sites with a minimum width of 35 feet. | | X | X | X | | | | | | | | | X | X | | X | | | X | | | X | | | X | | X | |

Table A-1: Tidal Back River Action Strategies - Goal Objective Matrix

| Action | Goal 1 | | | | | | Goal 2 | | | | | | Goal 3 | | | Goal 4 | | | | | | | Goal 5 | | | | Goal 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 1 | 2 |
| **18** Plant trees on PAA sites, focusing efforts on sites identified as mostly open pervious cover type and requiring minimal site preparation. (This includes working with MD SHA to plant trees in suitable medians and rights-of-way.) | | X | X | X | | X | | | | | | | X | X | | X | | | X | | | | | | | | X | X |
| **19** Encourage street and shade tree planting in the 27 recommended neighborhoods. | | X | X | X | | X | | | | | | | X | X | | | | | | | | | | | | | | |
| **20** Encourage institutions to plant trees on available open space at the 25 sites identified. | | X | X | X | | X | | | | | | | X | X | | | | | | | | | | | | | X | X |
| **21** Baltimore County shall continue to require riparian buffers and forest conservation for all new and re-development. | | X | X | X | | X | | | | | | | X | X | | X | | | | | | | | | | | X | |
| **22** Maintain trees planted at reforestation/tree planting sites. | | X | X | X | | X | | | | | | | X | X | | | | | | | | | | | | | X | X |
| ***Trash Management*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **23** Install trash boom/collector device downstream of the beltway. | | | | X | | | | | X | | X | | | X | | X | | | | | | X | | X | X | | X | X |
| **24** Maintain trash boom/collective device downstream of the beltway. | | | | X | | | | | X | | X | | | X | | X | | | | | | X | | X | X | | X | X |
| **25** Post no dumping signs in problem areas identified and enforce no dumping. | | | | | | | | | X | X | | | | X | | | | | | | | | | | X | | X | |
| **26** Identify areas where additional trash cans, covered receptacles, and/or better maintenance measures are needed (particularly at bus stops and the Essex Park and Ride). | | | | | | | | | X | | X | | | X | | | | | | | | | | | | | X | |
| **27** Implement recycling and add separate receptacles for recycling on public properties such as parks and the Essex Park and Ride. | | | | | | | | X | X | | | | X | X | | | | | | | | | | | | | X | |
| ***Tidal Waters*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **28** Install and maintain navigation channel markers to prevent encroachment of SAV and habitat areas. | | | | X | | | | | | | | | | X | | X | | | | X | | X | X | X | X | X | X | |
| **29** Post shallow water signs on the bridge support near the mudflats. | | | | | | | | | | | | | | X | | | | | | | X | X | | X | | X | | |
| **30** Explore options for wetland restoration and planting. | | X | X | X | | | | | | | | | X | X | | X | | | X | X | | X | | | X | | X | |
| **31** Implement wetland plantings at feasible sites. | | X | X | X | | | | | | | | | X | X | | X | | | X | X | | X | | | X | | X | |
| **32** Evaluate shoreline enhancement project potential of the six sites identified in Tidal Back River as part of DEPRM's Shoreline Feasibility Study. | | X | X | X | | | | | | | | | | X | | X | | | X | | | X | | | X | | X | |
| **33** Implement shoreline enhancement projects at feasible sites. | | X | X | X | | | | | | | | | | X | | X | | | X | | | X | | | X | | X | |
| ***Stream Corridor Restoration*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **34** Conduct a follow up inspection of the outfalls and exposed pipe locations rated as potentially severe or severe-moderate issues during the stream corridor assessments. | | X | X | X | | X | | | | | | | | X | | | X | | X | | | X | | | | | | |

