# Bear Creek/Old Road Bay
# *Small Watershed Action Plan*

## *Volume I*

*Prepared for:*

*Department of Environmental Protection and Sustainability*

*Submitted by: Parsons Brinckerhoff*

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PARSONS BRINCKERHOFF

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# ACKNOWLEDGEMENTS


## BEAR CREEK/OLD ROAD BAY STEERING COMMITTEE

| *Organization* | *Representative* |
|---|---|
| Anchor Bay East Marina | Art Cox |
| Dundalk Community College | Bill Delauder |
| Dundalk Renaissance Corporation | Leah Bunck, David Fielder, Amy Menzer |
| Eastfield/Stanbrook Community | Karen Cruz, Patricia Paul |
| EcoLogix Group | Candy Croswell, Fran Flanigan |
| Jones Creek/Harbor Team | Fran Taylor |
| Patapsco/Back River Tributary Team | Stuart Stainman |
| Private Citizen | Russell Donnelly |
| Turners Station | Larry Bannerman, Edie Brooks |
| State of Maryland Environmental Service | Fred Curtis |
| State of Maryland Port Administration | Bill Richardson |
| Baltimore County Planning | John Alexander, Terri Kingeter |
| Baltimore County Recreation and Parks | Neil Magness, Bob Smith |
| Baltimore County Department of Environmental Protection and Sustainability (EPS) | Betty Kelley, Dave Riter, Steve Stewart, Erin Wisnieski |
| Parsons Brinckerhoff | Everett Gupton, Kelly Lennon |

## TECHNICAL ASSISTANCE/REPORTS

| *Technical Report* | *Representative* |
|---|---|
| Upland Surveys (Neighborhood Source Assessments, Hotspot Assessments, Pervious Area Assessments, and Institutional Site Assessments) and Stormwater Facility Assessment | Nathan Forand, Steve Stewart, Erin Wisnieski - EPS<br>Parsons Brinckerhoff, Inc. in association with NMP Engineering Consultants, Inc. |
| Watershed Characterization | Parsons Brinckerhoff, Inc. |

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# CHAPTER 1: INTRODUCTION

## 1.1 Purpose

This Small Watershed Action Plan (SWAP) is a strategy for the restoration of the Bear Creek/Old Road Bay watershed. This report presents recommendations for watershed restoration, describes management strategies for each of the 14 subwatersheds comprising Bear Creek/Old Road Bay, and identifies priority projects for implementation. A schedule for implementation through 2025 is presented in addition to planning level cost estimates where feasible. Financial and technical partners for plan implementation are suggested for the various recommendations. This SWAP is intended to assist the Baltimore County Department of Environmental Protection and Sustainability (EPS) and other partners to keep moving forward with restoration of Bear Creek/Old Road Bay. Figure 1-1 provides a graphic representation of the planning area covered in this SWAP.

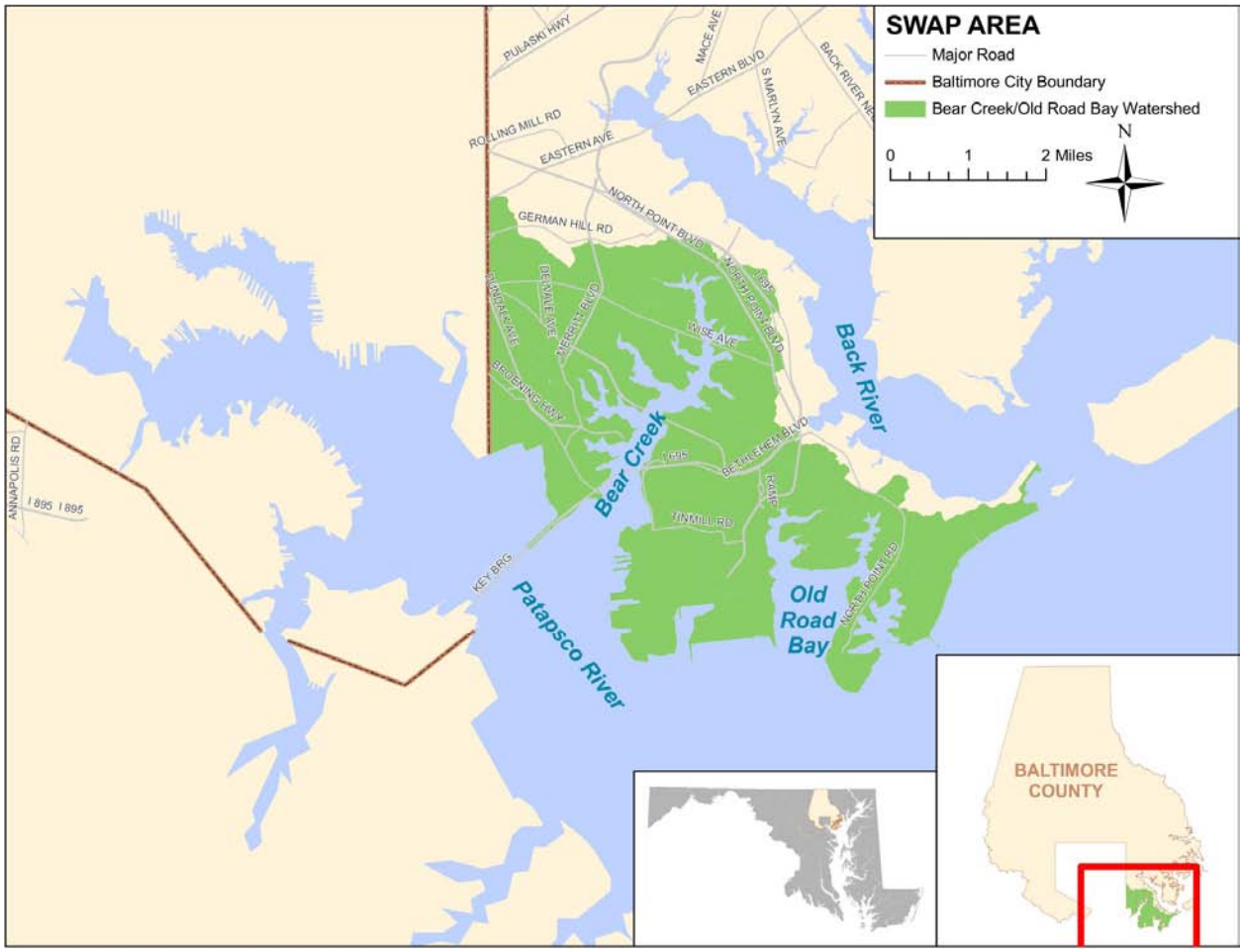


Figure 1-1: Location of Bear Creek/Old Road Bay Watershed

## 1.2 Background

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

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

| | | |
|---|---|---|
| Dundalk Community College | …… | Bill Delauder |
| Dundalk Renaissance Corporation | …… | Leah Bunck<br>David Fielder<br>Amy Menzer |
| Eastfield/Stanbrook Community | …… | Karen Cruz<br>Patricia Paul |
| Ecologix | …… | Candy Croswell<br>Fran Flanigan |
| Jones Creek/Harbor Team | …… | Fran Taylor |
| Marine Trades Associations | …… | Art Cox |
| Patapsco/Back River Tributary Team | …… | Stuart Stainman |
| Private Citizen | …… | Russell Donnelly |
| Turners Station | …… | Larry Bannerman<br>Edie Brooks |
| State of Maryland Environmental Service | …… | Fred Curtis |
| State of Maryland Port Administration | …… | Bill Richardson |
| Baltimore County Planning | …… | John Alexander<br>Terri Kingeter |
| Baltimore County Recreation and Parks | …… | Neil Magness<br>Bob Smith |

| | | |
|---|---|---|
| Baltimore County Department of Environmental Protection and Sustainability (EPS) | …… | Betty Kelley<br>Dave Riter<br>Steve Stewart<br>Erin Wisnieski |
| Parsons Brinckerhoff | …… | Everett Gupton<br>Kelly Lennon |

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

- ***Stakeholder Meeting #1*** (March 12, 2012; 26 attendees): This meeting included an introduction of the SWAP process and the Bear Creek/Old Road Bay SWAP Steering Committee members. A description of the watershed, the County's goals, environmental requirements (see Section 1.3), and a SWAP framework were presented. The current conditions of the Bear Creek/Old Road Bay watershed were also presented based on desktop analyses and field assessments conducted. A Vision & Goals Questionnaire was conducted during the meeting where attendees were asked to rate the importance of a list of thirteen watershed goals. Attendees were also given an opportunity to fill out a "blue card" to report the type and location of environmental problems (e.g. dumping, erosion, illicit discharges, etc.) in the watershed. An "actions survey" was conducted to gage citizens' interest in potential restoration activities. The results of the surveys were used later to identify rates of participation for certain restoration actions that are recommended for the watershed. Finally, Leah Bunck, from the Dundalk Renaissance Corporation, presented an overview of the group along with a schedule of upcoming restoration activities taking place in the watershed.
- ***Stakeholder Meeting #2*** (September 20, 2012; 35 attendees): An overview of the Draft SWAP developed for Bear Creek/Old Road Bay was presented at this meeting including the SWAP process, watershed profile, key municipal and citizen-based strategies (e.g., stormwater management, reforestation, etc,), pollutant removal analysis, subwatershed prioritization, and SWAP implementation and evaluation. In addition, watershed-wide strategies were discussed including a trash campaign and a campaign to promote Clean Marina and Boater Programs. The meeting then moved to a discussion of the past, present, and future of the planning area. Robert Reyes spoke about the historical significance of the area, and Art Cox and John Long spoke about present actions being conducted by marinas and watershed groups. A representative from the DRC presented on the activities the organization is involved with along with educational and environmental awareness events that the citizens of the watershed can participate in the future. Following the presentation, citizen action displays and sign-ups were setup for attendees to obtain more information regarding storm drain marking, proper pet waste management, downspout disconnection and rain barrels, and composting.

## 1.3 Environmental Requirements

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

- National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit assessment and planning requirements
- 303(d) listings and Total Maximum Daily Load (TMDL) reductions for Bear Creek, Old Road Bay, and the receiving tidal water segment of this watershed, the Patapsco River Mesohaline (MD_PATMH)
- TMDLs for the Chesapeake Bay for nutrient and sediment reductions to meet water quality standards
- 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 structural and non-structural water quality improvement opportunities
- Specification of overall watershed restoration goals

The County's NPDES permit also requires the County to address 10% of the impervious cover during each 5-year permit term. It is anticipated that future permits will have the same requirement. To date, restoration projects have addressed 16.1% of the impervious cover county-wide, and 21.5% of the impervious cover in the Bear Creek/Old Road Bay watershed. Restoration actions and stormwater management have reduced phosphorus by 12.0% and nitrogen by 3.6%. The Bear Creek/Old Road Bay SWAP addresses an additional 7.7% of the County's impervious area.

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

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

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

The water quality segments in Bear Creek/Old Road Bay that are applicable to the current SWAP area are listed for the following impairments: sediment, chlordane, polychlorinated biphenyls (PCBs), zinc, and impacts to biological communities (2002 and 2004 listings) and submerged aquatic vegetation (1996 listing).

Note that in 2005, a Water Quality Assessments (WQA) was submitted for the Northwest Branch and Bear Creek subsegments of the Patapsco River in response to impairment listings for zinc, lead, and chromium. The WQA justified the removal of these listing as these pollutants did not exceed impairment levels under water quality criteria. TMDLs are currently pending for PCBs in the Northwest Branch and Bear Creek subsegments along with zinc in the Middle Harbor subsegment.

### 1.3.3 TMDLs for Chesapeake Bay Nutrient and Sediment Impairment

The Chesapeake Bay Program (CBP) has developed the Phase 5 Watershed Model. This model, in conjunction with the Estuary Model, is used to determine the sources and reductions of nitrogen, phosphorus, and sediment needed to meet Chesapeake Bay tidal water quality standards. The Phase 5 model was used to develop a Chesapeake Bay-wide TMDL and to assign nutrient and sediment load reductions to individual states and ultimately local jurisdictions based on the segment loads. In Maryland, nutrient load reductions were assigned on a County-by-County basis for achievement by a 2025 timeframe. 2017 was established as an intermediary milestone with specific targeted load reductions to be achieved. Specific sediment reductions for sediment have not been assigned, but it is assumed that meeting nutrient load reductions will address needed sediment load reductions. Table 1-1 lists the nutrient load reduction requirements for Baltimore County, and in turn the Bear Creek/Old Road Bay study area, under the Chesapeake Bay TMDL.

**Table 1-1: Baltimore County Pollutant Load Reductions**

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

### 1.3.4 SAV and Water Clarity

MDE has established targets for submerged aquatic vegetation (SAV) and water clarity since these are both indicators of good water quality and habitat. Standards are based on water quality segments that are derived from the CPB model. The Patapsco River Mesohaline (PATMH) segment covers the Patapsco River segment between Baltimore City, Baltimore County, and Anne Arundel County extending west to Old Road Bay. SAV targets in this segment include coverage of 389 acres and a water clarity target depth of 1.0 meters. The other tidal segment contained in the study area, the Upper Central Chesapeake Bay Mesohaline (CB3MH), covers a portion of the main stem of the Chesapeake Bay extending to the eastern shore of Maryland. SAV coverage and water clarity targets for this segment are 1,307 acres and 0.5 meters respectively.

## 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 NPS pollution using incremental Section 319 funds must meet USEPA's A through I criteria for watershed planning:

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

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

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

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

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

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

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

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

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

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

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

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

## 1.5 Partner Capabilities

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

### 1.5.1 Baltimore County

Baltimore County has a waterway restoration program to implement restoration projects, including stream restoration, stormwater conversions and retrofits, reforestation, and shoreline enhancement projects. In the Bear Creek/Old Road Bay watershed, over 7,600 linear feet of shoreline have been restored, 284 acres of urban land has been either addressed with new stormwater management (SWM) practices or retrofits of existing SWM practices to provide additional water quality improvements. Approximately $2.6 million have been spent to date on restoration activities within the entire Bear Creek/Old Road Bay watershed. An additional $4.3 million has been allocated for restoration projects currently either in design or construction.

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

Baltimore County is under a consent decree with USEPA and MDE to address Sanitary Sewer Overflows (SSOs). The consent decree has specific requirements for improvements to pumping stations, remediation of sanitary sewer lines, maintenance, and inspection. Since the implementation of the consent decree in 2005, SSOs into the Bear Creek/Old Road Bay study area has decreased by 95%.

Continued implementation of the consent decree requirements will continue to help reduce bacterial contamination, as well as, reduce nitrogen and phosphorus in streams.

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

The County also initiated a comprehensive dredging program in 1987 to address the need for access to waterways 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 EPS 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 EPS has planned, designed, permitted and overseen the construction of dredging projects on several tributaries in the Bear Creek/Old Road Bay study area including:

- Lynch Cove
- Chink Creek
- Tobasco Cove
- Schoolhouse (Oakleigh) Cove
- Jones Creek
- North Point Creek
- Shallow Creek

Baltimore County EPS also maintains aids to navigation on the aforementioned waterways and conducts annual spring and summer submerged aquatic vegetation surveys. In October, 2012, EPS will end the placement of navigational aids marking dredged channels. This responsibility is expected to be assumed by the Maryland Department of Natural Resources (DNR) Boating Services Unit Hydrographic Operations Division in 2013. Bathymetry surveys in the next several years will help to determine the need and frequency of future maintenance dredging.

### 1.5.2 Dundalk Renaissance Corporation

The Dundalk Renaissance Corporation (DRC) is a non-profit, community-based membership organization and community development corporation dedicated to revitalizing the greater Dundalk community. Its mission statement reads as follow:

> *DRC's mission is to develop and implement community-endorsed plans to revitalize, improve and promote Dundalk's neighborhoods, economy, and quality of life.*

As a volunteer based organization, DRC has conducted a variety of restoration projects in the watershed ranging from tree planting to stream cleanups. In addition, the group is currently partnered with the

Back River Restoration Committee to implement restoration actions from the Tidal Back River SWAP developed by Baltimore County.

### 1.5.3 Local Businesses and Civic Organizations

A variety of community businesses and civic organizations in the Bear Creek/Old Road Bay planning area have a vested interest in improving water quality in the watershed. Each of these organizations will have an important role in achieving the goals and objectives of the SWAP.

Community representatives involved with the planning process include representatives from the Eastfield Stanbrook Civic Association as well as the Turners Station Conservation Team.

With 15 marinas located in the study area, the Baltimore County Marine Trade Association (BCMTA) is another important stakeholder representing the interests of the community. Boating is a popular recreational activity and important economic driver in the area, and BCMTA has the ability to promote cleaner boating practices with area marinas as well as local and visiting boaters.

### 1.5.4 Large Landowners

33% of the Bear Creek/Old Road Bay watershed consists of property occupied by five (5) large landowners. They include:

- Maryland Port Administration – Dundalk Marine Terminal
- RG Steel – Sparrows Point Facility
- Constellation Energy – Riverside Generating Station
- Community College of Baltimore County – Dundalk Campus
- US Veterans Administration – Fort Howard Hospital

Currently, each of these facilities is required to maintain a NPDES permit for their operations. The facilities, in accordance with the NPDES permits, are undertaking processes to prevent stormwater pollutants from reaching adjacent waterways in the area.

EPS and Parsons Brinckerhoff staff conducted site visits to each of the large landowners. More details regarding the findings of the site visits can be found in Section 4.7 of the *Bear Creek/Old Road Bay Watershed Characterization Report* and in Section 4.3 of this report. During the visits, it was noted that each of the facilities has undertaken additional activities in an effort to be more environmentally sustainable. By continuing to expand environmental programs and mitigating pollution-causing practices on-site, large landowners within the watershed can assist in the effort to meet pollution reduction goals.

## 1.6 Bear Creek/Old Road Bay Watershed Overview

The total study area of the SWAP including the Bear Creek, Old Road Bay and Shallow Creek watersheds is comprised of 14 subwatersheds and approximately 11,413 acres (17.8 square miles) as shown in Table 1-3.