Table A-1: Tidal Back River Action Strategies - Goal Objective Matrix

| Action | Goal 1 | | | | | | Goal 2 | | | | | | Goal 3 | | | Goal 4 | | | | | | | Goal 5 | | | | Goal 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 1 | 2 |
| **35** Evaluate the restoration potential and feasibility of restoring eroded stream banks and channel alterations identified in the stream corridor assessments. | | X | X | X | | | | | | | | | | X | | X | | | X | | | X | | | | | | |
| **36** Complete stream restoration projects at feasible sites. | | X | X | X | | | | | | | | | | X | | X | | | X | | | X | | | | | | |
| **OUTREACH & AWARENESS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **37** Distribute pollution prevention information to facilities falling within hotspot categories identified in the watershed and provide guidance/workshops. Include working with business partners to cut off stream access in areas with dumping issues and encourage them to keep parking lots free of trash and debris. | | X | X | X | | | | X | X | X | | | X | X | | | | | | | | | | | | | | |
| **38** Locally recognize the 3 marinas that are certified Maryland Clean Marinas and encourage the remaining 2 marinas to participate in the Clean Marina Initiative. | | X | X | X | | | | | | | | | X | X | | | | | | | | | | | X | | | |
| **39** Form partnerships with community groups and discuss the BMP recommendations from the neighborhood assessments and implementation options. | | X | X | X | | X | X | X | X | X | X | X | X | X | | | | | X | | | | | | X | | | |
| **40** Form partnerships with institutions and discuss the BMP recommendations from the institutional assessments and implementation options. Include implementing/enhancing recycling programs on their properties. | | X | X | X | | X | X | X | X | X | X | X | X | X | | | | | X | | | | | | | | X | |
| **41** Work with community groups to install storm drain markers in the 35 recommended neighborhoods. | | X | X | X | | | | | | X | | | X | X | | | | | | | | | | | | | X | |
| **42** Work with institutional sites to install storm drain markers at the 19 recommended sites. | | X | X | X | | | | | | X | | | X | X | | | | | | | | | | | | | X | |
| **43** Develop and implement signs and educational material for the trash campaign in the watershed. | | | | X | | | X | | X | X | | | X | X | | | | | | | | | | | X | | | |
| **44** Develop and implement signs and educational material for a recycling campaign in the watershed. | | | | X | | | X | X | X | X | | | X | X | | | | | | | | | | | X | | | |
| **45** Develop a trash treaty for institutions, public properties and neighorhoods. | | | | | | | X | X | X | X | | X | X | X | | | | | X | | | | | | X | | X | |
| **46** Encourage institional partners, community groups, and patrons of public properties to sign and support a trash treaty. | | | | | | | | X | X | X | | X | X | X | | | | | X | | | | | | X | | X | |
| **47** Encourage and support community cleanups in neighborhoods. | | | | X | | | X | | X | | | X | X | X | | | | | X | | | | | | | | | |
| **48** Encourage and support waterway cleanups in streams and tidal areas. | | | | X | | | | | X | | | X | X | X | | X | | | X | | | X | | | X | | X | |
| **49** Conduct a tour of a completed water quality project/BMP on public property. | | | | | | | | | | | | | X | X | | | | | | | | | | | | | | X |
| **50** Develop and distribute a brochure advertising and encouraging public access points to Tidal Back River. | | | | | | | | | | | | | X | X | | | | | | | | | X | X | X | X | | |
| **51** Conduct water trail tours for community groups including description of public access points, navigation channel markings, shoreline/wetland enhancement project(s), etc. | | | | | | | | | | | | | X | X | | | | | | | | | X | X | X | X | | X |

Table A-1: Tidal Back River Action Strategies - Goal Objective Matrix

| Action | Goal 1 | | | | | | Goal 2 | | | | | | Goal 3 | | | Goal 4 | | | | | | | Goal 5 | | | | Goal 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 1 | 2 |
| **MONITORING** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **52** Continue to remove illicit connections when discovered through Illicit Connect Program | | X | X | X | | X | | | | | | | | X | | | X | | X | | | X | | | | | | |
| **53** Continue the illicit connection monitoring at the major outfalls in the watershed and complete one inspection at each of the minor outfalls. | | X | X | X | | X | | | | | | | | X | | | X | | | | | | | | | | | |
| **54** Implement a Stream Watch program, a citizen-based program to increase the ability to monitor/identify sources of water quality and habitat degradation. | | X | X | X | | X | | | X | | | X | X | X | | | X | X | X | | | X | | | | | X | |
| **55** Conduct periodic inspection of implemented BMPs and provide on-going maintence. | | X | X | X | | X | | | | | | | | X | | | X | X | | | | | | | | | | |
| **56** Continue probabilistic biological monitoring program. | | X | X | X | | X | | | | | | | | X | | X | X | | | | | | | | | | | |
| **57** Work with teachers to develop water quality monitoring activities for students at Baltimore County public schools. | | | | | | | | | | X | | | X | X | | | X | X | | | | | | | | | | |
| **58** Continue to address/research issues related to midges through the midge subcomittee and Secchi disk monitoring. | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | |
| **FUNDING** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **59** Coordinate grant funding requests to secure funding and implement restoration projects to meet TMDL nutrient reductions requirements. | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **60** Increase applications for the Baltimore County - Green Building Tax Credit Program as a model. | | | | | | | | | | | | | X | X | X | | | | | | | | | | | | | |
| **REPORTING** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **61** Tidal Back River SWAP Implementation Committee will meet to discuss implementation progress and assess any changes needed to meet the goals. | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **62** Coordinate restoration activities between and among Baltimore County and the Back River Restoration Committee. | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **63** Designated County personnel to provide updates to the SWAP Implementation Committee on the status of the consent decree projects for sewer infrastructure repair. | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | |
| **64** Produce a water quality monitoring report in conjunction with the Baltimore Watershed Agreement. | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **65** Develop a unified restoration tracking system to track progress toward meeting TMDL reduction requirements. | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **66** Update the status of citizen-based restoration projects and BMPs. | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **67** Continue to update status of County capital budget restoration projects and BMPs | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |

# APPENDIX B:

# Cost Analysis and Potential Funding Sources

# Cost Analysis and Potential Funding Sources

This appendix presents cost estimates and potential funding sources for the implementation of proposed restoration BMPs in the Tidal Back River SWAP. Each is described below.

## Cost Analysis

The cost analysis is based on the actions detailed in Appendix A. Cost estimates are summarized in Tables B-1 and B-2. Table B-1 presents cost estimates based on the maximum implementation scenario described in Chapter 3. Table B-2 presents costs estimates based on the projected participation rates needed to achieve the 15 percent reduction in nutrient loads from urban runoff, also described in Chapter 3. For both scenarios, estimates provided are in 2009 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., Upper Back 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 and phosphorus 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 $481,027,344 for maximum implementation and $471,227,494 based on projected participation rates. Excluding WWTP upgrades, the total cost of implementation is approximately $21,027,344 for maximum implementation and $11,227,494 based on projected participation rates.

**Table B-1: Maximum Estimated Costs for Tidal Back River SWAP Implementation**

| Action | Unit Cost | | Max Quantity | | Max Total Cost | Max TN Load Reduction (lbs) | Max Cost / lb of TN Removal | Max TP Load Reduction (lbs) | Max Cost / lb of TP Removal |
|---|---|---|---|---|---|---|---|---|---|
| WWTP Upgrade | $ 460,000,000 | / upgrade | 1 | upgrade | $ 460,000,000 | NA | NA | NA | NA |
| Lawn Care Education | $ 300 | / event | 5 | events | $ 1,500 | 1,018 | $ 1 | 78 | $ 19 |
| Bayscaping Education | $ 300 | / event | 5 | events | $ 1,500 | 1,279 | $ 1 | 98 | $ 15 |
| SWM Conversions | $ 75,000 | / pond | 2 | ponds | $ 150,000 | 132 | $ 1,133 | 6 | $ 27,090 |
| SW Retrofits | $ 50,000 | / retrofit | 32 | retrofits | $ 1,600,000 | 895 | $ 1,788 | 201 | $ 7,970 |
| Impervious Cover Removal | $ 25,000 | / acre | 1 | acre | $ 25,000 | 68 | $ 365 | 18 | $ 1,365 |
| Downspout Disconnection Program | $ 150 | / house | 4,958 | houses | $ 743,700 | 6,571 | $ 113 | 1,474 | $ 504 |
| Reforest Stream Buffer | $ 15,000 | / acre | 240 | acres | $ 3,600,000 | 30,418 | $ 118 | 2,487 | $ 1,448 |
| Reforest Shoreline Buffer | $ 15,000 | / acre | 301 | acres | $ 4,515,000 | 17,949 | $ 252 | 1,231 | $ 3,669 |
| Pervious Area Reforestation | $ 6,000 | / acre | 70 | acres | $ 420,000 | 4,154 | $ 101 | 285 | $ 1,475 |
| Neighborhood Tree Planting | $ 175 | / tree | 2,125 | trees | $ 371,875 | 317 | $ 1,174 | 22 | $ 17,115 |
| Institutional Tree Planting | $ 175 | / tree | 1,425 | trees | $ 249,375 | 213 | $ 1,174 | 15 | $ 17,115 |
| Tree Maintenance | $ 1,300 | / acre | 620 | acres | $ 806,000 | NA | NA | NA | NA |
| Trash Boom | $ 150,000 | / boom | 1 | boom | $ 150,000 | NA | NA | NA | NA |
| Trash Boom Maintenance | $ 50,000 | / year | 10 | years | $ 500,000 | NA | NA | NA | NA |
| No Dumping Signs | $ 40 | / sign | 24 | signs | $ 960 | NA | NA | NA | NA |
| Navigation Channel Markers | $ 5,000 | / year | 10 | years | $ 50,000 | NA | NA | NA | NA |
| Shallow Water Signs | $ 40 | / sign | 4 | signs | $ 160 | NA | NA | NA | NA |
| Wetland Plantings | $ 11 | / sq yd | 3,630 | sq yards | $ 39,930 | NA | NA | NA | NA |
| Shoreline Enhancement Projects | $ 1,000,000 | / project | 6 | projects | $ 6,000,000 | NA | NA | NA | NA |
| Stream Restoration | $ 350 | / ln ft | 4,589 | ln ft | $ 1,606,150 | 45,894 | $ 35 | 2,431 | $ 661 |
| Pollution Prevention Workshops | $ 300 | / workshop | 2 | workshops | $ 600 | NA | NA | NA | NA |
| Neighborhood BMP Meetings | $ 300 | / meeting | 20 | meetings | $ 6,000 | NA | NA | NA | NA |
| Storm Drain Markers | $ 11 | / site | 54 | sites | $ 594 | NA | NA | NA | NA |
| Trash Campaign Billboard | $ 9,000 | / year | 1 | year | $ 9,000 | NA | NA | NA | NA |
| Waterway Cleanups | $ 1,000 | / cleanup | 10 | cleanups | $ 10,000 | NA | NA | NA | NA |
| Water Quality Monitoring Report | $ 34,000 | / report | 5 | reports | $ 170,000 | NA | NA | NA | NA |
| | | | | ***Total:*** | ***$ 481,027,344*** | | | | |
| | *Total (not including WWTP Upgrade):* | | | | *$ 21,027,344* | | | | |