**Table 1-3: Bear Creek/Old Road Bay Subwatershed Areas**

| Subwatershed | Area (Acres) | Area (Sq Miles) |
|---|---|---|
| Colgate Creek | 1,649.3 | 2.58 |
| Peach Orchard Cove | 450.2 | 0.70 |
| Bullneck Creek | 632.2 | 0.99 |
| Lynch Cove | 648.4 | 1.01 |
| Chink Creek | 364.8 | 0.57 |
| Bear Creek Headwaters | 592.0 | 0.92 |
| Charlesmont/Tobasco Coves | 417.4 | 0.65 |
| Oakleigh/Schoolhouse Coves | 328.8 | 0.51 |
| Country Club Cove/Humphrey Creek Remnant | 797.9 | 1.25 |
| Jones Creek | 922.9 | 1.44 |
| North Point Creek | 576.2 | 0.90 |
| Shallow Creek | 706.2 | 1.10 |
| Black Marsh | 569.2 | 0.89 |
| Sparrows Point | 2,757.9 | 4.31 |
| ***Total*** | ***11,413.4*** | ***17.83*** |

As shown in Figure 1-2, the Bear Creek/Old Road Bay watershed was subdivided for planning and management purposes into 14 subwatersheds. The smaller drainage areas are intended to focus restoration, preservation and monitoring efforts. The *Bear Creek/Old Road Bay Watershed Characterization Report* includes detailed analyses and descriptions of the current watershed conditions and potential water quality issues. This is included as Appendix E of this report. A summary of the key watershed characteristics for Bear Creek/Old Road Bay based on the characterization report is provided in the Table 1-4.

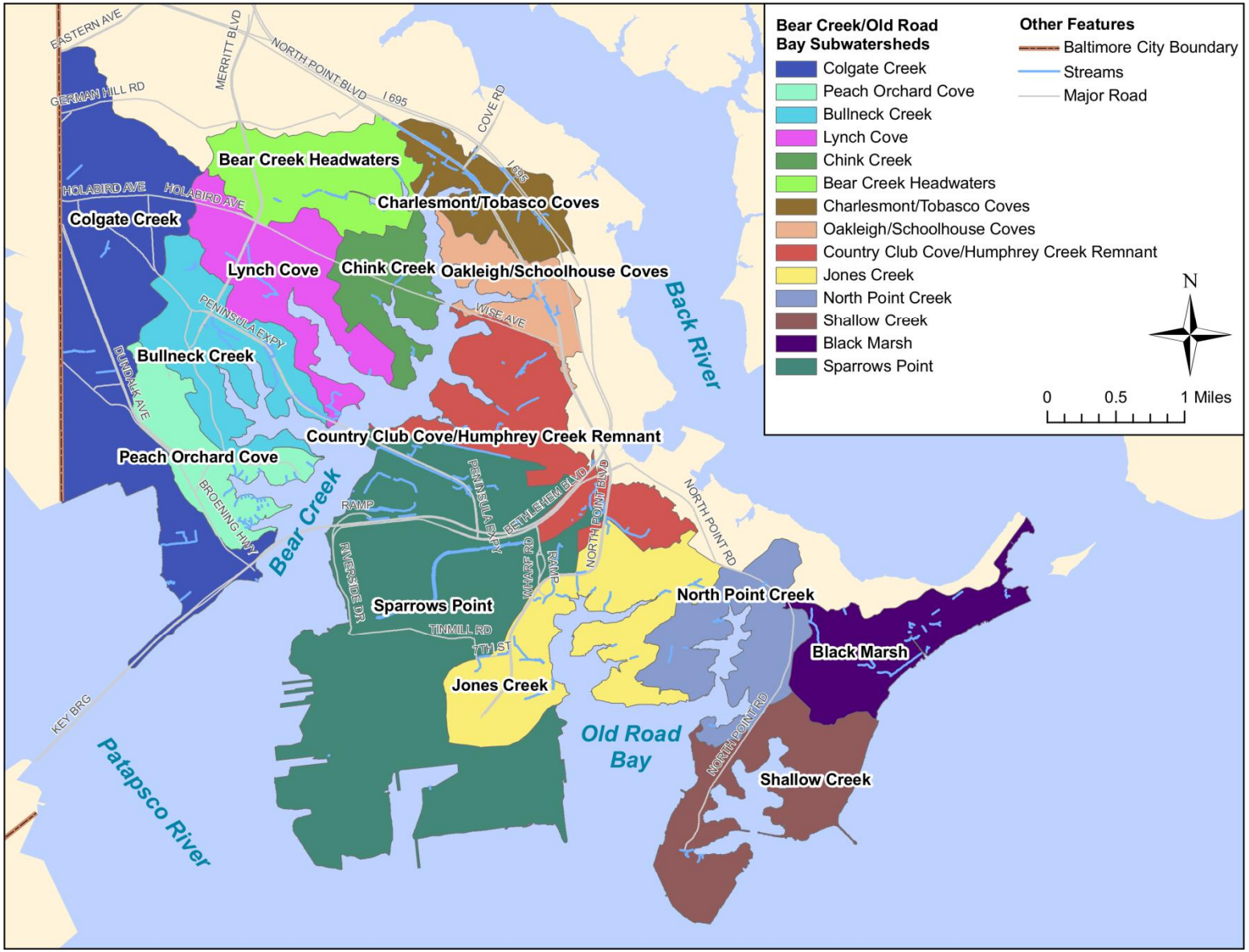


Figure 1-2: Bear Creek/Old Road Bay SWAP Planning Area and Subwatersheds

**Table 1-4: Bear Creek/Old Road Bay Key Watershed Characteristics**

| | | |
|---|---|---|
| **Drainage Area** | 11,413 acres (17.8 sq. mi.) | |
| **Stream Length** | 19.8 miles | |
| **Coastline Length** | 60.9 miles | |
| **Tidal Waters** | 2,073 acres (3.2 sq. mi.) | |
| **Jurisdictions** | Baltimore County | |
| **Population** | 56,128 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 0.4% |
| | Medium Density Residential: | 16.6% |
| | High Density Residential: | 15.3% |
| | Commercial: | 4.7% |
| | Industrial: | 31.5% |
| | Institutional: | 5.1% |
| | Open Urban: | 6.8% |
| | Forest: | 10.3% |
| | Agriculture: | 3.0% |
| | Water/Wetlands: | 5.0% |
| | Transportation | 1.2% |
| **Impervious Cover** | 29.2% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.1% |
| | B Soils: | 14.6% |
| | C Soils: | 39.4% |
| | D Soils (high runoff potential): | 44.7% |
| | Water | 1.2% |

## 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 Bear Creek/Old Road Bay watershed.

Chapter 3 describes the types of watershed restoration practices recommended for Bear Creek/Old Road Bay and estimated pollutant load reductions.

Chapter 4 discusses prioritization of the 14 subwatersheds in the Bear Creek/Old Road Bay 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: Bear Creek/Old Road Bay Action Strategies
- Appendix B: Cost Analysis and Potential Funding Sources
- Appendix C: Chesapeake Bay Program Pollutant Load Reduction Efficiencies and Maryland *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated.*
- Appendix D: Bear Creek/Old Road Bay SWAP Uplands Assessment Map

A second volume (Volume II) includes the following appendices with supporting documentation related to the current conditions of the Bear Creek/Old Road Bay watershed:

- Appendix E: Bear Creek/Old Road Bay Watershed Characterization Report (PB 2012)
- Appendix F: Chesapeake Bay TMDL Executive Summary
- Appendix G: Total Maximum Daily Load (TMDL) Documentation for Chlordane in Baltimore Harbor
- Appendix H: Water Quality Analyses of Chromium in the Inner Harbor/Northwest Branch and Bear Creek Portions of Baltimore Harbor in Baltimore City and Baltimore County, Maryland
- Appendix I: Water Quality Analyses for Lead in the Inner Harbor/Northwest Branch and Zinc in the Inner Harbor/Northwest Branch and Bear Creek Portions of Baltimore Harbor in Baltimore City and Baltimore County, Maryland

# CHAPTER 2: VISION, GOALS AND OBJECTIVES

## 2.1 Vision Statement

The Bear Creek/Old Road Bay Steering Committee adopted the following vision statement that served as a guide in the development of the SWAP:

> *We envision a cleaner Chesapeake Bay watesrhed where communities live, work, and play responsibly. We imagine an environment where eco-systems support and sustain a balance of activities important to life. Achievable now, achievable tomorrow, one watershed at a time: Bear Creek/Old Road Bay.*

## 2.2 Bear Creek/Old Road Bay SWAP Goals & Objectives

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

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

When possible, action strategies are expressed as quantifiable measures (e.g., linear feet of forested buffer planted). However, the numerical values assigned to these actions are intended to serve as a guide rather than an absolute measure in achieving watershed goals and objectives. Many actions address multiple watershed goals and objectives. Appendix A, Table A2 lists the action strategies proposed for Bear Creek/Old Road Bay and their applicable goals and objectives.

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

### Goal 1: Restore and maintain clean water

As part of the bay-wide Chesapeake Bay TMDL requirements, Baltimore County is required to reduce the nutrient and sediment loadings into Bear Creek/Old Road Bay by the year 2025, with intermediate milestones established for 2017. Percentage reductions will be measured against the baseline year of

2009. In addition, other contaminants such as PCBs are of particular concern to residents in the planning area. The objectives below are designed to meet the nitrogen, phosphorous, and sediment TMDL reduction requirements in the watershed while also decreasing the release of other toxins. As of the date for this report, sediment targets have not been determined for Baltimore County.

**Objectives:**

1. Reduce annual average Total Nitrogen loads (urban stormwater) by 20.3% in 2017 and 29.0% in 2025 compared to loading estimated for the baseline period.
2. Reduce annual average Total Phosphorous loads (urban stormwater) by 31.6% in 2017 and 45.1% in 2025 compared to loading estimated for the baseline period.
3. Reduce annual average PCB loads by 91.5%
4. Reduce the run-off of oil and grease to waterways.
5. Implement stormwater control practices throughout the watershed and incorporate new technologies and controls to the maximum extent practicable.

### Goal 2: Improve the biological health of local streams, wetlands, and shallow water habitats and support healthy fish and wildlife

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

**Objectives:**

1. Encourage riparian buffer preservation and plantings to help stabilize stream banks and reduce pollutant-laden sediment from entering the stream channels.
2. Eliminate invasive vegetation from stream and shoreline buffer areas.
3. Increase the tree canopy throughout the watershed, especially in the Critical Area.
4. Implement additional shoreline stabilization opportunities within the watershed.
5. Enhance the function of degraded wetlands in the watershed.
6. Increase SAV coverage in the planning area.
7. Reduce toxic discharge to eliminate fish consumption advisories.
8. Reestablish shellfish beds within the watershed.
9. Continue to mark navigable channels and encourage boaters to stay within marked channels.
10. Educate boaters and waterfront property owners about the importance of SAVs to the tidal ecosystem.

## Goal 3: Reduce trash and dumping

Trash and debris is generated throughout the watershed and readily moves through storm drains and tributaries and is carried by wind into surface waters. Trash and other bulk materials are also thrown directly into the streams and tidal waters. Besides the glaring visual detriment to natural beauty, trash contributes toxins and presents hazards to water fowl, other wildlife, and people. Reducing trash and dumping is mainly an issue of public awareness and stewardship. By engaging citizens of all ages to help clean up and dispose of trash responsibly, the stage will be set to change behaviors, and will lead to a healthier Bear Creek/Old Road Bay.

**Objectives:**

1. Reduce trash in upland areas.
2. Reduce dumping of trash and other materials.
3. Support and increase community clean-ups.
4. Increase recycling of bottles, cans, plastic bags and paper.
5. Remove historical debris and trash embedded in sediment from tidal waters.

## Goal 4: Improve, maintain, and expand public parks, natural areas and water access areas available for public use in an environmentally sustainable manner

In developed communities, the presence of and access to parks, natural areas, and other environmental resources is of vital importance. Protecting and enhancing these areas, while also making them accessible to citizens promotes a sense of stewardship in the community and provides a natural habitat to native plant and wildlife species.

Objectives:

1. Protect, preserve, and enhance sensitive areas.
2. Support the development of water trails through an increase in the number of public water access sites.
3. Increase signage to public water access points.
4. Encourage boaters to participate in Maryland DNR's Clean Boater program.

## Goal 5: Expand public stewardship and awareness of environmental concerns in the watershed while promoting environmental literacy through education, community partnerships, and efforts to connect youth to nature

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

**Objectives:**

1. Promote and increase the use of rain barrels, rain gardens and bayscaping in upland areas.
2. Engage students and teachers at local schools to participate in public stewardship projects.
3. Establish a Bear Creek/ Old Road Bay Partner Community and connect public sites with other Chesapeake Bay gateway networks.
4. Support watershed-related learning opportunities and hands-on experiences for youth as well as training for all types of educators and recreation service providers.
5. Expand volunteer engagement in habitat restoration and conservation.

### Goal 6: Support environmentally sustainable waterfront and water-related businesses and industries

With over 60 miles of coastline in the Bear Creek/Old Road Bay watershed, the waterfront is an important economic and natural resource. The objectives below relate to improving and promoting the waterfront to realize all the economic and recreational opportunities it can provide.

**Objectives:**

1. Encourage marinas to participate in Maryland DNR's Clean Marina program.
2. Support the maintenance of deep-water channels and water-dependent facilities.
3. Work with MDE to achieve environmental remediation at industrial hotspots within the area.
4. Continue to provide information to businesses and industries on pollution prevention.
5. Continue to conduct surveys to identify pollution problems.

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

Specific communities in the Bear Creek/Old Road Bay planning area have been identified as being vulnerable to a disproportionate and burdensome amount of environmental hazards from development. By focusing on these areas, the following objectives are intended to address environmental inequality by increasing and enhancing environmental amenities and decreasing environmental hazards.

**Objectives:**

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

# CHAPTER 3: RESTORATION STRATEGIES

## 3.1 Introduction

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

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

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

## 3.2 Municipal Strategies

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

### 3.2.1 Stormwater Management

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

is to distribute flow throughout a development site and reduce stormwater runoff leaving that site. This will also reduce pollutant loads and prevent stream channel erosion.

#### *3.2.1.1 Existing Stormwater Management*

A total of 52 existing SWM facilities are located within the Bear Creek/Old Road Bay watershed including dry and wet ponds, wetlands, infiltration/filtration practices, extended detention, proprietary BMPs, grassed swales, and underground detention facilities. Existing SWM facilities treat a total drainage area of approximately 749 acres of urban land or 8 percent of the total urban land use in the watershed.

#### *3.2.1.2 Stormwater Management Conversions*

Detention ponds are typically designed to address water quantity only (flood control) and therefore, provide almost no pollutant removal. Therefore, they are good candidates for conversion to a type of facility that provides water quality benefits in addition to quantity control. Nine existing detention ponds within the Bear Creek/Old Road Bay watershed were investigated for potential conversion to stormwater quality management facilities. For example, dry extended detention ponds are designed to capture and retain stormwater runoff to allow sediment and pollutants to settle out while also providing flood control. Out of the nine (9) detention ponds assessed, six (6) were considered to have potential for conversion for water quality.

#### *3.2.1.3 Stormwater Retrofits*

Stormwater retrofits involve implementing BMPs in existing developed areas where SWM practices do not exist to help improve water quality. Stormwater retrofits improve water quality by capturing and treating runoff before it reaches receiving water bodies. Based on initial field and desktop evaluations, several sites with sufficient open space for stormwater retrofits to treat runoff from impervious parking lots or alleys were identified. These sites were located in three (3) of the four (4) upland components surveyed: neighborhoods, institutions and pervious areas.

#### *3.2.1.4 Impervious Cover Removal*

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

#### *3.2.1.5 Stormwater Education and Outreach*

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

### 3.2.2 Shoreline Enhancement Projects

The Bear Creek/Old Road Bay 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 EPS has a well established program for waterway improvement and coastal management to protect these and other County resources while meeting public demands for access and recreation. The County has implemented ten (10) shoreline enhancement projects within Bear Creek/Old Road Bay between 1990 and 2007. These include the following projects (more detail is provided in Section 3.4.2.1):

1. Concrete Homes (1990)
2. Watersedge Park (1990 and repaired in 1999)
3. Merritt Point Park (1990)
4. Bear Creek I (1990)
5. West Inverness (1990)
6. Charlesmont Park (1993)
7. Battle Grove Park (1995)
8. Sandy Plains Elementary (1998)
9. Bear Creek II (1999)
10. Fleming Park (2007)

### 3.2.3 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, simple stream repairs such as vegetative bank stabilization and localized grade control to comprehensive repairs such as full channel redesign and realignment. Uplands assessments performed in Bear Creek/Old Road Bay showed isolated opportunities for stream repair, stream cleanups, and buffer reforestation near institutions in the Bear Creek Headwaters and Lynch Cove subwatersheds. Stabilizing the stream channel improves water quality by preventing eroded soils and the pollutants contained in them from entering the stream and Bear Creek.

### 3.2.4 Community Reforestation Program

The Community Reforestation Program (CRP) was established by the Department of Environmental Protection and Sustainability to provide a dedicated workforce for planting, monitoring, and maintaining forest mitigation projects. The Program is funded primarily through fees-in-lieu of mitigation for forests removed as a result of public and private land development, as required by the implementation of the County's Forest Conservation Act and Chesapeake Bay Critical Area Regulations. In a change from

previous reports, the plantings conducted with mitigation monies will not be given nutrient reduction credits due to the fact that these tree plantings are offsetting deforestation. The CRP is the only full-time County-wide reforestation mitigation program among Maryland's counties.