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

**Table B-2: Projected Estimated Costs for Tidal Back River SWAP Implementation**

| Action | Unit Cost | | Proj. Quantity | | Proj. Total Cost | Proj. TN Load Reduction (lbs) | Proj. Cost / lb of TN Removal | Proj. TP Load Reduction (lbs) | Proj. Cost / lb of TP Removal |
|---|---|---|---|---|---|---|---|---|---|
| WWTP Upgrade | $ 460,000,000 | / upgrade | 1 | upgrade | $ 460,000,000 | NA | NA | NA | NA |
| Lawn Care Education | $ 300 | / event | 5 | events | $ 1,500 | 38 | $ 39 | 3 | $ 510 |
| Bayscaping Education | $ 300 | / event | 5 | events | $ 1,500 | 48 | $ 31 | 4 | $ 405 |
| SWM Conversions | $ 75,000 | / pond | 2 | ponds | $ 150,000 | 132 | $ 1,133 | 6 | $ 27,090 |
| SW Retrofits | $ 50,000 | / retrofit | 16 | retrofits | $ 800,000 | 447 | $ 1,788 | 100 | $ 7,970 |
| Impervious Cover Removal | $ 25,000 | / acre | 1 | acres | $ 12,500 | 34 | $ 365 | 9 | $ 1,365 |
| Downspout Disconnection Program | $ 150 | / house | 645 | houses | $ 96,750 | 2,168 | $ 45 | 487 | $ 199 |
| Reforest Stream Buffer | $ 15,000 | / acre | 156 | acres | $ 2,340,000 | 19,772 | $ 118 | 1,616 | $ 1,448 |
| Reforest Shoreline Buffer | $ 15,000 | / acre | 181 | acres | $ 2,715,000 | 10,769 | $ 252 | 738 | $ 3,677 |
| Pervious Area Reforestation | $ 6,000 | / acre | 35 | acres | $ 210,000 | 2,077 | $ 101 | 142 | $ 1,475 |
| Neighborhood Tree Planting | $ 175 | / tree | 700 | trees | $ 122,500 | 105 | $ 1,171 | 7 | $ 17,084 |
| Institutional Tree Planting | $ 175 | / tree | 840 | trees | $ 147,000 | 128 | $ 1,153 | 9 | $ 16,815 |
| Tree Maintenance | $ 1,300 | / acre | 376 | acres | $ 488,800 | NA | NA | NA | NA |
| Trash Boom | $ 150,000 | / boom | 1 | boom | $ 150,000 | NA | NA | NA | NA |
| Trash Boom Maintenance | $ 50,000 | / year | 10 | years | $ 500,000 | NA | NA | NA | NA |
| No Dumping Signs | $ 40 | / sign | 24 | signs | $ 960 | NA | NA | NA | NA |
| Navigation Channel Markers | $ 5,000 | / year | 10 | years | $ 50,000 | NA | NA | NA | NA |
| Shallow Water Signs | $ 40 | / sign | 4 | signs | $ 160 | NA | NA | NA | NA |
| Wetland Plantings | $ 11 | / sq yd | 3,630 | plantings | $ 39,930 | NA | NA | NA | NA |
| Shoreline Enhancement Projects | $ 1,000,000 | / project | 2 | projects | $ 2,000,000 | NA | NA | NA | NA |
| Stream Restoration | $ 350 | / ln ft | 3,442 | ln ft | $ 1,204,700 | 34,421 | $ 35 | 1,823 | $ 661 |
| Pollution Prevention Workshops | $ 300 | / workshop | 2 | workshops | $ 600 | NA | NA | NA | NA |
| Neighborhood BMP Meetings | $ 300 | / meeting | 20 | meetings | $ 6,000 | NA | NA | NA | NA |
| Storm Drain Markers | $ 11 | / site | 54 | sites | $ 594 | NA | NA | NA | NA |
| Trash Campaign Billboard | $ 9,000 | / year | 1 | months | $ 9,000 | NA | NA | NA | NA |
| Waterway Cleanups | $ 1,000 | / cleanup | 10 | cleanups | $ 10,000 | NA | NA | NA | NA |
| Water Quality Monitoring Report | $ 34,000 | / report | 5 | reports | $ 170,000 | NA | NA | NA | NA |
| | | | | ***Total:*** | ***$ 471,227,494*** | | | | |
| | *Total (not including WWTP Upgrade):* | | | | *$ 11,227,494* | | | | |

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

## Potential Funding Sources

Funding sources for the implementation of the Tidal Back River SWAP include local government funding for Baltimore County, monetary and time contributions to the Back River Restoration 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 Back River watershed as a whole currently has $2.95 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 B-2, additional funding from grants will be required. Table B-2 presents potential funding sources to support the implementation of the Tidal Back River 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 2010 Trust Fund (2010 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 2010 Trust Fund, with multiple State agencies receiving moneys from the 2010 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 million 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), the U.S. Department of Agriculture Forest Service (USFS), and the National Oceanic and Atmospheric Administration (NOAA).
- ***MD State Highway Administration (SHA) Transportation Enhancement Program (TEP)*:** This is a reimbursable, federal-aid funding program for transportation-related community projects designed to strengthen the intermodal transportation system. The TEP supports communities in developing projects that improve the quality of life for their citizens and enhance the travel experience for people traveling by all modes. Among the qualifying TEP categories is environmental mitigation to address water pollution due to highway runoff or to reduce vehicle-caused wildlife mortality while maintaining habitat connectivity.
- ***Chesapeake Bay Trust:*** Provides grants through a variety of grant programs that focus on environmental education, urban greening, fisheries, and remediation of water quality issues. Specifically the Targeted Watershed Grant Program provides funding for on-the-ground solutions that address the most pressing nonpoint source pollution challenges facing a small watershed, and that result in measurable improvements in water quality and wildlife habitat. The program also seeks to support cost effective approaches to Chesapeake Bay restoration actions at the small watershed scale and establish replicable model of restoration that can be transferred and used throughout the region.