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

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

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

### 3.2.5 Street Sweeping

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

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

### 3.2.6 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.

### 3.2.7 Sanitary Sewer Consent Decree

In September 2005, USEPA and MDE issued a consent decree to Baltimore County with deadlines to reduce and eliminate sanitary sewer overflows (SSOs). 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 Bear Creek/Old Road Bay surface waters. A summary of the SSOs in Bear Creek/Old Road Bay can be found in the *Watershed Characterization Report.*

## 3.3 Citizen-Based Strategies

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

### 3.3.1 Reforestation

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

***Riparian Buffer***

Stream and shoreline riparian buffers are critical to maintaining healthy streams and rivers. Forested buffer areas along streams and shorelines improve water quality and prevent flooding by filtering pollutants, reducing surface runoff, stabilizing stream banks, trapping sediment, and providing habitat for various types of terrestrial and aquatic life. Buffer encroachment as a result of development was noted during uplands and stream surveys conducted throughout the watershed. Areas on privately-owned land (e.g., residential properties) can be targeted for buffer awareness initiatives to encourage landowners to plant trees and/or create a no-mow area adjacent to streams and shorelines. Open pervious areas identified within the 100-foot stream and shoreline buffer areas via 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.

***Street and Shade Tree Plantings***

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

### 3.3.2 Downspout Disconnection

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

### 3.3.3 Urban Nutrient Management

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

***Lawn Maintenance Education***

A well-maintained lawn can be beneficial to the watershed. However, lawn maintenance activities often involve over-fertilization, poor pest-management, and over-watering resulting in polluted stormwater runoff to local streams. Lawns with a dense, uniform grass cover or signs designating poisonous lawn care indicate high lawn maintenance activities. With the passage of the Maryland's Fertilizer Use Act in 2011, the amount of phosphorus and nitrogen contained in fertilizers sold in Maryland is regulated, limiting the amount of nutrients that can be applied to lawns. Neighborhoods identified as having high lawn maintenance practices should still be targeted for awareness programs emphasizing responsible fertilizing techniques such as proper application amounts, proper time of year for fertilization, soil

testing for nutrient requirements, and keeping fertilizers away from impervious surfaces. Lawn maintenance education can be achieved through door-to-door canvassing, informational brochures/mailings, excerpts in community newsletters, or demonstrations at community meetings. Information on organic alternatives to chemical lawn treatments should also be included in these outreach efforts. Because of the passage of the Fertilizer Use Act, specific pollution reductions for lawn maintenance education are not computed for Bear Creek/Old Road Bay.

Bayscaping

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

## 3.4 Pollutant Loading & Removal Analyses

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

### 3.4.1 Pollutant Loading Analysis

A pollutant loading analysis was performed to estimate total nitrogen, total phosphorus, and sediment loads currently generated by all non-point and septic sources present within the Bear Creek/Old Road watershed.

#### *3.4.1.1 Land-Use Pollutant Loading*

Land-use pollutant loading 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 and Baltimore County for non-urban land uses and CBP for urban land uses. The pollutant loading analysis is described in detail in Chapter 3.3 of the *Watershed Characterization Report* (Appendix E). Table 3-1 summarizes the results from the watershed pollutant loading analysis including areas, pollutant loading rates, and annual pollutant loads for each nonpoint source/land use type.

**Table 3-1: Bear Creek/Old Road Bay Land-Use Nitrogen, Phosphorus, and Total Suspended Solids Loads**

| WRE Land Use | Area (acres) | NITROGEN | | PHOSPHORUS | | TOTAL SUSPENDED SOILDS | |
|---|---|---|---|---|---|---|---|
| | | Loading Rate (lbs/ac) | Load (lbs) | Loading Rate (lbs/ac) | Load (lbs) | Loading Rate (lbs/ac) | Load (lbs) |
| Impervious Urban | 3,335.5 | 9.64 | 32,142 | 1.48 | 4,937 | 675.86 | 2,254,352 |
| Pervious Urban | 5,996.2 | 6.40 | 38,374 | 0.28 | 1,671 | 92.26 | 553,213 |
| Cropland | 344.2 | 21.38 | 7,358 | 1.32 | 453 | 664.57 | 228,722 |
| Pasture | 0.0 | 7.97 | 0 | 0.74 | 0 | 118.85 | 0 |
| Livestock (AFO/CAFO) | 0.0 | 94.26 | 0 | 23.95 | 0 | 2,452.00 | 0 |
| Forest | 1,171.2 | 1.53 | 1,790 | 0.04 | 42 | 31.05 | 36,366 |
| Wetlands | 370.5 | 1.53 | 566 | 0.04 | 13 | 31.05 | 11,503 |
| Water* | 195.8 | - | - | - | - | - | - |
| ***Total*** | ***11,413.4*** | | ***80,230*** | | ***7,117*** | | ***3,084,155*** |

*Nutrient loadings from Water were not included in the analysis

#### *3.4.1.2 Septic System Pollutant Loading*

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

**Table 3-2: Bear Creek/Old Road Bay Pollutant Loads from Septic Systems**

| Other Pollution Sources | Nitrogen (lbs/year) | Phosphorus (lbs/year) | Total Suspended Solids (lbs/year) |
|---|---|---|---|
| Septic Systems | 3,736 | 0 | 0 |

### 3.4.2 Pollutant Removal Analysis

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

The Maryland Department of Natural Resources owns the bulk of the 344 acres of agricultural land in the watershed, require the implementation agricultural BMPs for leased State-owned agricultural land to the extent that those lands meet or exceed the nutrient load reductions assigned to the agricultural sector. The remaining private agricultural lands may need additional BMPs for load reductions. The Baltimore County Soil Conservation District oversees implementation of agricultural BMPs.

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

**Table 3-3: Bear Creek/Old Road Bay Nitrogen and Phosphorus Load Reductions**

| Source | Area (acres) | TN Load (lbs/yr) | TP Load (lbs/yr) | TSS Load (lbs/yr) |
|---|---|---|---|---|
| Baseline Urban Load | 9,332 | 70,516 | 6,608 | 2,807,565 |
| ***2017 Reduction Goal:*** | | ***14,308*** | ***2,086*** | **-** |
| ***2025 Reduction Goal:*** | | ***20,440*** | ***2,980*** | **-** |

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

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

#### *3.4.2.1 Implemented Capital Improvement Projects*

Baltimore County has implemented several capital improvement projects in Bear Creek/Old Road Bay including shoreline enhancements, stormwater retrofits, and stormwater wetlands. Because nutrient reductions based on existing stormwater treatment facilities such as ponds and wetlands are calculated in Section 3.4.2.2, they were not counted in this section. Nutrient reductions associated with shoreline enhancement capital improvement projects were taken from the Baltimore County *NPDES – Municipal Stormwater Discharge Permit 2011 Annual Report*. A summary of the pollutant load reductions from these projects is seen in Table 3-4.

**Table 3-4: Completed Shoreline Enhancement Projects in Bear Creek/Old Road Bay**

| | | | | | Removal Rate (lbs/year) | | | |
|---|---|---|---|---|---|---|---|---|
| Project | Facility Type | Linear Feet | Cost | Date | TN | TP | TSS | Impervious Acres |
| Concrete Homes | SE | 430 | $65,000 | 1990 | 133.4 | 87.7 | 365,452 | 38.8 |
| Watersedge Park | SE | 480 | $92,000 | 1990 | 72.8 | 47.9 | 199,400 | 21.2 |
| Merritt Point Park | SE | 1,880 | $175,000 | 1990 | 128.5 | 84.5 | 352,000 | 37.4 |
| Bear Creek I | SE | 475 | $66,000 | 1990 | 112.6 | 74.1 | 308,599 | 32.8 |
| West Inverness | SE | 230 | $19,000 | 1990 | 14.1 | 9.3 | 38,800 | 4.1 |
| Charlesmont Park | SE | 750 | $47,000 | 1993 | 76.9 | 50.5 | 210,600 | 22.3 |
| Battle Grove Park | SE | 420 | $82,000 | 1995 | 153.2 | 100.8 | 419,852 | 44.6 |
| Sandy Plains Elementary | SE | 380 | $108,000 | 1998 | 82.7 | 54.4 | 226,568 | 24.1 |
| Bear Creek II Shore | SE | 700 | $138,558 | 1999 | 83.2 | 54.7 | 228,010 | 24.2 |
| *Fleming Park | SE | 1,767 | $540,303 | 2007 | 25.6 | 16.9 | 70,228 | 7.5 |
| **Totals** | | **7,512** | **$1,332,861** | | **883** | **581** | **2,419,509** | **257** |

SE – Shoreline Enhancement; NA - not applicable

### *3.4.2.2 Existing Stormwater Management (SWM)*

As described in detail in Section 2.3.6 of the *Watershed Characterization Report* (Appendix E), there are 52 existing SWM facilities in Bear Creek/Old Road Bay including dry and wet ponds, wetlands, infiltration/filtration practices, extended detention, proprietary BMPs and other types of SWM facilities (i.e., underground detention). The pollutant removal capability of existing SWM in the watershed is not accounted for in the pollutant loading analysis. Therefore, it is included in the pollutant removal analysis.

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

$$\left[7.56(lbs/ac/yr)\times DA(acres)\right]\times efficiency(\%)$$

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

$$\left[0.71(lbs/ac/yr)\times DA(acres)\right]\times efficiency(\%)$$

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

$$\left[301(lbs/ac/yr)\times DA(acres)\right]\times efficiency(\%)$$

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, 7.56 lbs TN/ac/yr, 0.71 lbs TP/ac/yr, and 301 lbs TSS/ac/yr represent the weighted average of impervious and pervious urban rates used in the pollutant loading analysis (Table 3-1) since this represents the likely

sources of runoff being treated. Note that impervious and pervious urban loading rates are based on CBP's Watershed Model run from July of 2011. The percent pollutant removal efficiency depends on the type of facility and is based on the values shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. The total pollutant load reduction expected from existing SWM is a sum of the removal capacities of the individual facilities. A summary of existing SWM load reduction calculations and results are shown in Table 3-5.

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

| SWM Facility Type | No. (#) | DA (acres) | TN Load from DA (lbs/yr) | TN Removal Efficiency (%) | Max Potential TN Load Reduction (lbs/yr) | TP Load from DA (lbs/yr) | TP Removal Efficiency (%) | Max Potential TP Load Reduction (lbs/yr) | TSS Load from DA (lbs/yr) | TSS Removal Efficiency (%) | Max Potential TSS Load Reduction (lbs/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dry Pond | 9 | 226.7 | 7.56 | 5% | 86 | 0.71 | 10% | 16.0 | 301 | 10% | 6,819 |
| Wet Pond | 5 | 137.1 | 7.56 | 20% | 207 | 0.71 | 45% | 43.7 | 301 | 60% | 24,751 |
| Underground Detention | 6 | 7.7 | 7.56 | 5% | 3 | 0.71 | 10% | 0.5 | 301 | 10% | 230 |
| Wetland | 4 | 259.2 | 7.56 | 20% | 392 | 0.71 | 45% | 82.6 | 301 | 60% | 46,794 |
| Infiltration | 5 | 8.0 | 7.56 | 80% | 48 | 0.71 | 85% | 4.8 | 301 | 95% | 2,272 |
| Filtration | 3 | 17.7 | 7.56 | 40% | 54 | 0.71 | 60% | 7.5 | 301 | 80% | 4,260 |
| Extended Detention | 10 | 82.9 | 7.56 | 20% | 125 | 0.71 | 20% | 11.7 | 301 | 60% | 14,970 |
| Proprietary BMP | 2 | 2.4 | 7.56 | 5% | 1 | 0.71 | 10% | 0.2 | 301 | 10% | 71 |
| Grassed Swale/Channel | 2 | 2.5 | 7.56 | 10% | 2 | 0.71 | 10% | 0.2 | 301 | 50% | 378 |
| Other | 6 | 5.3 | 7.56 | 5% | 2 | 0.71 | 10% | 0.4 | 301 | 10% | 158 |
| ***Totals:*** | ***52*** | ***749*** | | | ***919*** | | | ***167.6*** | | | ***100,703*** |

### *3.4.2.3 Stormwater Management Conversions*

As described previously, six (6) of the nine (9) existing detention ponds surveyed have the potential for horizontal expansion and 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 TN load reductions for SWM conversions is expressed as:

$$\left[7.56(lbs/ac/yr)\times DA(acres)\right]\times 15\%$$

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

$$\left[0.71(lbs/ac/yr)\times DA(acres)\right]\times 10\%$$

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

$$\left[301(lbs/ac/yr)\times DA(acres)\right]\times 50\%$$

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

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

| | | | | REMOVAL EFFICIENCY | | | |
|---|---|---|---|---|---|---|---|
| Pollutant | DA for SWM Conversion (acres) | Overall Urban Loading Rate (lbs/ac/yr) | Load from DA (lbs/yr) | Detention Pond (%) | Extended Detention (%) | Increase in Efficiency (%) | Max Potential Load Reduction (lbs/yr) |
| TN | 79.65 | 7.56 | 602 | 5% | 20% | 15% | 90 |
| TP | 79.65 | 0.71 | 56 | 10% | 20% | 10% | 6 |
| TSS | 79.65 | 301 | 23,964 | 10% | 60% | 50% | 11,982 |

### *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 TN load reductions for stormwater retrofits is expressed as:

$$\left[9.64(lbs/ac/yr) \times DA(acres)\right] \times 50\%$$

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

$$\left[1.48(lbs/ac/yr) \times DA(acres)\right] \times 60\%$$

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

$$\left[676(lbs/ac/yr) \times DA(acres)\right] \times 90\%$$

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 9.64 lbs TN/ac/yr, 1.48 lbs TP/ac/yr, and 676 lbs TSS/ac/yr are the impervious urban rates used in the pollutant loading analysis (Table 3-1) since this represents the source of runoff being treated. Pollutant removal efficiencies are those reported for infiltration practices, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. A summary of stormwater retrofit load reduction calculations and results for the Bear Creek/Old Road Bay SWAP area are shown Table 3-7.

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

| Pollutant | Impervious Urban Loading Rate (lbs/ac/yr) | Impervious Area for SW Retrofit (acres) | Load from DA (lbs/yr) | Removal Efficiency (%) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|---|
| TN | 9.64 | 10.6 | 102 | 50% | 51 |
| TP | 1.48 | 10.6 | 16 | 60% | 9 |
| TSS | 676 | 10.6 | 7158 | 90% | 6,442 |

### *3.4.2.5 Impervious Cover Removal*

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

$$[9.64(lbs/ac/yr) - 6.40(lbs/ac/yr)] \times impervious_area(acres)$$

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

$$[1.48(lbs/ac/yr) - 0.28(lbs/ac/yr)] \times impervious_area(acres)$$

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

$$[676(lbs/ac/yr) - 92(lbs/ac/yr)] \times impervious_area(acres)$$

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

**Table 3-8: Impervious Cover Removal Load Reductions**

| Pollutant | Impervious Urban Loading Rate (lbs/ac/yr) | Pervious Urban Loading Rate (lbs/ac/yr) | Reduction in Loading Rate (lbs/ac/yr) | Impervious Area Removed (acres) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|---|
| TN | 9.64 | 6.40 | 3.24 | 1.45 | 4.68 |
| TP | 1.48 | 0.28 | 1.20 | 1.45 | 1.74 |
| TSS | 676 | 92 | 584 | 1.45 | 845 |

#### *3.4.2.6 Stream Buffer Reforestation*

The current vegetative condition of the stream riparian buffer (100 feet on either side of stream system) was analyzed in Section 2.2.7 of the *Watershed Characterization Report*. Buffer conditions were either classified as impervious, open pervious, or forested areas. Open pervious areas are the best areas to initially target for restoration. Approximately 227 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 TN load reductions for the land use conversion portion of stream buffer reforestation is expressed as:

$$\text{Land Use Conversion (TN)} = \left[6.40(lbs/ac/yr) - 1.53(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$$

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

$$\text{Land Use Conversion (TP)} = \left[0.28(lbs/ac/yr) - 0.04(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$$

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

$$\text{Land Use Conversion (TSS)} = \left[92(lbs/ac/yr) - 31(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$$

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 (Table 3-1). This reduction in loading rate is then multiplied by the available open pervious area for reforestation to determine the loads reductions from land use conversion.

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

$$\text{Buffer BMP Removal (TN)} = \left[OpenPerviousArea(acres) \times \frac{1(uplandacres)}{1(bufferacre)} \times 7.03(lbs/ac/yr)\right] \times 25\%$$

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

Buffer BMP Removal (TP) =

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

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

Buffer BMP Removal (TSS) =

$$\left[OpenPerviousArea(acres) \times \frac{1(uplandacres)}{1(bufferacre)} \times 270(lbs/ac/yr)\right] \times 50\%$$

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

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

| | | LU CONVERSION | | | BUFFER BMP REMOVAL | | | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | Open Pervious Area (acres) | Pervious Urban Loading Rate (lbs/ac/yr) | Forest Loading Rate (lbs/ac/yr) | Land Use Conversion Reduction (lbs/yr) | Reduction Efficiency (%) | Overall Watershed Loading Rate (lbs/ac/yr) | Efficiency Load Reduction (lbs/yr) | Max Potential Load Reduction (lbs/yr) |
| TN | 227 | 6.40 | 1.53 | 1,107 | 25% | 7.03 | 1.76 | 1,109 |
| TP | 227 | 0.28 | 0.04 | 55 | 50% | 0.62 | 0.31 | 55 |
| TSS | 227 | 92 | 31 | 13,908 | 50% | 270 | 135 | 14,043 |

### *3.4.2.7 Shoreline Buffer Reforestation*

The current vegetative condition of the shoreline riparian buffer (100 feet from shoreline) was analyzed in Section 2.2.8 of the *Watershed Characterization Report*. Shoreline buffer conditions were either classified as impervious, open pervious, or forested areas. Open pervious areas are the best areas to initially target for restoration. Approximately 360 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 TN load reductions for shoreline buffer reforestation is expressed as:

Land Use Conversion (TN) = $\left[6.40(lbs/ac/yr) - 1.53(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$

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

$$\text{Land Use Conversion (TP)} = \left[0.28(lbs/ac/yr) - 0.04(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$$

The equation used to estimate TSS load reductions for shoreline buffer reforestation is expressed as:

$$\text{Land Use Conversion (TSS)} = \left[92(lbs/ac/yr) - 31(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$$

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 (Table 3-1). This reduction in loading rate is then multiplied by the available open pervious area for reforestation to determine the loads reductions from land use conversion. A summary of shoreline buffer reforestation reduction calculations and results are shown in Table 3-10.

**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 | 360 | 6.40 | 1.53 | 4.87 | 1,755 |
| TP | 360 | 0.28 | 0.04 | 0.24 | 87 |
| TSS | 360 | 92 | 31 | 61 | 22,055 |

#### *3.4.2.8 Pervious Area Reforestation*

Fifteen (15) 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 TN load reductions for pervious area reforestation is expressed as:

$$\text{Land Use Conversion (TN)} = \left[6.40(lbs/ac/yr) - 1.53(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$$

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

$$\text{Land Use Conversion (TP)} = \left[0.28(lbs/ac/yr) - 0.04(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$$

The equation used to estimate TSS load reductions for pervious area reforestation is expressed as:

$$\text{Land Use Conversion (TSS)} = \left[92(lbs/ac/yr) - 31(lbs/ac/yr)\right] \times OpenPerviousArea(acres)$$

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 Table 3-11.

**Table 3-11: Pervious Area 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 | 20 | 6.40 | 1.53 | 4.87 | 98 |
| TP | 20 | 0.28 | 0.04 | 0.24 | 5 |
| TSS | 20 | 92 | 31 | 61 | 1,233 |

### *3.4.2.9 Downspout Disconnection*

A total of 76 neighborhoods (out of 91 surveyed) have potential for downspout disconnection. A neighborhood is recommended for disconnection if at least 25 percent of the downspouts are directly and/or indirectly connected to the storm drain system and the average lot has at least 15 feet of pervious area available down gradient from the downspout. During the uplands survey, the percentage of homes with connected downspouts was noted. This percentage was used to determine the rooftop area that could be addressed by disconnection in recommended neighborhoods. This is explained in further detail in Chapter 4 of the *Watershed Characterization Report*.

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

$$\left[9.64(lbs/ac/yr) \times DA(acres)\right] \times 50\%$$

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

$$\left[1.48(lbs/ac/yr) \times DA(acres)\right] \times 60\%$$

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

$$\left[676(lbs/ac/yr) \times DA(acres)\right] \times 90\%$$

The pollutant load received from the impervious rooftop drainage area recommended for disconnection is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 9.64 lbs TN/ac/yr, 1.48 lbs TP/ac/yr, and 676 lbs TSS/ac/yr are the impervious urban rates used in the pollutant loading analysis. Pollutant removal efficiencies are those reported for "Disconnection of Rooftop Runoff," in the *Accounting for Stormwater Wasteload Allocations and Impervious Areas Treated* released by MDE. A summary of downspout disconnection load reduction calculations and results are shown in Table 3-12.

**Table 3-12: 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 | 9.64 | 288 | 50% | 1,386 |
| TP | 1.48 | 288 | 60% | 256 |
| TSS | 676 | 288 | 90% | 175,023 |

### *3.4.2.10 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 30 feet for street tree planting and a planting density of 135 trees per acre for reforestation and shade tree planting. Pollutant reductions for pervious area reforestation are calculated based on a land use conversion from pervious urban to forest. An approximation of 135 trees per acre is used to calculate the area available for conversion. This density was taken from the *Baltimore County Policy and Guidelines for Community Tree Planting Projects* and assumes a survival density of 100 trees per acre after 25 years. The equation used to estimate TN load reductions for tree plantings is expressed as:

$$\left[6.40(lbs/ac/yr) - 1.53(lbs/ac/yr)\right] \times \left[\#Trees \cdot \frac{1(acre)}{135(trees)}\right]$$

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

$$\left[0.28(lbs/ac/yr) - 0.04(lbs/ac/yr)\right] \times \left[\#Trees \cdot \frac{1(acre)}{135(trees)}\right]$$

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

$$\left[92(lbs/ac/yr) - 61(lbs/ac/yr)\right] \times \left[\#Trees \cdot \frac{1(acre)}{135(trees)}\right]$$

Tree plantings would involve converting open pervious area to forest. Therefore, the loading rate would be reduced by a factor equal to the difference between pervious urban and forest loading rates used in the watershed pollutant loading analysis, as shown in the first expression in brackets in the equations above. The approximate reduction in pollutant load is then the reduced loading rate multiplied by the open pervious area available for reforestation (i.e., the expression in the second brackets in the equations above). A summary of tree planting load reduction calculations and results are shown in Table 3-13 and Table 3-14.

**Table 3-13: 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 | 6.40 | 1.53 | 4.87 | 3,817 | 28.27 | 138 |
| TP | 0.28 | 0.04 | 0.24 | 3,817 | 28.27 | 7 |
| TSS | 92 | 31 | 61 | 3,817 | 28.27 | 1,731 |

**Table 3-14: 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 | 6.40 | 1.53 | 4.87 | 3,285 | 24.33 | 59 |
| TP | 0.28 | 0.04 | 0.24 | 3,285 | 24.33 | 3 |
| TSS | 92 | 31 | 61 | 3,285 | 24.33 | 744 |

#### *3.4.2.11 Bayscaping*

Bayscaping refers to educating citizens about environmentally friendly lawn care techniques by reducing the amount of mowed lawn. Neighborhoods targeted for bayscaping education were those where the typical lot was at least ¼ acre in size, was less than 25 percent landscaped, and where there was sufficient grass area available (23 out of 91 NSAs). The total area of lawn that can be addressed through bayscaping is based on NSA results which are explained in Chapter 4 of the *Watershed Characterization Report.*

Pollutant reductions for bayscaping are calculated based on the pollutant load received from the total lawn DA recommended for bayscaping and removal efficiency. The equation used to estimate TN load reductions for bayscaping is expressed as:

$$\left[6.40(lbs/ac/yr)\times DA(acres)\right]\times 17\%$$

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

$$\left[0.28(lbs/ac/yr)\times DA(acres)\right]\times 22\%$$

No reduction of TSS is calculated for implementation of bayscaping.

The pollutant load received from the lawn area recommended for bayscaping is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 6.40 lbs TN/ac/yr, 0.28 lbs TP/ac/yr, and 92 lbs TSS/ac/yr are the pervious urban rates used in the pollutant loading analysis (Table 3-1) since this represents the source of runoff being addressed. Pollutant removal efficiencies are those reported for urban nutrient management, based on CBP guidance shown in

Appendix C under Urban and Mixed Open BMPs. A summary of bayscaping reduction calculations and results are shown in Table 3-15.

**Table 3-15: Bayscaping Load Reductions**

| Pollutant | Pervious Urban Loading Rate (lbs/ac/yr) | Estimated Area Available for Bayscaping (acres) | Removal Efficiency (%) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|
| TN | 6.40 | 115 | 17% | 125 |
| TP | 0.28 | 115 | 22% | 7 |
| TSS | 92 | 115 | 0% | 0 |

### *3.4.2.12 Street Sweeping*

Nineteen (19) neighborhoods were recommended for street sweeping in Bear Creek/Old Road Bay and contain approximately 31.5 miles of road. A review of the aerial mapping of the SWAP study area and specifically the neighborhoods recommended for street sweeping was conducted and an average street width of 30 feet was assumed to determine the total area of street sweeping

Pollutant reductions for street sweeping are calculated based on the pollutant load received from the total street DA recommended for sweeping and removal efficiency. The equation used to estimate TN load reductions for street sweeping is expressed as:

$$\left[9.64(lbs/ac/yr) \times DA(acres)\right] \times 3\%$$

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

$$\left[1.48(lbs/ac/yr) \times DA(acres)\right] \times 3\%$$

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

$$\left[676(lbs/ac/yr) \times DA(acres)\right] \times 3\%$$

The pollutant load received from the roadway areas recommended for street sweeping is represented by the first term in the brackets above which is the impervious urban pollutant loading rate. Removal efficiencies are those reported for urban nutrient management, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs. A summary of street sweeping reduction calculations and results are shown in Table 3-16.

**Table 3-16: Street Sweeping Load Reductions**

| Pollutant | Impervious Urban Loading Rate (lbs/ac/yr) | Proposed Miles of Street Sweeping (miles) | Proposed Area of Street Sweeping* (acres) | Removal Efficiency (%) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|---|
| TN | 9.64 | 44.7 | 162.6 | 3% | 47 |
| TP | 1.48 | 44.7 | 162.6 | 3% | 7 |
| TSS | 676 | 44.7 | 162.6 | 9% | 9,889 |

### *3.4.2.13 Sanitary Sewer Overflows*

A total of 35, SSO events were documented between 2000 and 2011 within the Bear Creek/Old Road Bay planning area. An estimated 439,993 gallons were discharged over this 12-year period. Pollutant loads associated with these SSO events and volume were calculated based on the following assumptions (more detail can be found in Section 3.5 of the *Watershed Characterization Report*):

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

Based on these conversion factors, approximately 219 lbs of TN, 37 lbs of TP, and 1,461 lbs of TSS were released over the 12-year period as a result of SSOs. This is equivalent to pollutant reduction capabilities of 18 lbs TN/yr, 3 lbs TP/yr, and 122 lbs TSS/yr. Note that TN, TP, and TSS concentrations shown above are values for wastewater characteristics from CWP's Watershed Treatment Model version 3.1.

### *3.4.2.14 Proposed Shoreline Enhancements*

Shoreline enhancement concepts were developed for seven (7) reaches in Bear Creek/Old Road Bay as part of EPS's Shoreline Feasibility Study (EPS 1998). Nutrient reductions associated with the proposed shoreline enhancement project are estimated based on length of reach and pollutant removal rates from MDE's *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated*. Shoreline lengths were estimated from project concept plans in the feasibility study. The equation used to estimate TN load reductions for shoreline enhancement is expressed as:

$$\left[0.16(lbs/linearfoot) \times reach_length(feet)\right]$$

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

$$\left[0.11(lbs/linearfoot) \times reach_length(feet)\right]$$

The equation used to estimate TSS load reductions for shoreline enhancement is expressed as:

$$\left[451(lbs/linearfoot)\times reach_length(feet)\right]$$

A summary of potential shoreline enhancement project reduction calculations and results are shown in Table 3-17.

**Table 3-17: Shoreline Enhancement Load Reductions**

| Proposed Project Location | Proposed Length (ft) | Reduction in TN Loading Rate (lbs/ft) | Reduction in TP Loading Rate (lbs/ft) | Reduction in TSS Loading Rate (lbs/ft) | Max Potential TN Reduction (lbs/yr) | Max Potential TP Reduction (lbs/yr) | Max Potential TSS Reduction (lbs/yr) |
|---|---|---|---|---|---|---|---|
| Concrete Homes Park | 4,200 | 0.16 | 0.11 | 451 | 672 | 462 | 1,894,200 |
| Stansbury Park | 300 | 0.16 | 0.11 | 451 | 48 | 33 | 135,300 |
| West Inverness Park | 2,600 | 0.16 | 0.11 | 451 | 416 | 286 | 1,172,600 |
| Jones Creek | 9,000 | 0.16 | 0.11 | 451 | 1,440 | 990 | 4,059,000 |
| Fort Howard Park (Fastland Park segment) | 2,200 | 0.16 | 0.11 | 451 | 352 | 242 | 992,200 |
| Fort Howard Park ( Bay Marsh segment) | 1,600 | 0.16 | 0.11 | 451 | 256 | 176 | 721,600 |
| North Point State Park | 3,800 | 0.16 | 0.11 | 451 | 608 | 418 | 1,713,800 |
| ***Totals:*** | ***23,700*** | ***0.16*** | ***0.11*** | ***451*** | ***3,792*** | ***2,607*** | ***10,688,700*** |

### *3.4.2.15 Potential Redevelopment of Urban Areas*

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

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

$$\left[7.56(lbs/ac/yr)\times DA(acres)\right]\times 59\%$$

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

$$\left[0.71(lbs/ac/yr)\times DA(acres)\right]\times 55\%$$

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

$$\left[301(lbs/ac/yr)\times DA(acres)\right]\times 60\%$$

A summary of potential urban redevelopment reduction calculations and results are shown in Table 3-18.

**Table 3-18: Load Reductions from Redevelopment of Urban Land**

| Pollutant | Weighted Urban Loading Rate (lbs/ac/yr) | Estimated Area Available for Redevelopment (acres) | Removal Efficiency (%) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|
| TN | 7.56 | 1191 | 59% | 5,310 |
| TP | 0.71 | 1191 | 55% | 464 |
| TSS | 301 | 1191 | 60% | 214,996 |

### *3.4.2.16 Fertilizer Act of 2011*

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

Pollutant reductions from the Fertilizer Act of 2011 are calculated based on the pollutant removal efficiencies from the current pervious urban nutrient loading developed from Table 3-1. The equation used to estimate TN load reductions from redevelopment is expressed as:

$$\left[6.40(lbs/ac/yr)\times Urban_Pervious_Area(acres)\right]\times 17\%$$

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

$$\left[0.28(lbs/ac/yr)\times Urban_Pervious_Area(acres)\right]\times 22\%$$

It is assumed that no reduction in TSS will occur because of the new law. Calculations and results of the nutrient reductions derived from the Fertilizer Act of 2011 are summarized in Table 3-19.

**Table 3-19: Load Reductions from Fertilizer Act of 2011**

| Pollutant | Pervious Urban Loading Rate (lbs/ac/yr) | Pervious Urban Area (acres) | Removal Efficiency (%) | Max Potential Load Reduction (lbs/yr) |
|---|---|---|---|---|
| TN | 6.40 | 5,996 | 17% | 6,523 |
| TP | 0.28 | 5,996 | 22% | 368 |
| TSS | 92 | 5,996 | 0% | 0 |

#### *3.4.2.17 Overall Pollutant Load Reductions*

The sum of maximum potential pollutant load reductions calculated for individual BMPs represents the overall pollutant removal capacity for a maximum implementation scenario (i.e., 100% of projects implemented). A practicable pollutant load reduction was estimated for each BMP as the maximum potential load reduction multiplied by a projected participation factor. An overall projected pollutant removal capacity is the sum of practicable pollutant load reductions for individual BMPs. Projected participation factor assumptions are described in Table 3-20. Participation rates for existing measures that have already been implemented are 100%.

**Table 3-20: Projected Participation Factors**

| BMP | Projected Participation | Basis of Assumption |
|---|---|---|
| SWM Conversions | 50% | Complete 3 conversions |
| SW Retrofits (NSA, ISI, PAA) | 50% | General estimate to achieve reduction goal |
| NSA SW Retrofit | 50% | General estimate to achieve reduction goal |
| ISI SW Retrofit | 50% | General estimate to achieve reduction goal |
| HSI SW Retrofit | 50% | General estimate to achieve reduction goal |
| PAA SW Retrofit | 50% | General estimate to achieve reduction goal |
| ISI Impervious Cover Removal | 75% | General estimate to achieve reduction goal |
| Reforest Stream Buffer | 20% | General estimate to achieve reduction goal |
| Reforest Shoreline Buffer | 10% | General estimate to achieve reduction goal |
| Pervious Area Reforestation | 90% | General estimate to achieve reduction goal |
| NSA Downspout Disconnection | 67% | 67% willingness factor |
| NSA Tree Plantings | 75% | 75% willingness factor |
| ISI Tree Plantings | 88% | 88% of estimated trees on public lands |
| NSA Bayscaping Education | 2% | 10% recall rate (workshop/public mtg) * 25% willingness factor |
| Street Sweeping | 100% | General estimate to achieve reduction goal |
| Shoreline Enhancement | 75% | General estimate to achieve reduction goal |
| Redevelopment of Urban Areas | 67% | General estimate to achieve reduction goal |
| Credits for Fertilizer Act of 2011 | 100% | 100% participation as part of Maryland law |

Table 3-21 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. Currently, the project implementation plan shown in Table 3-20 does not meet the 2017 and 2025 goals for nitrogen and phosphorous reduction. Consequently, since nutrient reduction goals are not being met, it is assumed that the required sediment reductions will not be met for the planning area. There are opportunities to achieve greater reductions if restoration BMPs are implemented to a greater extent than those assumed by projected participation factors. Greater reductions may also be achieved through restoration actions not included in this analysis such as public education/outreach efforts (e.g., watershed trash and recycling campaign, 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.