**Table B-3: Tidal Back River 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<br>Local Government<br>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<br><br>YES | 6 months (?) |
| Chesapeake Bay Trust | Targeted Watershed Initiative Grant Program | Non-profits 501(c)<br>Institutions<br>Soil/Water Conservation Districts<br>Local Government | Involve local organizations; Address non-point source pollution; Projects related to water quality and habitat restoration | $50 to $200,000 | 0%<br><br>YES | 1-2 years |
| Chesapeake Bay Trust | Capacity Building Initiative Grant Program | Non-profits 501(c) with a board on which half the members participate meaningfully and at least one paid staff (or a part-time paid staff and volunteer) | Strengthen an organization through management operations, technology, governance, fundraising, and communications | $15,000 per year | 0%<br><br>YES | 3 years |
| Chesapeake Bay Trust | Stewardship Grant Program | Non-profits 501(c)<br>Schools/Universities<br>Soil/Water Conservation Districts<br>Local Government<br>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%<br><br>YES | 1 Year |
| DNR | Clean Water Action Plan Nonpoint Source Program 319 Grant | Non-profits 501(c)<br>Universities<br>Soil/Water Conservation Districts<br>Local Government<br>State Government | Located in a Category I and Category III watershed as outlined in the MD unified watershed assessment; Establish cover crops; Address Stream restoration and riparian buffers | $5,000 to $40,000 | 40% | Annual |
| MDE | Bay Restoration Fund | Local Governments | Green Restoration Project | None specified | 50%<br><br>YES | None specified |

**Table B-3 (con't): Tidal Back River SWAP Potential Funding Sources**

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

# APPENDIX C:

## Chesapeake Bay Program Pollutant Load Reduction Efficiencies

# Table 1: Nonpoint Source Best Management Practices that have been Peer-Reviewed and CBP-Approved for Phase 5.0 of the Chesapeake Bay Program Watershed Model Revised 1/18/06

| Agricultural BMPs | How Credited | TN Reduction Efficiency | TP Reduction Efficiency | SED Reduction Efficiency |
|---|---|---|---|---|
| Riparian Forest Buffers and Wetland Restoration - Agriculture[1]: | Landuse conversion + efficiency | Efficiency applied to 4 upland acres | Efficiency applied to 2 upland acres | Efficiency applied to 2 upland acres |
| Coastal Plain Lowlands | Efficiency | 25% | 75% | 75% |
| Coastal Plain Dissected Uplands | Efficiency | 40% | 75% | 75% |
| Coastal Plain Uplands | Efficiency | 83% | 69% | 69% |
| Piedmont Crystalline | Efficiency | 60% | 60% | 60% |
| Blue Ridge | Efficiency | 45% | 50% | 50% |
| Mesozoic Lowlands | Efficiency | 70% | 70% | 70% |
| Piedmont Carbonate | Efficiency | 45% | 50% | 50% |
| Valley and Ridge Carbonate | Efficiency | 45% | 50% | 50% |
| Valley and Ridge Siliciclastic | Efficiency | 55% | 65% | 65% |
| Appalachian Plateau Siliciclastic | Efficiency | 60% | 60% | 60% |
| Riparian Grass Buffers - Agriculture: | Landuse conversion + efficiency | Efficiency applied to 4 upland acres | Efficiency applied to 2 upland acres | Efficiency applied to 2 upland acres |
| Coastal Plain Lowlands | Efficiency | 17% | 75% | 75% |
| Coastal Plain Dissected Uplands | Efficiency | 27% | 75% | 75% |
| Coastal Plain Uplands | Efficiency | 57% | 69% | 69% |
| Piedmont Crystalline | Efficiency | 41% | 60% | 60% |
| Blue Ridge | Efficiency | 31% | 50% | 50% |
| Mesozoic Lowlands | Efficiency | 48% | 70% | 70% |
| Piedmont Carbonate | Efficiency | 31% | 50% | 50% |
| Valley and Ridge Carbonate | Efficiency | 31% | 50% | 50% |
| Valley and Ridge Siliciclastic | Efficiency | 37% | 65% | 65% |
| Appalachian Plateau Siliciclastic | Efficiency | 41% | 60% | 60% |

[1] These peer-reviewed BMP efficiencies and/or landuse conversions will be refined with more recent data for use in Phase 5.0 of the Chesapeake Bay Program Watershed Model based on results of the EPA CBPO FY2006 BMP Literature Synthesis project. Estimated Completion Date: TBD.