**Table 3-21: Summary of Pollutant Load Reduction Estimates**

| BMP | How Credited | TN Efficiency | TP Efficiency | TSS Efficiency | Units Available | | Projected Participation | Max Potential TN Load Reduction | Max Potential TP Load Reduction | Max Potential TSS Load Reduction | Projected 2017 TN Load Reduction | Projected 2017 TP Load Reduction | Projected 2017 TSS Load Reduction | Projected 2025 TN Load Reduction | Projected 2025 TP Load Reduction | Projected 2025 TSS Load Reduction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Completed Measures** | | | | | | | | | | | | | | | | |
| CIP - Shoreline Enhancement | NPDES Permit | varies | varies | varies | 7,512 | ft | 100% | 883 | 581 | 2,419,509 | 883 | 581 | 2,419,509 | 883 | 581 | 2,419,509 |
| Existing SWM | Efficiency | varies | varies | varies | 749 | acres | 100% | 919 | 168 | 100,703 | 919 | 168 | 100,703 | 919 | 168 | 100,703 |
| SSO Reduction/Elimination | Direct Removal | N/A | N/A | N/A | 223,390 | gal | 100% | 18 | 3 | 122 | 18 | 3 | 122 | 18 | 3 | 122 |
| **Proposed Measures** | | | | | | | | | | | | | | | | |
| SWM Conversions | Efficiency | 15% | 10% | 50% | 80 | acres | 50% | 90 | 6 | 11,982 | 30 | 2 | 3,994 | 45 | 3 | 5,991 |
| SW Retrofits (NSA, ISI, PAA) | Efficiency | 50% | 60% | 90% | 11 | acres | 50% | 51 | 9 | 6,442 | 15 | 3 | 1,841 | 26 | 5 | 3,221 |
| NSA SW Retrofit | Efficiency | 50% | 60% | 90% | 5 | acres | 50% | 22 | 4 | 2,835 | 6 | 1 | 810 | 11 | 2 | 1,418 |
| ISI SW Retrofit | Efficiency | 50% | 60% | 90% | 5 | acres | 50% | 26 | 5 | 3,259 | 7 | 1 | 931 | 13 | 2 | 1,629 |
| HSI SW Retrofit | Efficiency | 50% | 60% | 90% | 0 | acres | 50% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PAA SW Retrofit | Efficiency | 50% | 60% | 90% | 1 | acres | 50% | 3 | 1 | 348 | 1 | 0 | 100 | 1 | 0 | 174 |
| ISI Impervious Cover Removal | LU Conversion | N/A | N/A | N/A | 1 | acre | 75% | 5 | 2 | 845 | 4 | 1 | 633 | 4 | 1 | 633 |
| Reforest Stream Buffer | LU Conversion + Efficiency | 25% | 50% | 50% | 227 | acres | 20% | 1,109 | 55 | 14,043 | 85 | 4 | 1,080 | 222 | 11 | 2,809 |
| Reforest Shoreline Buffer | LU Conversion | N/A | N/A | N/A | 360 | acres | 10% | 1,755 | 87 | 22,055 | 68 | 3 | 848 | 176 | 9 | 2,206 |
| Pervious Area Reforestation | LU Conversion | N/A | N/A | N/A | 20 | acres | 90% | 98 | 5 | 1,233 | 34 | 2 | 427 | 88 | 4 | 1,109 |
| NSA Downspout Disconnection | Efficiency | 50% | 60% | 90% | 288 | acres | 67% | 1,386 | 256 | 175,023 | 357 | 66 | 45,102 | 929 | 171 | 117,266 |
| NSA Tree Plantings | LU Conversion | N/A | N/A | N/A | 28 | acres | 75% | 138 | 7 | 1,731 | 40 | 2 | 499 | 103 | 5 | 1,298 |
| ISI Tree Plantings | LU Conversion | N/A | N/A | N/A | 24 | acres | 88% | 119 | 6 | 1,489 | 40 | 2 | 504 | 104 | 5 | 1,311 |
| NSA Bayscaping Education | Efficiency | 17% | 22% | 0% | 115 | acres | 2% | 125 | 7 | 0 | 2 | 0 | 0 | 2 | 0 | 0 |
| Street Sweeping | Efficiency | 3% | 3% | 9% | 45 | miles | 100% | 47 | 7 | 9,889 | 47 | 7 | 9,889 | 47 | 7 | 9,889 |
| Shoreline Enhancement | Lbs per Ln Ft | 0.16 | 0.11 | 451 | 23,700 | ft | 75% | 3,792 | 2,607 | 10,688,700 | 711 | 489 | 2,004,131 | 2,844 | 1,955 | 8,016,525 |
| Redevelopment of Urban Areas | Efficiency | 59% | 55% | 60% | 1,191 | acres | 67% | 5,310 | 464 | 214,996 | 2,023 | 177 | 81,916 | 3,558 | 311 | 144,047 |
| Credits for Fertilizer Act of 2011 | Efficiency | 17% | 22% | 0% | 5,996 | acres | 100% | 6,523 | 368 | 0 | 6,523 | 368 | 0 | 6,523 | 368 | 0 |
| Additional Retrofits to be Identified | Efficiency | POLLUTION REDUCTION PROJECTS TO BE INDENTIFIED AND QUANTIFIED IN THE FUTURE | | | | | | | | | | | | | | |
| Adjusted Credits for Stream Restoration | Lbs per Ln Ft | POLLUTION REDUCTION PROJECTS TO BE INDENTIFIED AND QUANTIFIED IN THE FUTURE | | | | | | | | | | | | | | |
| | | | | | | | ***Total Load Reduction (lbs/yr):*** | ***22,368*** | ***4,637*** | ***13,668,763*** | ***11,799*** | ***1,877*** | ***4,671,199*** | ***16,491*** | ***3,607*** | ***10,826,639*** |
| | | | | | | | Total Existing Urban Load (lbs/yr) | 70,516 | 6,608 | 2,807,565 | 70,516 | 6,608 | 2,807,565 | 70,516 | 6,608 | 2,807,565 |
| | | | | | | | ***Reduction Achieved:*** | ***32%*** | ***70%*** | ***487%*** | ***17%*** | ***28%*** | ***166%*** | ***23%*** | ***55%*** | ***386%*** |
| | | | | | | | ***Chesapeake Bay TMDL Reduction Goals*** | | | | ***14,308*** | ***2,086*** | ***-*** | ***14,308*** | ***2,086*** | ***-*** |

# CHAPTER 4: SUBWATERSHED MANAGEMENT STRATEGIES

## 4.1 Introduction

This chapter describes the criteria and methodology used to rank the 14 subwatersheds comprising the Bear Creek/Old Road Bay planning area (see Figure 4-1). The subwatershed ranking provides a tool for targeting restoration actions by location/water body. This chapter also summarizes management strategies and implementation priorities within each subwatershed. Individual subwatershed summaries include key subwatershed characteristics. More detailed information on a subwatershed basis can be found in the *Bear Creek/Old Road Bay Watershed Characterization Report* included as Appendix E.

## 4.2 Subwatershed Prioritization

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

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

- Nitrogen Loads
- Phosphorus Loads
- Sediment Load
- Impervious Surfaces
- Neighborhood Restoration Opportunity/Pollution Source Indexes
- Neighborhood Downspout Disconnection
- Neighborhood Trash Management
- Industrial and Commercial Areas
- Institutional Site Index
- Pervious Area Restoration
- Municipal Street Sweeping
- Municipal Stormwater Conversions
- Illicit Discharge Data
- Stream Buffer Improvement
- Shoreline Buffer Improvement

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

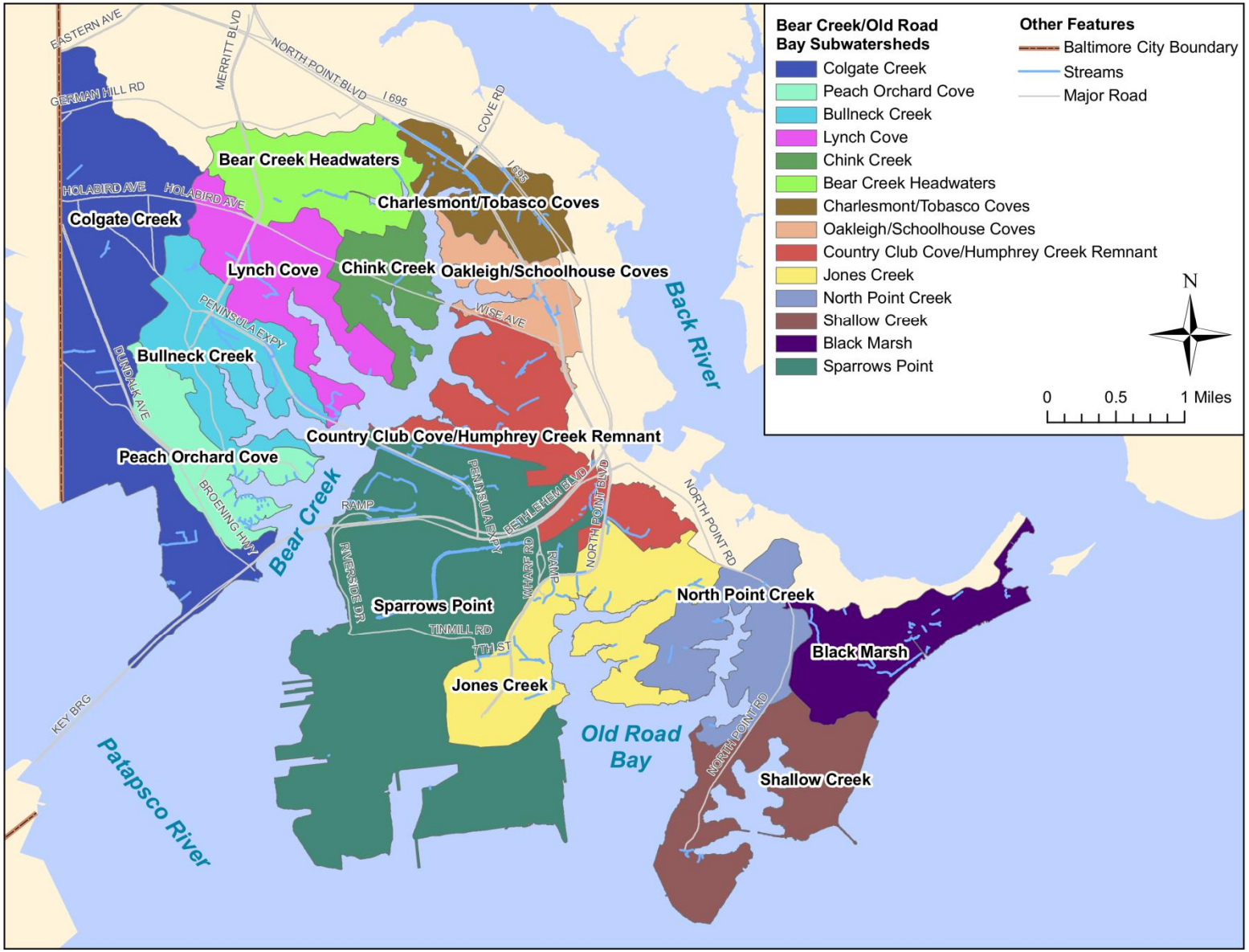


Figure 4-1: Bear Creek/Old Road Bay Subwatersheds

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

### 4.2.1 Nitrogen, Phosphorus, and Sediment Loads

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

For each subwatershed, annual nitrogen, phosphorus, and sediment loads were divided by the subwatershed's area. This represents pollutant loadings rates (lbs/acre/year) and allows a direct comparison between the 14 subwatersheds since they vary greatly in size. Subwatersheds with higher pollutant loading rates are higher priorities for restoration within the Middle Bear Creek/Old Road Bay. Therefore, higher pollutant loading rates are assigned high scores to denote greater water quality impacts and restoration need.

Subwatershed nitrogen loading rates ranged from 3.59 to 8.64 lbs/acre/year. The following point system was used to assign nitrogen load scores to the 14 subwatersheds based on the range and distribution of subwatershed nitrogen loading rates:

- ≥ 8.00 lbs/acres/year = 4 pts
- 7.40 – 7.99 lbs/acre/year = 3 pts
- 6.25 – 7.39 lbs/acre/year = 2 pts
- ≤ 6.24 lbs/acre/year = 1 pt

Subwatershed phosphorus loading rates ranged from 0.21 to 0.79 lbs/acre/year. The following point system was used to assign phosphorus load scores to the 14 subwatersheds based on the range and distribution of subwatershed phosphorus loading rates:

- ≥ 0.75 lbs/acres/year = 4 pts
- 0.70 – 0.74 lbs/acre/year = 3 pts
- 0.50– 0.74 lbs/acre/year = 2 pts
- ≤ 0.49 lbs/acre/year = 1 pt

Subwatershed sediment loading rates ranged from 109 to 343 lbs/acre/year. The following point system was used to assign sediment load scores to the 14 subwatersheds based on the range and distribution of subwatershed phosphorus loading rates:

- ≥ 325 lbs/acres/year = 4 pts
- 275 – 324 lbs/acre/year = 3 pts
- 225– 274 lbs/acre/year = 2 pts
- ≤ 224 lbs/acre/year = 1 pt

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

**Table 4-1: Nitrogen and Phosphorus Load Scores**

| SUBWATERSHED | Nitrogen Loading Rate (lbs/acre/yr) | Nitrogen Load Score | Phosphorus Loading Rate (lbs/acre/yr) | Phosphorus Load Score | Sediment Loading Rate (lbs/acre/yr) | Sediment Load Score |
|---|---|---|---|---|---|---|
| Colgate Creek | 7.62 | 3 | 0.79 | 4 | 341 | 4 |
| Peach Orchard Cove | 7.47 | 3 | 0.71 | 3 | 303 | 3 |
| Bullneck Creek | 7.24 | 2 | 0.63 | 2 | 264 | 2 |
| Lynch Cove | 7.49 | 3 | 0.71 | 3 | 302 | 3 |
| Chink Creek | 7.40 | 3 | 0.70 | 3 | 296 | 3 |
| Bear Creek Headwaters | 7.55 | 3 | 0.72 | 3 | 309 | 3 |
| Charlesmont/Tobasco Coves | 7.22 | 2 | 0.78 | 4 | 343 | 4 |
| Oakleigh/Schoolhouse Coves | 7.58 | 3 | 0.76 | 4 | 326 | 4 |
| Country Club Cove/Humphrey Creek Remnant | 6.25 | 2 | 0.53 | 2 | 223 | 2 |
| Jones Creek | 6.31 | 2 | 0.55 | 2 | 236 | 2 |
| North Point Creek | 8.64 | 4 | 0.62 | 2 | 286 | 3 |
| Shallow Creek | 8.23 | 4 | 0.53 | 2 | 260 | 2 |
| Black Marsh | 3.59 | 1 | 0.21 | 1 | 109 | 1 |
| Sparrows Point | 6.72 | 2 | 0.58 | 2 | 245 | 2 |

### 4.2.2 Impervious Surfaces

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

As described in the *Watershed Characterization Report*, roads and buildings data layers were used to derive impervious surface areas and the percent impervious area for each subwatershed. Similar to the pollutant load criteria, percentages of impervious area for subwatersheds were used to assign scores as it allows a direct comparison between the 14 subwatersheds. Subwatersheds with higher percentages of impervious cover are higher priorities for restoration within Bear Creek/Old Road Bay. Therefore,

higher percentages of imperviousness are assigned high scores to denote greater water quality impacts and restoration need.

Impervious cover represents about 29.2% of the overall Bear Creek/Old Road Bay watershed. Subwatershed percent impervious values range from approximately 4.4 to 44.3%. The Center for Watershed Protection (CWP) compiled stream research conducted in various parts of the country and developed a simple model that relates stream quality to percentage of impervious cover in a watershed. The following point system was used to assign percent impervious scores to the 14 subwatershed based on CWP's Impervious Cover model (see Section 2.3.3 of the *Watershed Characterization Report*) and subwatershed impervious surface percentages:

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

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

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

| SUBWATERSHED | % Impervious | % Impervious Score |
|---|---|---|
| Colgate Creek | 43% | 3 |
| Peach Orchard Cove | 36% | 3 |
| Bullneck Creek | 30% | 3 |
| Lynch Cove | 36% | 3 |
| Chink Creek | 35% | 3 |
| Bear Creek Headwaters | 37% | 3 |
| Charlesmont/Tobasco Coves | 44% | 3 |
| Oakleigh/Schoolhouse Coves | 40% | 3 |
| Country Club Cove/Humphrey Creek Remnant | 25% | 2 |
| Jones Creek | 27% | 3 |
| North Point Creek | 16% | 2 |
| Shallow Creek | 8% | 1 |
| Black Marsh | 4% | 1 |
| Sparrows Point | 27% | 3 |

### 4.2.3 Neighborhood Restoration Opportunity/Pollution Source Indexes

As described in the *Watershed Characterization Report*, neighborhood pollution severity and restoration potential were rated during NSAs. The severity of pollution generated by a neighborhood is denoted by the Pollution Severity Index (PSI) and was rated as severe, high, moderate, or none. A neighborhood's potential for residential restoration projects was also rated as high, moderate, or low according to the Restoration Opportunity Index (ROI). Out of the 91 neighborhoods assessed, the majority were rated as both moderate for PSI and ROI. Three (3) were rated as high for both PSI and ROI, two (2) were rated as a high PSI with a moderate ROI, and ten (10) were rated as a moderate PSI with a high ROI.

Neighborhoods with high PSI and high ROI ratings represent the best areas to initially target for restoration. Because some neighborhoods were encompassed within two separate subwatersheds, those neighborhoods were counted for both subwatersheds to portray a more accurate subwatershed ranking.

Two subwatersheds, Colgate Creek and Peach Orchard Cove, were given a score of four (4). Colgate Creek intersects the highest number of neighborhoods, 34, while Peach Orchard Cove is the only subwatershed to have multiple neighborhoods rated as high for both PSI/ROI. Bullneck Creek, Lynch Cove, and Bear Creek Headwaters were the only other subwatersheds with at least one neighborhood rated as high for both PSI/ROI and were given a score of three (3). The remaining subwatersheds with either a PSI or ROI rating of high were given a score of two (2). Subwatersheds with no neighborhoods rated as high for PSI or ROI were given a score of one (1). PSI/ROI ratings and corresponding NSA PSI/ROI scores are summarized in Table 4-3 below by subwatershed. One watershed (Sparrows Point) had no neighborhoods and was thus assigned a score of zero (0).

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

| SUBWATERSHED | # of NEIGHBORHOODS FOR PSI/ROI RATINGS | | | | | | | NSA PSI/ROI Score |
|---|---|---|---|---|---|---|---|---|
| | High/ High | High/ Mod | High/ Low | Mod/ High | Mod/ Mod | Mod/ Low | None/ Mod | |
| Colgate Creek | 1 | | | 2 | 28 | 2 | 1 | 4 |
| Peach Orchard Cove | 2 | | | 3 | 8 | 1 | 1 | 4 |
| Bullneck Creek | 1 | | | 4 | 4 | | 1 | 3 |
| Lynch Cove | 1 | | | 4 | 7 | 1 | | 3 |
| Chink Creek | | 1 | | 4 | 5 | | | 2 |
| Bear Creek Headwaters | 1 | | | 2 | 6 | | | 3 |
| Charlesmont/Tobasco Coves | | | | | 6 | | | 1 |
| Oakleigh/Schoolhouse Coves | | | | | 5 | | | 1 |
| Country Club Cove/Humphrey Creek Remnant | | | | | 5 | | | 1 |
| Jones Creek | | | | | 6 | 1 | | 1 |
| North Point Creek | | | | | 5 | | 1 | 1 |
| Shallow Creek | | | | | 4 | | | 1 |
| Black Marsh | | 1 | | | 1 | | | 2 |
| Sparrows Point | | | | | | | | 0 |

### 4.2.4 Neighborhood Downspout Disconnection

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

Downspout disconnection was recommended for neighborhoods where at least 25 percent of the downspouts are connected to impervious area or directly to the storm drain system and where the average lot has at least 15 feet of pervious area available down gradient from the connected downspout

for redirection. Similar to lawn fertilizer reduction, this criterion is used for subwatershed prioritization because it has a quantitative pollution reduction efficiency related to nutrient reduction goals.

The acres of rooftop addressed if downspout disconnection were initiated in the recommended neighborhoods were calculated in the *Watershed Characterization Report*. The percentage of subwatershed rooftop area addressed was also calculated and was used to compare the restoration potential among the 14 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 0 to 46%. One subwatershed had no NSA and was assigned a score of zero (0). The following point system was used to assign downspout disconnect scores to the 14 subwatersheds based on the distribution and range of percentages of subwatershed rooftop areas addressed:

- ≥ 41% = 4 pts
- 30 – 40% = 3 pts
- 19 – 29% = 2 pts
- ≤ 18% = 1 pt

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

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

| SUBWATERSHED | % Rooftop Area Addressed | NSA Downspout Disconnect Score |
|---|---|---|
| Colgate Creek | 46% | 4 |
| Peach Orchard Cove | 46% | 4 |
| Bullneck Creek | 34% | 3 |
| Lynch Cove | 40% | 3 |
| Chink Creek | 38% | 3 |
| Bear Creek Headwaters | 45% | 4 |
| Charlesmont/Tobasco Coves | 14% | 1 |
| Oakleigh/Schoolhouse Coves | 21% | 2 |
| Country Club Cove/Humphrey Creek Remnant | 12% | 1 |
| Jones Creek | 20% | 2 |
| North Point Creek | 36% | 3 |
| Shallow Creek | 25% | 2 |
| Black Marsh | 40% | 3 |
| Sparrows Point | 0% | 0 |

### 4.2.5 Neighborhood Trash Management

Trash is one of the major pollutants of concern and focuses of the Steering Committee's Goals in Bear Creek/Old Road Bay. For this reason, NSA results for trash pollution sources and management

opportunities were used as a criterion for prioritizing subwatershed. Trash management initiatives involve raising awareness of the trash issue and ways to solve it. Some ways to raise citizen awareness of trash as a problem include community cleanups, trash management education (e.g., presentations about recycling, reuse, and disposal options), storm drain markers, a watershed trash campaign, and/or targeted trash can inspection throughout a neighborhood.

Neighborhoods where junk or trash was observed in 15 percent of yards were recommended for trash management initiatives. Neighborhoods with less than 15 percent of yards with junk/trash but had other warning signs such as overflowing dumpsters or dumping in alleys or other common areas were also included as a potential source of trash pollution. The acres of land addressed if trash management was implemented in the recommended neighborhoods were calculated for each subwatershed in the *Watershed Characterization Report*. The percentages of subwatershed areas addressed via neighborhood trash management were also calculated. This was used to directly compare restoration potential among the 14 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 40 percent. The following point system was used to assign trash management scores to the 14 subwatershed based on the distribution and range of percentages of subwatershed areas addressed:

- ≥ 40% = 4 pts
- 31 – 39% = 3 pts
- 21 – 30% = 2 pts
- 1 – 19% = 1 pt

Percentage of area addressed by neighborhood trash management and corresponding scores are summarized in Table 4-5 by subwatershed. Subwatersheds with an area addressed value of 0% were assigned no score.

**Table 4-5: NSA Trash Management Scores**

| SUBWATERSHED | % Area Addressed | NSA Trash Management Score |
|---|---|---|
| Colgate Creek | 0.7% | 1 |
| Peach Orchard Cove | 40.2% | 4 |
| Bullneck Creek | 24.2% | 2 |
| Lynch Cove | 33.8% | 3 |
| Chink Creek | 29.5% | 2 |
| Bear Creek Headwaters | 0.9% | 1 |
| Charlesmont/Tobasco Coves | 0.0% | 0 |
| Oakleigh/Schoolhouse Coves | 0.0% | 0 |
| Country Club Cove/Humphrey Creek Remnant | 0.0% | 0 |
| Jones Creek | 0.2% | 1 |
| North Point Creek | 0.0% | 0 |
| Shallow Creek | 0.0% | 0 |
| Black Marsh | 0.0% | 0 |
| Sparrows Point | 0.0% | 0 |

### 4.2.6 Industrial and Commercial Areas

Industrial and commercial land uses in a watershed have the potential to contribute higher pollutant loadings to surface waters due to the nature of the operations that occur in these locations. Many of these areas can be classified as hotspots. In the Bear Creek/Old Road Bay planning area, 36% of the upland area is categorized as either commercial or industrial in the 2007 land use data from the MDP.

Percentages of subwatershed areas comprised of commercial or industrial land uses range from approximately 0 to 87 percent. The following point system was used to develop industrial and commercial area scores to the 14 subwatershed based on the distribution and range of percentages of subwatershed areas categorized as industrial or commercial:

- ≥ 40% = 4 pts
- 31 – 39% = 3 pts
- 11 – 30% = 2 pts
- ≤ 10% = 1 pt

Percentages of industrial or commercial area in each subwatershed and corresponding scores are summarized in Table 4-6 by subwatershed. Subwatersheds with an area value of 0% were assigned no score.

**Table 4-6: Industrial and Commercial Area Scores**

| SUBWATERSHED | % Industrial and Commercial Area | Industrial and Commercial Area Score |
|---|---|---|
| Colgate Creek | 34.5% | 3 |
| Peach Orchard Cove | 7.6% | 1 |
| Bullneck Creek | 7.3% | 1 |
| Lynch Cove | 12.8% | 2 |
| Chink Creek | 1.9% | 1 |
| Bear Creek Headwaters | 20.6% | 2 |
| Charlesmont/Tobasco Coves | 49.3% | 4 |
| Oakleigh/Schoolhouse Coves | 37.1% | 3 |
| Country Club Cove/Humphrey Creek Remnant | 29.6% | 2 |
| Jones Creek | 32.7% | 3 |
| North Point Creek | 0.3% | 0 |
| Shallow Creek | 0.0% | 0 |
| Black Marsh | 0.5% | 1 |
| Sparrows Point | 87.1% | 4 |

### 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 19 community-based facilities were surveyed during Institutional Site Investigations (ISIs) including faith-based facilities, community centers, municipal facilities (e.g., fire and rescue stations), schools, and care centers (e.g., nursing homes). The focus of ISIs is to identify potential restoration opportunities, educate the community and provide water quality benefits. Subwatersheds with more institutional sites present more opportunities for implementing restoration actions (e.g., tree planting, stormwater retrofits, community cleanups, etc.) and encouraging citizen participation. Public institutional sites are good candidates for initial restoration efforts because there are opportunities to make use of and build upon existing partnerships and in many cases, incorporate student projects. While private institutions also have restoration potential, they will require a different approach and the development of new partnerships to implement restoration efforts. For all of these reasons, subwatershed prioritization for this criterion was based on the number of institutions and considering public versus private ownership.

For purposes of this prioritization, publicly owned ISIs are given a greater score because they have the greatest restoration potential. The number of publicly owned institutions were summed and then multiplied by two to give them a weighted score. The number of privately owned institutions was then added to this number to give a total weighted number. The following point system was used to assign institutional site scores to the 14 subwatersheds based on the distribution and range ISIs addressed:

- ≥ 6 = 4 pts
- 4 – 5 = 3 pts

- 2 – 3 = 2 pts
- 1 = 1 pt

The total number of institutions including public versus private ISIs and corresponding institutional site index scores are summarized by subwatershed in Table 4-7. Subwatersheds with no assessed institutions were assigned a score of 0.

**Table 4-7: ISI Scores**

| SUBWATERSHED | # of Public ISIs | Weighted # of Public ISIs (x2) | # of Private ISIs | Total Weighted # of ISIs | ISI Score |
|---|---|---|---|---|---|
| Colgate Creek | 3 | 6 | 1 | 7 | 4 |
| Peach Orchard Cove | 1 | 2 | 0 | 2 | 2 |
| Bullneck Creek | 2 | 4 | 0 | 4 | 3 |
| Lynch Cove | 3 | 6 | 1 | 7 | 4 |
| Chink Creek | 1 | 2 | 0 | 2 | 2 |
| Bear Creek Headwaters | 1 | 2 | 0 | 2 | 2 |
| Charlesmont/Tobasco Coves | 1 | 2 | 0 | 2 | 2 |
| Oakleigh/Schoolhouse Coves | 0 | 0 | 1 | 1 | 1 |
| Country Club Cove/Humphrey Creek Remnant | 0 | 0 | 1 | 1 | 1 |
| Jones Creek | 0 | 0 | 1 | 1 | 1 |
| North Point Creek | 1 | 2 | 0 | 2 | 2 |
| Shallow Creek | 1 | 2 | 0 | 2 | 2 |
| Black Marsh | 0 | 0 | 0 | 0 | 0 |
| Sparrows Point | 0 | 0 | 0 | 0 | 0 |

### 4.2.8 Pervious Area Reforestation

The most likely candidates for successful pervious area reforestation efforts are those on public lands with minimal site preparation required. Public sites are eligible for tree planting through DNR's "Tree-Mendous Maryland" program and are good opportunities for volunteer or community projects. Privately-owned lands are often planned for future development or expansion of an existing facility. In addition, larger open parcels have greater potential for reforestation and water quality benefits than smaller areas. Subwatershed prioritization related to pervious area reforestation was based on the number of possible sites, the acreage of land, and ownership of land found in each subwatershed as described in the *Watershed Characterization Report*. Percentages of subwatershed areas available for pervious area reforestation range from approximately 0 to 31 percent.

For purposes of this prioritization, sites that are in public ownership are given a greater score because of the greater likelihood that they can be converted to tree cover. The acres of PAAs in public ownership were summed and then multiplied by two to give them a weighted score. The acres of PAAs in private ownership were then added to this number to give a total weighted acreage. The total weighted acreage was then divided by the total acres of the subwatershed to normalize the acreage across the five subwatersheds. The following point system was used to assign pervious area scores to the five subwatersheds based on the distribution and range of percentages of subwatershed areas addressed:

- ≥ 20.0% = 4 pts
- 10.0 – 19.9% = 3 pts
- 1.1 – 9.9% = 2 pts
- ≤ 1.0% = 1 pt

Public pervious area acreages and corresponding scores are summarized in Table 4-8 by subwatershed. Subwatersheds with no assessed pervious areas were assigned a score of 0.

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

| SUBWATERSHED | Public Acres | Weighted Public Acres (x2) | Private Acres | Total Weighted Acres | % Acres Per Subwatershed | PAA Score |
|---|---|---|---|---|---|---|
| Colgate Creek | 19.3 | 38.6 | 0.0 | 38.6 | 2.3% | 2 |
| Peach Orchard Cove | 17.0 | 33.9 | 0.0 | 33.9 | 7.5% | 2 |
| Bullneck Creek | 98.7 | 197.3 | 0.0 | 197.3 | 31.2% | 4 |
| Lynch Cove | 44.7 | 89.4 | 1.0 | 90.3 | 13.9% | 3 |
| Chink Creek | 5.0 | 10.0 | 10.3 | 20.3 | 5.6% | 2 |
| Bear Creek Headwaters | 36.0 | 72.0 | 0.0 | 72.0 | 12.2% | 3 |
| Charlesmont/Tobasco Coves | 1.1 | 2.2 | 0.0 | 2.2 | 0.5% | 1 |
| Oakleigh/Schoolhouse Coves | 0.0 | 0.0 | 0.0 | 0.0 | 0.0% | 0 |
| Country Club Cove/Humphrey Creek Remnant | 0.0 | 0.0 | 0.0 | 0.0 | 0.0% | 0 |
| Jones Creek | 8.3 | 16.6 | 8.8 | 25.4 | 2.8% | 2 |
| North Point Creek | 0.0 | 0.0 | 0.0 | 0.0 | 0.0% | 0 |
| Shallow Creek | 35.3 | 70.6 | 0.0 | 70.6 | 10.0% | 3 |
| Black Marsh | 0.5 | 1.1 | 0.0 | 1.1 | 0.2% | 1 |
| Sparrows Point | 8.7 | 17.5 | 0.0 | 17.5 | 0.6% | 1 |

### 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 15.8. The following point system was used to assign street sweeping scores to the 14 subwatershed based on the distribution and range of miles addressed:

- ≥ 12.0 miles = 4 pts
- 9.0 – 11.9 miles = 3 pts
- 6.0 – 8.9 miles = 2 pts
- 0.1 – 5.9 miles = 1 pt

Subwatersheds with no street sweeping recommended were assigned a score of 0. Miles addressed by municipal street sweeping and corresponding scores are summarized in Table 4-9 by subwatershed.

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

| SUBWATERSHED | Miles of Road Addressed | Street Sweeping Score |
|---|---|---|
| Colgate Creek | 3.2 | 1 |
| Peach Orchard Cove | 10.5 | 3 |
| Bullneck Creek | 6.4 | 2 |
| Lynch Cove | 0.0 | 0 |
| Chink Creek | 8.1 | 2 |
| Bear Creek Headwaters | 0.0 | 0 |
| Charlesmont/Tobasco Coves | 0.6 | 1 |
| Oakleigh/Schoolhouse Coves | 15.8 | 4 |
| Country Club Cove/Humphrey Creek Remnant | 0.0 | 0 |
| Jones Creek | 0.0 | 0 |
| North Point Creek | 0.0 | 0 |
| Shallow Creek | 0.0 | 0 |
| Black Marsh | 0.0 | 0 |
| Sparrows Point | 0.0 | 0 |

### 4.2.10 Municipal Stormwater Conversions

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

Nine (9) 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 nine (9) detention ponds assessed, six (6) were considered as having either horizontal or vertical potential for conversion to an extended detention facility.

Subwatershed scoring for stormwater conversion potential is based upon the potential for horizontal and vertical expansion at dry ponds in the 14 subwatersheds. Subwatersheds with multiple ponds and

at least one (1) with the potential for horizontal or vertical expansion were given the highest score (4 points). Subwatersheds with only a single pond with both horizontal and vertical expansion potential were given a score of 3 points. Subwatersheds with at least one pond having only horizontal expansion or vertical expansion potential were given a score of 2 points. Subwatersheds with ponds with no capability for horizontal or vertical expansion were given 1 point. Subwatersheds with no ponds were given a score of 0 points.

Country Club Cove/Humphrey Creek Remnant contains two (2) detention ponds, with one (1) considered as having potential for horizontal expansion, and one (1) having potential for vertical expansion. SWM_D_234 is located at an industrial facility off of Grays Road. The major finding during the assessment of this facility which treats 7.14 acres is the lack of any downstream berm within the pond. The lack of a berm at this location prevents flow from being detained, instead allowing runoff to flow directly through the pond and into the downstream outlet. There is room for horizontal expansion in the turf area around the pond but the major recommendation here is to enforce the owner's to construct a pond that reflects the permitted design. SWM_D_290 in Country Club Cove/Humphrey Creek Remnant was found to be completely engulfed in invasive species such as phragmites. Due to its state, the functional status of the pond could not be determined. It is recommended that this pond be maintained and a reassessment be conducted to determine if further retrofits could be accomplished. Country Club Cove/Humphrey Creek was given a score of 4 points.

Charlesmont/Tobasco Coves contains one (1) detention pond, having both horizontal expansion and vertical excavation potential. SWM_D_722 is a privately-owned detention pond off of Fischer Road. There is a gravel parking lot to the northeast of the pond that could provide horizontal expansion potential if it is unused as was observed in the field. Charlesmont/Tobasco Coves was given a score of 3 points.

The Bullneck Creek subwatershed contains one (1) detention pond with potential for horizontal and vertical expansion and was assigned a score of 3 points. Detention pond, SWM_D_463, is a publicly owned facility located at the Community College of Baltimore County's Dundalk Campus. The pond is recommended for removal of the existing channels that have formed in the bottom from more frequent low-flow events or conversion of the channels to vegetative swales to provide more treatment. Bullneck Creek was assigned a score of 3 points.

The Lynch Cove subwatershed contains one (1) detention pond with potential for horizontal and vertical expansion and was assigned a score of 3 points. Detention pond, SWM_D_726, is located at the Baltimore County government complex on Merritt Boulevard and handles runoff from 7.28 acres. The pond is recommended for horizontal expansion on its eastern side and removal or conversion of low-flow channels that have formed during more frequent low-flow storm events. Lynch Cove was assigned a score of 3 points.

The Oakleigh/Schoolhouse Coves subwatershed contains one (1) detention pond with potential for vertical expansion but not horizontal expansion. SWM_D_326, located in an industrial area off of North Point Road, is a large depression treating 1.44 acres of parking lot. Currently, the pond is being used to store recreational vehicles and boats, indicating that the ponding depth in the pond remains relatively low. The site was recommended for potential conversion to a sand filter or bioretention area which would be more suitable to the size of the drainage area. Oakleigh/Schoolhouse Coves was assigned a score of 2 points

Bear Creek Headwaters contains two (2) ponds, neither of which have potential for horizontal or vertical expansion. SWM_D_926 and SWM_D_927 are located in a privately-owned commercial area off of Merritt Boulevard. The ponds are hydraulically connected and the only recommendation is removal of any trees that are threatening the downstream embankments and invasive species management. Bear Creek Headwaters was assigned a score of 1.

Colgate Creek contains one (1) detention pond treating a 28-acre residential area on Villager Circle. The pond is constrained on all sides and vertically so the only recommendation was the removal of trees from the embankment and invasive species management. Colgate Creek was assigned a score of 1.

The remaining subwatersheds without dry detention pond assessments were given a score of zero. Municipal stormwater conversion scores are summarized in Table 4-10 by subwatershed.