| *Agricultural BMPs (continued)* | *How Credited* | *TN Reduction Efficiency* | *TP Reduction Efficiency* | *SED Reduction Efficiency* |
|---|---|---|---|---|
| Conservation Plans - Agriculture[1] (Solely structural practices such as installation of grass waterways in areas with concentrated flow, terraces, diversions, drop structures, etc.): | Efficiency | | | |
| Conservation Plans on Conventional-Till | Efficiency | 8% | 15% | 25% |
| Conservation Plans on Conservation-Till and Hay | Efficiency | 3% | 5% | 8% |
| Conservation Plans on Pasture | Efficiency | 5% | 10% | 14% |
| Cover Crops[1]: | Efficiency | | | |
| Cereal Cover Crops on Conventional-Till: | Efficiency | | | |
| Early-Planting - Up to 7 days prior to published first frost date | Efficiency | 45% | 15% | 20% |
| Late-Planting - Up to 7 after published first frost date | Efficiency | 30% | 7% | 10% |
| Cereal Cover Crops on Conservation-Till: | Efficiency | | | |
| Early-Planting - Up to 7 days prior to published first frost date | Efficiency | 45% | 0% | 0% |
| Late-Planting - Up to 7 after published first frost date | Efficiency | 30% | 0% | 0% |
| Commodity Cereal Cover Crops / Small Grain Enhancement on Conventional-Till: | Efficiency | | | |
| Early-Planting - Up to 7 days prior to published first frost date | Efficiency | 25% | 0% | 0% |
| Late-Planting - Up to 7 after published first frost date | Efficiency | 17% | 0% | 0% |
| Commodity Cereal Cover Crops / Small Grain Enhancement on Conservation-Till: | Efficiency | | | |
| Early-Planting - Up to 7 days prior to published first frost date | Efficiency | 25% | 0% | 0% |
| Late-Planting - Up to 7 after prior to published first frost date | Efficiency | 17% | 0% | 0% |
| Off-stream Watering with Stream Fencing (Pasture)[2] | Efficiency | 60% | 60% | 75% |
| Off-stream Watering with Stream Fencing and Rotational Grazing (Pasture) [3] | Efficiency | 20% | 20% | 40% |

[1] These peer-reviewed BMP efficiencies and/or landuse conversions will be refined with more recent data for use in Phase 5.0 of the Chesapeake Bay Program Watershed Model based on results of the EPA CBPO FY2006 BMP Literature Synthesis project. Estimated Completion Date: TBD.
[2] Will be credited as a landuse conversion in the final Phase 5.0 of the Watershed Model.
[3] Will be credited as a landuse conversion and efficiency in the final Phase 5.0 of the Watershed Model.

| *Agricultural BMPs (continued)* | *How Credited* | *TN Reduction Efficiency* | *TP Reduction Efficiency* | *SED Reduction Efficiency* |
|---|---|---|---|---|
| Off-stream Watering without Fencing (Pasture) | Efficiency | 30% | 30% | 38% |
| Animal Waste Management Systems - Applied to model manure acre where 1 manure acre = runoff from 145 animal units:[2] | Reduction in manure acres | | | |
| Livestock Systems[2] | Reduction in manure acres | 100% | 100% | N/A |
| Poultry Systems[2] | Reduction in manure acres | 100% | 100% | N/A |
| Barnyard Runoff Control / Loafing Lot Management[2] | Reduction in manure acres | 100% | 100% | N/A |
| Conservation-Tillage[1] | Landuse conversion | N/A | N/A | N/A |
| Land Retirement - Agriculture | Landuse conversion | N/A | N/A | N/A |
| Tree Planting - Agriculture | Landuse conversion | N/A | N/A | N/A |
| Carbon Sequestration / Alternative Crops | Landuse conversion | N/A | N/A | N/A |
| Nutrient Management Plan Implementation - Agriculture | Landuse conversion | 135% of modeled crop uptake | 135% of modeled crop uptake | N/A |
| Enhanced Nutrient Management Plan Implementation – Agriculture[1] | Landuse conversion + Built into simulation | 115% of modeled crop uptake | 115% of modeled crop uptake | N/A |
| Alternative Uses of Manure / Manure Transport | Built into preprocessing | Reduction in nutrient mass applied to cropland | Reduction in nutrient mass applied to cropland | N/A |
| Poultry Phytase | Built into preprocessing | N/A | Reduction in nutrient mass applied to cropland | N/A |

[1] These peer-reviewed BMP efficiencies and/or landuse conversions will be refined with more recent data for use in Phase 5.0 of the Chesapeake Bay Program Watershed Model based on results of the EPA CBPO FY2006 BMP Literature Synthesis project. Estimated Completion Date: TBD.

[2] Will be credited as a landuse conversion in the final Phase 5.0 of the Watershed Model.

| *Agricultural BMPs (continued)* | *How Credited* | *TN Reduction Efficiency* | *TP Reduction Efficiency* | *SED Reduction Efficiency* |
|---|---|---|---|---|
| Dairy Precision Feeding / and Forage Management[1] | Built into preprocessing | Reduction in nutrient mass applied to cropland | Reduction in nutrient mass applied to cropland | N/A |
| Swine Phytase | Built into preprocessing | N/A | Reduction in nutrient mass applied to cropland | N/A |
| Continuous No-Till: | | | | |
| Below Fall Line | Efficiency | 10% | 20% | 70% |
| Above Fall Line | Efficiency | 15% | 40% | 70% |
| Water Control Structures | Efficiency | 33% | N/A | N/A |
| *Urban and Mixed Open BMPs* | | | | |
| Stormwater Management:: | Efficiency | | | |
| Wet Ponds and Wetlands[1] | Efficiency | 30% | 50% | 80% |
| Dry Detention Ponds and Hydrodynamic Structures[1] | Efficiency | 5% | 10% | 10% |
| Dry Extended Detention Ponds[1] | Efficiency | 30% | 20% | 60% |
| Infiltration Practices | Efficiency | 50% | 70% | 90% |
| Filtering Practices | Efficiency | 40% | 60% | 85% |
| Erosion and Sediment Control[1] | Efficiency | 33% | 50% | 50% |