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

| SUBWATERSHED | # of Dry Ponds | # of Ponds with Conversion Potential (Horizontal Expansion) | # of Ponds with Conversion Potential (Vertical Expansion) | # of Ponds with Maintenance Needed | Municipal Stormwater Conversion Score |
|---|---|---|---|---|---|
| Colgate Creek | 1 | 0 | 0 | 1 | 1 |
| Peach Orchard Cove | 0 | 0 | 0 | 0 | 0 |
| Bullneck Creek | 1 | 1 | 1 | 1 | 3 |
| Lynch Cove | 1 | 1 | 1 | 1 | 3 |
| Chink Creek | 0 | 0 | 0 | 0 | 0 |
| Bear Creek Headwaters | 2 | 0 | 0 | 2 | 1 |
| Charlesmont/Tobasco Coves | 1 | 1 | 1 | 1 | 3 |
| Oakleigh/Schoolhouse Coves | 1 | 0 | 1 | 1 | 2 |
| Country Club Cove/Humphrey Creek Remnant | 2 | 1 | 0 | 2 | 4 |
| Jones Creek | 0 | 0 | 0 | 0 | 0 |
| North Point Creek | 0 | 0 | 0 | 0 | 0 |
| Shallow Creek | 0 | 0 | 0 | 0 | 0 |
| Black Marsh | 0 | 0 | 0 | 0 | 0 |
| Sparrows Point | 0 | 0 | 0 | 0 | 0 |

### 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 (greater than 3 feet in diameter) are assigned one of the following priority ratings: critical, high, low, or none. Critical outfalls are those with problems that require immediate correction and/or close monitoring, or outfalls with recurring problems. These are sampled the most frequently (4 times per year). On the other end of the rating scheme, outfalls that are not prioritized have insufficient data to determine a priority rating. More information regarding the County's outfall screening and prioritization system is included in the *Watershed Characterization Report.*

There are 37 major outfalls in Bear Creek/Old Road Bay with a priority rating. Subwatersheds with the most illicit discharge data and highest prioritization ratings represent the best areas to target for restoration initially. Therefore, subwatersheds with multiple major outfalls rated as critical received the highest scores (4 points). Subwatersheds with one major outfall rated as critical received the second highest scores (3 points). Subwatersheds with one or more major outfalls rated as high but no critical outfalls were assigned the third highest scores (2 points). Subwatersheds with major outfalls only listed as low or not a priority were assigned a score of 1 point. Lastly, 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 Table 4-11 by subwatershed.

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

| | COUNTY OUTFALL PRIORITIZATION RATINGS | | | | Illicit Discharge Data Score |
|---|---|---|---|---|---|
| SUBWATERSHED | Priority 1 (Critical) | Priority 2 (High ) | Priority 3 (Low) | Priority 0 (None) | |
| Colgate Creek | 2 | 1 | 0 | 2 | 4 |
| Peach Orchard Cove | 1 | 0 | 1 | 0 | 3 |
| Bullneck Creek | 2 | 1 | 0 | 2 | 4 |
| Lynch Cove | 1 | 1 | 0 | 3 | 3 |
| Chink Creek | 0 | 1 | 1 | 0 | 2 |
| Bear Creek Headwaters | 3 | 1 | 2 | 1 | 4 |
| Charlesmont/Tobasco Coves | 0 | 1 | 0 | 0 | 2 |
| Oakleigh/Schoolhouse Coves | 0 | 2 | 1 | 0 | 2 |
| Country Club Cove/Humphrey Creek Remnant | 0 | 0 | 0 | 1 | 1 |
| Jones Creek | 1 | 1 | 0 | 1 | 3 |
| North Point Creek | 0 | 0 | 3 | 0 | 1 |
| Shallow Creek | 0 | 0 | 0 | 0 | 0 |
| Black Marsh | 0 | 0 | 0 | 0 | 0 |
| Sparrows Point | 0 | 0 | 0 | 0 | 0 |

### 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 Bear Creek, Old Road Bay, Shallow Creek, and the Chesapeake Bay. When stream buffers are converted from forest to developed areas, many of these benefits are lost and stream health declines. Riparian buffer zones can be reestablished or preserved as a BMP to reduce land use impacts by intercepting and controlling pollutants entering a water body.

In the *Watershed Characterization Report*, the vegetative condition of stream 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 17% to 81%. The following point system was used to assign stream buffer improvement scores to the 14 subwatersheds based on the distribution and range of open pervious buffer area percentages:

- ≥ 60% = 4 pts
- 40 – 59% = 3 pts
- 21 – 39% = 2 pts
- ≤ 20% = 1 pt

Percentages of open pervious stream buffer areas and corresponding scores are summarized in Table 4-12 by subwatershed.

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

| SUBWATERSHED | % Open Pervious Stream Buffer Area | Stream Buffer Improvement Score |
|---|---|---|
| Colgate Creek | 53% | 3 |
| Peach Orchard Cove | 66% | 4 |
| Bullneck Creek | 34% | 2 |
| Lynch Cove | 64% | 4 |
| Chink Creek | 48% | 3 |
| Bear Creek Headwaters | 56% | 3 |
| Charlesmont/Tobasco Coves | 45% | 3 |
| Oakleigh/Schoolhouse Coves | 38% | 2 |
| Country Club Cove/Humphrey Creek Remnant | 37% | 2 |
| Jones Creek | 35% | 2 |
| North Point Creek | 30% | 2 |
| Shallow Creek | 81% | 4 |
| Black Marsh | 17% | 1 |
| Sparrows Point | 62% | 4 |

### 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. A portion of the coastal area within the watersheds 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 Bear Creek/Old Road Bay surface waters.

In the *Watershed Characterization Report*, the vegetative condition of the shoreline buffer was analyzed using GIS 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 34% to 77%. The following point system was used to assign shoreline buffer improvement scores to the 14 subwatersheds based on the distribution and range of open pervious buffer area percentages:

- ≥ 56% = 4 pts
- 46 – 55% = 3 pts
- 40 – 45% = 2 pts
- ≤ 39% = 1 pt

Percentages of open pervious shoreline buffer areas and corresponding scores are summarized in Table 4-13 by subwatershed.

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

| SUBWATERSHED | % Open Pervious Shoreline Buffer Area | Shoreline Buffer Improvement Score |
|---|---|---|
| Colgate Creek | 61% | 4 |
| Peach Orchard Cove | 68% | 4 |
| Bullneck Creek | 51% | 3 |
| Lynch Cove | 42% | 2 |
| Chink Creek | 43% | 2 |
| Bear Creek Headwaters | 52% | 3 |
| Charlesmont/Tobasco Coves | 49% | 3 |
| Oakleigh/Schoolhouse Coves | 43% | 2 |
| Country Club Cove/Humphrey Creek Remnant | 34% | 1 |
| Jones Creek | 47% | 3 |
| North Point Creek | 39% | 1 |
| Shallow Creek | 43% | 2 |
| Black Marsh | 36% | 1 |
| Sparrows Point | 77% | 4 |

### 4.2.14 Subwatershed Prioritization Summary

The 14 subwatersheds comprising Bear Creek/Old Road Bay are ranked according to the total prioritization score (i.e., the sum of prioritization criterion scores). Subwatershed ranking results are summarized in Table 4-14 including criterion scores, total scores, and rankings by subwatershed. Subwatersheds were placed into one of four priority categories based on ranking results: very high, high, medium, and medium-low. These results are summarized in Table 4-15 and illustrated in Figure 4-2.

Because the Sparrows Point subwatershed is almost entirely comprised of industrial land uses, the prioritization scores do not reflect the importance of restoration in this area. Of the fifteen (15) prioritization criteria, seven (7) are directly related to the results of the uplands assessments performed in the planning area. Due to the fact that no specific field assessments were performed in Sparrows Point, the subwatershed received a score of zero (0) for many of the criteria. Because of the contamination issues documented here by EPA and MDE and the emphasis placed on restoration in the Sparrows Point subwatershed by the Bear Creek/Old Road Bay Steering Committee, the prioritization score did not reflect the importance of restoration in Sparrows Point to the overall health of the watershed. Accordingly, the Sparrows Point subwatershed was assigned a priority of “very high” in order to reflect the goals and objectives set by the Bear Creek/Old Road Bay Steering Committee and the concerned citizens of the watershed.

For the remainder of the study area, subwatersheds with a total prioritization score greater than 40 received a very high priority rating (Colgate Creek and Peach Orchard Cove). Both of these areas are encompassed by a portion of the area of concern for environmental justice. Accordingly, its “very high” prioritization ranking and the presence of environmental justice areas of concern indicate that potential restoration projects in the Colgate Creek and Peach Orchard Cove should take priority in the implementation schedule.

A high rating was assigned to the next logical grouping of subwatersheds with total prioritization scores between 34 and 40 (Lynch Cove, Bear Creek Headwaters, Bullneck Creek, and Charlesmont/Tobasco Coves). A medium rating was assigned to the three subwatersheds with total prioritization scores between 25 and 33 (Chink Creek, Oakleigh Schoolhouse Coves, and Jones Creek). The remaining four subwatersheds (North Point Creek, Shallow Creek, Country Club Cove/Humphrey Creek Remnant, and Black Marsh) with total prioritization scores less than 25 were assigned a medium-low priority rating. Restoration actions will have to occur throughout Bear Creek/Old Road Bay in order to meet environmental goals and requirements; however, subwatershed prioritization provides a framework for focusing initial restoration efforts.

**Table 4-14: Subwatershed Ranking Results**

| SUBWATERSHED | Nitrogen Load | Phosphorus Load | Sediment Load | % Impervious | NSA PSI/ROI | NSA Downspout Disconnect | NSA Trash Management | % Industrial & Commercial | ISI Site Index | Pervious Area Reforestation | Municipal Street Sweeping | Municipal Stormwater Conversion | Illicit Discharge Data | Stream Buffer Improvement | Shoreline Buffer Improvement | TOTAL SCORE | SUBWATERSHED RANK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Colgate Creek | 3 | 4 | 4 | 3 | 4 | 4 | 1 | 3 | 4 | 2 | 1 | 1 | 4 | 3 | 4 | ***45*** | ***2*** |
| Peach Orchard Cove | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 1 | 2 | 1 | 3 | 0 | 3 | 4 | 4 | ***42*** | ***3*** |
| Bullneck Creek | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 1 | 2 | 3 | 4 | 2 | 3 | ***36*** | ***6*** |
| Lynch Cove | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 4 | 1 | 0 | 3 | 3 | 4 | 2 | ***40*** | ***4*** |
| Chink Creek | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | 2 | 0 | 2 | 3 | 2 | ***32*** | ***9*** |
| Bear Creek Headwaters | 3 | 3 | 3 | 3 | 3 | 4 | 1 | 2 | 2 | 4 | 0 | 1 | 4 | 3 | 3 | ***39*** | ***5*** |
| Charlesmont/Tobasco Coves | 2 | 4 | 4 | 3 | 1 | 1 | 0 | 4 | 2 | 2 | 1 | 3 | 2 | 3 | 3 | ***35*** | ***7*** |
| Oakleigh/Schoolhouse Coves | 3 | 4 | 4 | 3 | 1 | 2 | 0 | 3 | 1 | 0 | 4 | 2 | 2 | 2 | 2 | ***33*** | ***8*** |
| Country Club Cove/ Humphrey Creek Remnant | 2 | 2 | 2 | 2 | 1 | 1 | 0 | 2 | 1 | 0 | 0 | 4 | 1 | 2 | 1 | ***21*** | ***13*** |
| Jones Creek | 2 | 2 | 2 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 0 | 0 | 3 | 2 | 3 | ***28*** | ***10*** |
| North Point Creek | 4 | 2 | 3 | 2 | 1 | 3 | 0 | 0 | 2 | 3 | 0 | 0 | 1 | 2 | 1 | ***24*** | ***11*** |
| Shallow Creek | 4 | 2 | 2 | 1 | 1 | 2 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 4 | 2 | ***24*** | ***11*** |
| Black Marsh | 1 | 1 | 1 | 1 | 2 | 3 | 0 | 1 | 0 | 4 | 0 | 0 | 0 | 1 | 1 | ***16*** | ***14*** |
| Sparrows Point | 2 | 2 | 2 | 3 | 0 | 0 | 0 | 4 | 0 | 3 | 0 | 0 | 0 | 4 | 4 | ***-*** | ***1*** |

*Sparrows Point ranked first due to input from Steering Committee and contamination issues discussed in Section 4.2.14

**Table 4-15: Subwatershed Prioritization**

| Rank | Subwatershed | Total Score | Prioritization Category |
|---|---|---|---|
| 1 | Sparrows Point | - | Very High |
| 2 | Colgate Creek | 45 | Very High |
| 3 | Peach Orchard Cove | 42 | Very High |
| 4 | Lynch Cove | 40 | High |
| 5 | Bear Creek Headwaters | 39 | High |
| 6 | Bullneck Creek | 36 | High |
| 7 | Charlesmont/Tobasco Coves | 35 | High |
| 8 | Oakleigh/Schoolhouse Coves | 33 | Medium |
| 9 | Chink Creek | 32 | Medium |
| 10 | Jones Creek | 28 | Medium |
| 11 | North Point Creek | 24 | Medium-Low |
| 11 | Shallow Creek | 24 | Medium-Low |
| 13 | Country Club Cove/ Humphrey Creek Remnant | 21 | Medium-Low |
| 14 | Black Marsh | 16 | Medium-Low |

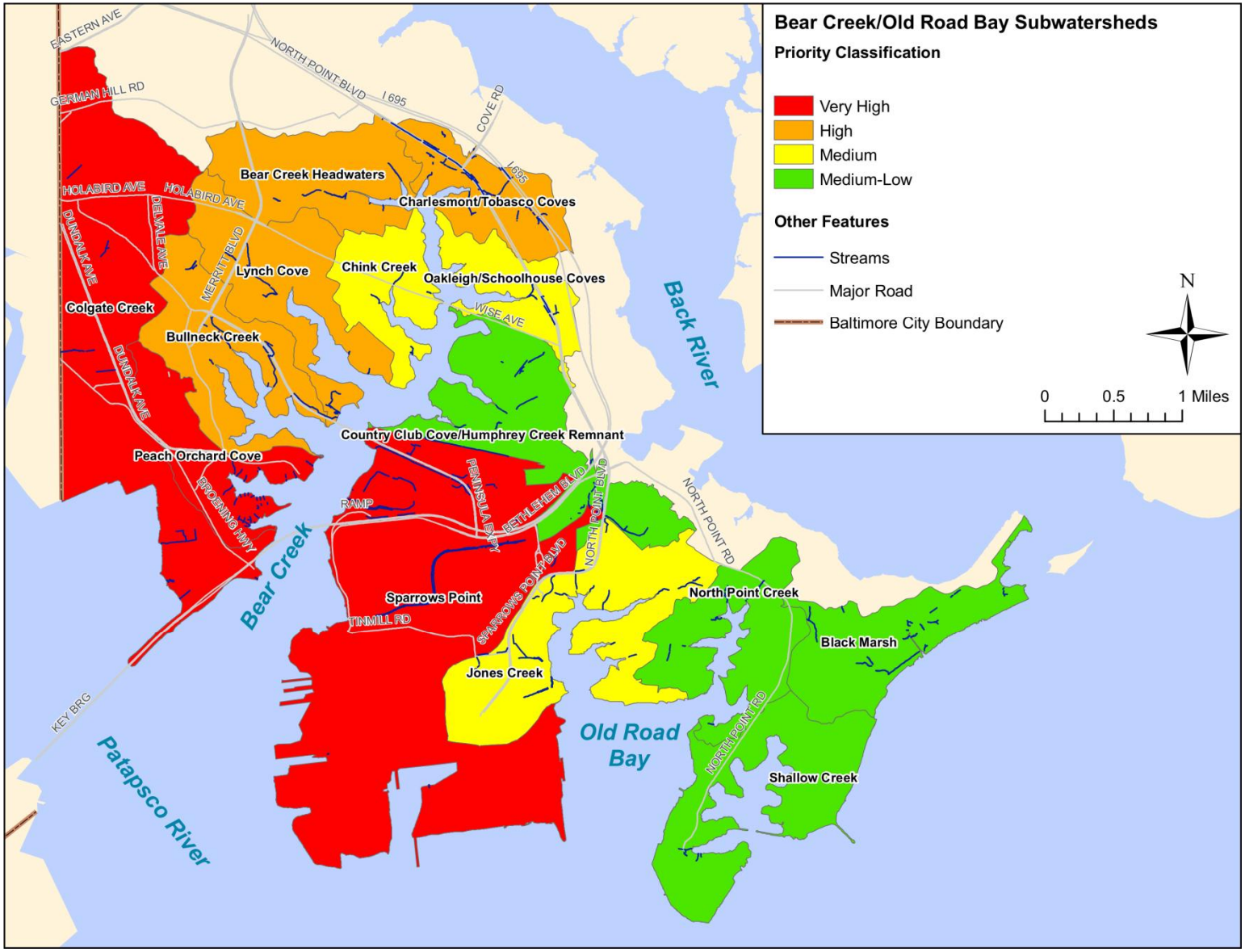


Figure 4-2: Bear Creek/Old Road Bay Subwatershed Prioritization

## 4.3 Subwatershed Restoration Strategies

Restoration strategies for each subwatershed are presented in the following subsections. Subwatersheds are presented in the numerical order based on the unique ID numbers assigned during the field assessments and summarized in Section 4.3.1 of the *Watershed Characterization Report*. A description of key watershed characteristics is presented for each subwatershed including drainage area, stream length, coastline length, population, land use/land cover, impervious cover, soils, and 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.

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

For example, because there are numerous operations that qualify as stormwater hotspots, not all could be individually evaluated during the uplands survey. The assessments are intended to represent common types of hotspot operations located throughout the watershed and help develop an overall strategy to encompass all hotspot operations. Because marinas are a significant portion of the local economy in this area, a separate assessment was completed for 5 marinas in the SWAP study area. Similarly, 5 large landowners compromising 33% of the SWAP study area and impacting several subwatersheds were each assessed and site visits taken when possible.