[1] These peer-reviewed BMP efficiencies and/or landuse conversions will be refined with more recent data for use in Phase 5.0 of the Chesapeake Bay Program Watershed Model based on results of the EPA CBPO FY2006 BMP Literature Synthesis project. Estimated Completion Date: TBD.

| *Urban and Mixed Open BMPs (continued)* | *How Credited* | *TN Reduction Efficiency* | *TP Reduction Efficiency* | *SED Reduction Efficiency* |
|---|---|---|---|---|
| Nutrient Management (Urban) | Efficiency | 17% | 22% | N/A |
| Nutrient Management (Mixed Open) | Efficiency | 17% | 22% | N/A |
| Abandoned Mine Reclamation[2] | Landuse change converted to efficiency | Varies by model segment | Varies by model segment | Varies by model segment |
| Riparian Forest Buffers – Urban and Mixed Open | Landuse conversion + efficiency | 25% | 50% | 50% |
| Wetland Restoration – Urban and Mixed Open | Landuse conversion | N/A | N/A | N/A |
| Stream Restoration – Urban and Mixed Open[1] | Load reduction converted to efficiency | 0.02 lbs/ft | 0.0035 lbs/ft | 2.55 lbs/ft |
| Impervious Surface and Urban Growth Reduction / Forest Conservation | Landuse conversion | N/A | N/A | N/A |
| Tree Planting – Urban and Mixed Open | Landuse conversion | N/A | N/A | N/A |
| *Resource and Septic BMPs* | | | | |
| Forest Harvesting Practices[1] | Efficiency | 50% | 50% | 50% |
| Septic Denitrification | Efficiency | 50% | N/A | N/A |
| Septic Pumping | Efficiency | 5% | N/A | N/A |
| Septic Connections / Hook-ups | Built into pre-Processing | N/A | N/A | N/A |

[1] These peer-reviewed BMP efficiencies and/or landuse conversions will be refined with more recent data for use in Phase 5.0 of the Chesapeake Bay Program Watershed Model based on results of the EPA CBPO FY2006 BMP Literature Synthesis project. Estimated Completion Date: TBD.

[2] Will be credited as a landuse conversion in the final Phase 5.0 of the Watershed Model.

***Table 2: Nonpoint Source Best Management Practices Requiring Additional Peer-Review for Phase 5.0 of the Chesapeake Bay Watershed Model Revised 1/12/06***

(Note: Credit and Efficiencies are listed in parenthesis since they have not received formal peer review)

| ***Agricultural BMPs Requiring Peer Review*** | ***How Credited*** | ***TN Reduction Efficiency*** | ***TP Reduction Efficiency*** | ***SED Reduction Efficiency*** | ***CBP Lead<br>Status<br>Estimated Completion Date*** |
|---|---|---|---|---|---|
| Precision Agriculture | (Built into simulation) | N/A | N/A | N/A | Tributary Strategy Workgroup<br>EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency for Phase 5.0<br>Completion Date: TBD<br><br>Delaware Maryland Agribusiness Association plans to work with CBPO to provide tracking data for this BMP. |
| Manure Additives | TBD | TBD | TBD | TBD | Agriculture Nutrient Reduction Workgroup<br>TBD<br>TBD |
| Ammonia Emission Reductions | (Built into preprocessing) | (Reduction in ammonia deposition) | N/A | N/A | Tributary Strategy Workgroup<br>EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency<br>Completion Date: TBD |
| Precision Grazing | Efficiency | (25%) | (25%) | (25%) | Agriculture Nutrient Reduction Workgroup<br>Tributary Strategy Workgroup EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency<br>Completion Date: TBD |
| Mortality Composters | Efficiency | (14%) | (14%) | N/A | Tributary Strategy Workgroup<br>EPA CBPO 2006/2007 project will determine efficiency<br>June 2008 |
| Horse Pasture Management | Efficiency | (20%) | (20%) | (40%) | Tributary Strategy Workgroup<br>EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency<br>Completion Date: TBD |

| ***Agricultural BMPs Requiring Peer Review (continued)*** | ***How Credited*** | ***TN Reduction Efficiency*** | ***TP Reduction Efficiency*** | ***SED Reduction Efficiency*** | ***CBP Lead Status Estimated Completion Date*** |
|---|---|---|---|---|---|
| Non-Urban Stream Restoration | Load reduction converted to efficiency | | | | |
| Non-Urban Stream Restoration on Conventional-Till and Pasture | Load reduction converted to efficiency | (0.026 lbs/ft) | (0.0046 lbs/ft) | (3.32 lbs/ft) | Tributary Strategy Workgroup<br>EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency<br>Completion Date: TBD |
| Non-Urban Stream Restoration on Conservation-Till, Hay | Load reduction converted to efficiency | (0.02 lbs/ft) | (0.0035 lbs/ft) | (2.55 lbs/ft) | Tributary Strategy Workgroup<br>EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency<br>Completion Date: TBD |
| ***Urban and Mixed Open BMPs Requiring Peer Review*** | | | | | |
| Non-Urban Stream Restoration on Mixed Open | Load reduction converted to efficiency | (0.02 lbs/ft) | (0.0035 lbs/ft) | (2.55 lbs/ft) | Tributary Strategy Workgroup<br>EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency<br>Completion Date: TBD |
| Dirt & Gravel Road Erosion & Sediment Control on Mixed Open | Load reduction converted to efficiency | (0.02 lbs/ft) | (0.0035 lbs/ft) | (2.55 lbs/ft) | Tributary Strategy Workgroup<br>EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency<br>Completion Date: TBD |
| Roadway Systems | TBD | TBD | TBD | TBD | Urban Stormwater Workgroup (USWG)<br>USWG will meet with Departments of Transportation to identify roadway BMPs and efficiencies<br>TBD |
| Urban Street Sweeping and Catch Basin Inserts | Efficiency | (10%) | (10%) | (10%) | Urban Stormwater Workgroup<br>EPA CBPO street sweeping project will provide efficiency recommendations for the Urban Stormwater Workgroup review in Fall 2007 |

| ***Urban and Mixed Open BMPs Requiring Peer Review (continued)*** | ***How Credited*** | ***TN Reduction Efficiency*** | ***TP Reduction Efficiency*** | ***SED Reduction Efficiency*** | ***CBP Lead<br>Status<br>Estimated Completion Date*** |
|---|---|---|---|---|---|
| Riparian Grass Buffers – Urban and Mixed Open | TBD | TBD | TBD | TBD | TBD |
| ***Resource BMPs Requiring Peer Review*** | | | | | |
| Non-Urban Stream Restoration on Forest | Load reduction converted to efficiency | (0.02 lbs/ft) | (0.0035 lbs/ft) | (2.55 lbs/ft) | Tributary Strategy Workgroup<br>EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency<br>Completion Date: TBD |
| Dirt & Gravel Road Erosion & Sediment Control on Forest | Load reduction converted to efficiency | (0.02 lbs/ft) | (0.0035 lbs/ft) | (2.55 lbs/ft) | Tributary Strategy Workgroup<br>EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency<br>Completion Date: TBD |
| Voluntary Air Emission Controls within Jurisdictions (Utility, Industrial, and Mobile) | Built into preprocessing | (Reduction in nitrogen species deposition) | N/A | N/A | Nutrient Subcommittee<br>TBD<br>TBD |

| ***Table 3: Nonpoint Source Best Management Practices that have been Peer Reviewed and CBP Approved for the Chesapeake Bay Water Quality Model Revised 1/12/06*** | | | | |
|---|---|---|---|---|
| ***Shoreline BMPs*** | ***How Credited*** | ***TN Reduction Efficiency*** | ***TP Reduction Efficiency*** | ***SED Reduction Efficiency*** |
| Structural Tidal Shoreline Erosion Control | Water Quality Model | N/A | N/A | N/A |
| Non-Structural Tidal Shoreline Erosion Control | Water Quality Model | N/A | N/A | N/A |

| ***Table 4: Nonpoint Source Best Management Practices Requiring Additional Peer Review for the Chesapeake Bay Water Quality Model Revised 1/12/06*** | | | | | |
|---|---|---|---|---|---|
| ***Resource BMPs*** | ***How Credited*** | ***TN Reduction Efficiency*** | ***TP Reduction Efficiency*** | ***SED Reduction Efficiency*** | ***CBP Lead<br>Status<br>Estimated Completion Date*** |
| Coastal Floodplain Flooding | TBD | TBD | TBD | TBD | Sediment Workgroup<br>TBD<br>TBD |
| SAV Planting and Preservation | Water Quality Model | TBD | TBD | TBD | Living Resources Subcommittee<br>TBD<br>TBD |
| Oyster Reef Restoration and Shellfish Aquaculture | Water Quality Model | TBD | TBD | TBD | TBD<br>TBD<br>TBD |
| Structural Shoreline Erosion Controls: | | | | | Sediment Workgroup<br>TBD<br>TBD |
| Shoreline hardening | Water Quality Model | TBD | TBD | TBD | Sediment Workgroup<br>TBD<br>TBD |

| ***Resource BMPs (continued)*** | ***How Credited*** | ***TN Reduction Efficiency*** | ***TP Reduction Efficiency*** | ***SED Reduction Efficiency*** | ***CBP Lead<br>Status<br>Estimated Completion Date*** |
|---|---|---|---|---|---|
| Off-shore breakwater | Water Quality Model | TBD | TBD | TBD | Sediment Workgroup<br>TBD<br>TBD |
| Headland control | Water Quality Model | TBD | TBD | TBD | Sediment Workgroup<br>TBD<br>TBD |
| Breakwater systems | Water Quality Model | TBD | TBD | TBD | Sediment Workgroup<br>TBD<br>TBD |