There are several open pervious areas throughout the watershed with reforestation potential, including over 500 acres of publicly-owned lands for recreation and parks. 16 pervious PAAs were conducted, most 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 Colgate Creek

Colgate Creek is the second largest subwatershed in the Bear Creek/Old Road Bay study area. Encompassing a large amount of residential and industrial area, Colgate Creek is almost entirely occupied by urban development (nearly 97%) including industrial, institutional, commercial, open urban, transportation and residential uses. Forest (1.6%) and wetlands (1.5%) make up the majority of the remaining subwatershed area. Table 4-16 summarizes key subwatershed characteristics of Colgate Creek.

**Table 4-16: Key Subwatershed Characteristics – Colgate Creek**

| | | |
|---|---|---|
| **Drainage Area** | 1,649.3 acres (2.58 sq. mi.) | |
| **Stream Length** | 0.8 miles | |
| **Coastline Length** | 4.1 miles | |
| **Population** | 12,690 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 0.0% |
| | Medium Density Residential: | 25.9% |
| | High Density Residential: | 23.8% |
| | Commercial: | 3.4% |
| | Industrial: | 31.1% |
| | Institutional: | 6.3% |
| | Open Urban: | 2.7% |
| | Forest: | 1.6% |
| | Agriculture: | 0.0% |
| | Water/Wetlands: | 1.5% |
| | Transportation | 3.8% |
| **Impervious Cover** | 42.9% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.0% |
| | B Soils: | 30.7% |
| | C Soils: | 22.9% |
| | D Soils (high runoff potential): | 45.4% |
| | Water | 1.0% |

#### *4.3.1.1 Neighborhoods*

A total of 27 distinct neighborhoods were identified and assessed within Colgate Creek during the uplands assessment of Bear Creek/Old Road Bay. 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. For example, NSA_D_43 encompasses portions of Lynch Cove. Qualitative descriptions of neighborhoods and recommendations are included within the subwatershed restoration strategy for the subwatershed where the majority of the neighborhood resides. While descriptions are not repeated for neighborhoods overlapping multiple subwatersheds, calculations presented in the *Watershed Characterization Report* were based on the fraction of the NSA area within respective watersheds.

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

**Table 4-17: NSA Recommendations – Colgate Creek**

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marking | Bayscape | Increase Lot Canopy | Buffer Improvement | Parking Lot Retrofit | Alley Retrofit | Street Sweeping | # of Street Trees | # of Shade Trees | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_D_05 | <1/4 | X | X | | | | X | | | | | | | |
| NSA_D_18 | <1/4 | X | X | | X | | X | | | X | | | | Blue alleys, cars parking in grass strip, damaging vegetation, a potential pollutant source |
| NSA_D_19 | <1/8 | X | X | | X | | X | | | X | | | | Blue alleys; cars parking on grass causing loss of vegetation and sediment source |
| NSA_D_20 | <1/8 | X | X | | | | X | | | X | | | | Blue alleys, sediment in gutters appears to be from several areas with bare soil |
| NSA_D_21 | <1/8 | X | X | | X | | X | | | X | | | | Blue alleys |
| NSA_D_22 | <1/8 | X | X | | | | X | | | X | 2.1 | 24 | | Blue alleys |
| NSA_D_23 | <1/4 | X | X | | X | | X | | | X | | | | Blue alleys |
| NSA_D_24 | <1/8 | X | X | X | | | X | | | | | | 7 | |
| NSA_D_25 | <1/8 | X | X | X | | | X | | | | | | 27 | Better trash management - multiple dumpsters in common area without lids and overflowing |
| NSA_D_26 | <1/4 | X | X | | X | | X | | | X | | | | Blue alley |
| NSA_D_27 | <1/8 | X | X | | X | | X | | | X | | | | Blue alley |
| NSA_D_28 | <1/4 | X | X | | X | | | | | | | 4 | | |
| NSA_D_29 | <1/8 | | X | | X | | X | | X | | 1.1 | | 8 | Repave parking lot- very old and breaking up, retrofit open spaces adjacent to parking lots to treat runoff |
| NSA_D_30 | <1/8 | X | X | | X | | X | | | X | | | | Blue alleys on paved alleys, potential water leak at 6902 Homeway |
| NSA_D_31 | 1/4 | X | X | X | X | X | X | | | X | | | | Blue alley, empty lot can be a planting opportunity |
| NSA_D_32 | <1/4 | X | X | | X | | X | X | | X | | | | Blue alley, empty lot - check with owner for possible tree planting, impervious cover removal next to stream |
| NSA_D_33 | <1/4 | X | X | | X | | X | | | | | 290 | | |
| NSA_D_34 | <1/4 | X | X | | X | | X | | | | | 46 | | |

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marking | Bayscape | Increase Lot Canopy | Buffer Improvement | Parking Lot Retrofit | Alley Retrofit | Street Sweeping | # of Street Trees | # of Shade Trees | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_D_35 | <1/4 | X | X | | X | | X | | | | | 70 | | |
| NSA_D_36 | <1/4 | X | X | | X | | X | | | | | 11 | | |
| NSA_D_37 | 1/4 | X | X | X | X | X | X | | | | | 40 | | |
| NSA_D_38 | <1/8 | X | X | | X | | X | | | | | 75 | | |
| NSA_D_39 | <1/8 | | | | X | | X | | | | | 2 | 7 | Pond maintenance |
| NSA_D_40 | <1/4 | X | X | | X | | X | | | | | | | |
| NSA_D_41 | <1/8 | | X | | X | | X | | | X | | | | Blue alleys |
| NSA_D_42 | <1/4 | X | X | X | X | | X | | | | | | | |
| NSA_D_43 | <1/4 | X | X | | X | | X | | | | | | | Two empty lots at Bayard and School Lane; potential SWM retrofit or tree planting |

Most of the neighborhoods in Colgate Creek are recommended for downspout disconnection, public education related to increasing lot tree canopy, and storm drain marking. One (1) neighborhood, NSA_D_32, is recommended for buffer improvement that may be achieved through public education about the benefits of providing a stream and shoreline buffer by reducing the amount of mowed lawn through tree and vegetation planting. Other issues encountered in Colgate Creek include the presence of empty lots that could be used for tree plantings, dumpsters without lids in common areas, and parking areas that are old and breaking up. This provides an opportunity for education on proper vehicle and boat maintenance and storage.

**Figure 4-3: Parking Lot Breaking Up at NSA_D_29 (left) and Overflowing Dumpsters at NSA_D_25 (right)**

In addition, many of the NSAs performed in Colgate Creek were at neighborhoods consisting entirely of row homes. Row homes are particularly prevalent in Bear Creek/Old Road Bay, and most row home neighborhoods contain alleys for rear access to residences. Several pilot projects have been undertaken

within Maryland called "blue alleys," where paved alleys are converted to a pervious surface to provide infiltration of stormwater runoff as well as water quality treatment. Neighborhoods containing alleys are noted with a "blue alleys" note in the NSA Recommendations table. Because these projects are still in the pilot phase though, specific pollution reductions from this type of stormwater retrofit are not enumerated in this planning document.

#### *4.3.1.2 Hotspots*

Two (2) hotspot investigations were performed within Colgate Creek on a commercial car repair facility and a container transport facility. Table 4-18 summarizes the potential pollution sources found at each of the sites.

**Table 4-18: HSI Results Summary – Colgate Creek**

| HSI_ID | HSI Status* | Description | Vehicle Operations | Outdoor Materials | Waste Management | Physical Plant | Turf/Landscape Management | Storm Water | Notes |
|---|---|---|---|---|---|---|---|---|---|
| HSI_D_0101 | Confirmed | Commercial – Auto Repair | X | X | X | | | | Parking lot stains, dilapidated vehicles, drums |
| HSI_D_0102 | Potential | Transport - Containers | X | X | | X | X | X | Stream bisecting site collecting runoff from storage area |

HSI_D_0101 is a commercial car repair and maintenance facility in Colgate Creek. Due to the nature of the operations at this facility, the major concerns noted here were the impact of vehicle operations, how outdoor materials were handled and stored, and the management of waste and waste products at the site. Specifically, as seen in Figure 4-4, the parking lot facility showed signs of staining from vehicle leaks and unlabeled drums were stored at the site, reflecting the need for education on the items mentioned as areas of concern.

**Figure 4-4: Evidence of Unlabeled Barrels (left) and Parking Lot Staining (right) at HSI_D_0101**

HSI_D_0102 is a large materials warehouse facility used to store materials prior to transit by shipping trucks. Materials seen at the site included solid building materials such as wood planks. Materials and vehicle at the site were stored outdoors but no specific evidence of staining or debris from the materials was observed. Instead, the major finding at HSI_D_0102 was the presence of a large amount of unused impervious area on the site that was breaking up, promoting ponding, and eventually draining to the public storm sewer system adjacent to the site. In addition, much of the runoff was directed to a concrete channel carrying storm flows through the center of the site. This site appears to have potential for impervious area removal as well as a potential retrofit to the concrete stormwater channel to provide water quality treatment to storm flows. Figure 4-5 illustrates the extent of the impervious area and the concrete channel at HSI_D_0102.

**Figure 4-5: Unused Impervious Surface (left) and Concrete Channel (right) at HSI_D_0102**

#### *4.3.1.3 Institutions*

Three (3) public and one (1) private institutional site was assessed for retrofit opportunities in Colgate Creek during the uplands assessment of Bear Creek/Old Road Bay. Table 4-19 summarizes recommendations for the institutional sites assessed in Colgate Creek.

**Table 4-19: ISI Recommendations – Colgate Creek**

| Site ID | Name | Public/ Private | # Trees for Planting | Stormwater Retrofit | Downspout Disconnection | Impervious Cover Removal | Trash Management | Storm Drain Marking | Buffer Improvement | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| ISI_D_0101 | The Workmen's Circle Cemetery | Private | | | | | X | | | No room for plantings/trash dumped on site |
| ISI_D_0102 | Holabird Middle School | Public | 236 | X | | X | X | X | | Planting, roadside swale for parking |
| ISI_D_0103 | Ateaze Senior Center | Public | 26 | X | X | X | X | X | | Shade plants west; curb retrofit to swale |
| ISI_D_0104 | Fleming Community Center | Public | 304 | X | | X | X | X | X | 3 plantings; swale next to court, remove court |

The four (4) institutions assessed in Colgate Creek consist of a private cemetery, a public middle school, a public senior center, and a public community center. All four (4) sites showed evidence for the need for trash management education while the three (3) public sites all had opportunities for tree planting, stormwater retrofits, impervious cover removal, and storm drain marking.

ISI_D_0101 is a private cemetery which limits the amount of restoration practices that can occur here. There was dumping of materials noted on site including discarded mattresses. In addition, there was excess trash debris found on site as well.

As noted previously, the three public institutions were noted as having the potential for removal of impervious surfaces. At ISI_D_0102, an asphalt track pad was found that was in disrepair and could be removed. At ISI_D_0103, an old driveway area in the rear of the building was found to be in disrepair and not in use. At ISI_D_0104, a basketball court was found that had vegetation growing through cracks in the surface. This area could be replaced with a newer pervious surface that would still allow for recreation but also would promote infiltration of stormwater. Figure 4-6 shows the impervious surface removal areas in Colgate Creek.

**Figure 4-6: Impervious Removal Potential for ISI_D_0102 (left), ISI_D_0103 (center), and ISI_D_0104 (right)**

Additionally, all three (3) public sites were noted for potential stormwater retrofits. At ISI_D_0102, a grassed area below the parking on the northwest side of the side could be retrofit with a bioretention area to collect runoff from the parking area. At ISI_D_0103, roof drains from the east side of the building drain across an asphalt parking area noted from removal in Figure 4-6. If removed, a bioretention area or bioswale could be constructed where the asphalt and curb were previously to provide treatment to roof drain runoff as well as runoff coming from off of the site. At ISI_D_0104, runoff from the parking lot on the south side of the facility could be treated with the installation of a bioretention area in the adjacent grassed area. Figure 4-7 provides a view of the potential retrofit areas at these three (3) public institutions.

**Figure 4-7: Stormwater Retrofit Potential at ISI_D_0102 (left), ISI_D_0103 (center), and ISI_D_0104 (right)**

ISI_D_0104 resides in the area of high concern for environmental justice, therefore implementation of restoration opportunities here should be a high priority. In addition to tree planting, impervious cover removal, and stormwater retrofits, the site was also recommended for improvement of its shoreline buffer. The site borders the Bear Creek shoreline and while there is a narrow "no-mow" buffer in places, it could be extended to provide more benefits to the watershed.

#### *4.3.1.4* Pervious Areas

One (1) pervious area was assessed for restoration potential in Colgate Creek and is summarized in Table 4-20.

**Table 4-20: PAA Descriptions – Colgate Creek**

| Site_ID | Location | Name | Acres | Ownership |
|---|---|---|---|---|
| PAA_D_0101 | Willow Spring Rd. | Saint Helena Park | 19.3 | Public |

Saint Helena Park, PAA_D_0101, is a 19.3 acre public park that is maintained by the Baltimore County Office of Budget and Finance, Property Management. The site is mostly turf (85%) and contains athletic fields, tennis and basketball courts, and an asphalt parking lot.

The assessment conducted at the site indicated a few restoration projects including potential buffer plantings at the north end of the site, shade tree planting, and the potential replacement of a dilapidated tennis court with a pervious surface. Planning has occurred in the past for possible expansion and renovation of the park in which community input was solicited. Any input provided at public meetings should be taken into account prior to the implementation of restoration actions. Figure 4-8 provides photographs of the potential buffer planting area as well as the impervious court suggested for removal.

**Figure 4-8: Potential Buffer Planting Area (left) and Impervious Surface Replacement (right) at PAA_D_0101**

#### *4.3.1.5 Marinas*

No marinas were assessed in Colgate Creek

#### *4.3.1.6 Large Landowners*

Two (2) large landowners have properties located within Colgate Creek including portions of the Dundalk Marine Terminal which is owned by the Maryland Port Administration (MPA) and the Riverside Generating Station owned by Baltimore Gas & Electric (BGE). Table 4-21 provides an overview of these large landowners.

**Table 4-21: Large Landowners – Colgate Creek**

| Site ID | Name | Acres |
|---|---|---|
| LLO_D_0101 | Maryland Port Authority | 304 |
| LLO_D_0102 | Baltimore Gas & Electric | 179 |

The Dundalk Marine Terminal is approximately 570 acres in total, encompassing approximately 304 acres in Colgate Creek and the remainder in Baltimore City. The facility handles the import and export of “roll-on/roll-off” materials which includes cars, tractors, construction equipment, and other bulk commodities. In addition, the facility has a paper importing operation on the site. The facility is owned by MPA, who is committed to environmental compliance and its obligation to comply with all applicable

state regulations including having a NPDES permit, a Stormwater Pollution Prevention Plan (SWPPP), and BMPs for discharges from the site. In addition to meeting these required state mandates, MPA has taken the initiative to develop their own Stormwater Management Plan summarizing the existing stormwater facilities on the site. MPA holds semi-annual port users meetings with leases to go over environmental requirements pertaining to the NPDES permit including having a permit or a "No Exposure Certification."

The site contains two (2) major storm sewers that enter the facility from off site and provides treatment to the base flow in one of these systems which was installed through an area identified as having legacy hazardous fill material. Other measures MPA has taken include standards for vehicle washing and spill containment. Vehicle washing procedures are in place for all tenants including containment and dechlorination of wash water. The facility has a formal spill response procedure in case of an accident at the site. There are no fueling areas within the portion of the site in Baltimore County. The MPA is studying potential BMPs that can be used on the site to provide stormwater treatment. The facility has a few already, none of which are owned by tenants. Representatives from MPA did express interest in potentially partnering with Baltimore County on future, off-site projects that could assist the port with meeting TMDL requirements.

It is recommended that Baltimore County coordinate with MPA to track illicit discharge eliminations at the site as well as to educate port users on proper hazardous and solid waste disposal. Additionally, Baltimore County should work with MPA and adjacent property holders to provide treatment of stormwater runoff from the two (2) storm sewers flowing onto the facility from off-site. MPA has expressed an interest in working with Baltimore County to identify and complete off-site projects to meet the Chesapeake Bay TMDL reduction requirements associated with the facility.

The Riverside Generating Station owned by Constellation Power Source Generation, Inc. occupies nearly 180 acres of land at the southern end of the Colgate Creek and Peach Orchards Cove subwatersheds. Located between the Dundalk Marine Terminal and the Francis Scott Key Memorial Bridge, the plant has one 78 megawatt (MW) stream-electric generating unit and one 85-MW natural gas burning unit. Discharges from the Constellation Energy facility must abide by regulations set forth in their individual NPDES permit. Upgrades to the natural gas burning unit, recently required an environmental review by DNR which was completed in January, 2009. Constellation Energy has already implemented many stormwater pollution prevention related measures proactively. The main recommendation at this site is for the County to continue dialogue with the plant and track the pollutant removal efficiency of existing and future restoration practices.

#### *4.3.1.7* Illicit *Discharges*

Baltimore County tracks illicit discharges through a program of routine screening at major outfalls. The County uses a prioritization system based on this data where outfalls are assigned one of the following priority ratings: none (priority 0), low (priority 3), high (priority 2), critical (priority 1). Priority 1 outfalls have major problems that require immediate correction and/or close monitoring, or have recurring problems. These outfalls are sampled four times each year. Priority 2 outfalls have moderate to minor problems with the potential to become more severe. These are sampled once a year. Priority 3 outfalls have minor to no problems and are monitored on a 10-year cycle. Priority 0 outfalls lack sufficient data to determine a priority rating. More information on Baltimore County's Illicit Discharge Elimination program can be found in Section 3.4.6 of the *Watershed Characterization Report*. Colgate Creek contains two (2) Priority 1 outfalls which indicate major or reoccurring problems that require either

immediate action or close monitoring. This subwatershed also contains one (1) Priority 2 outfall and two (2) Priority 0 outfalls. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

#### *4.3.1.8 Stormwater* Conversions

Colgate Creek contains one detention pond, located on Villager Circle. The facility is publically-owned and handles runoff from the 2, 10, and 100-year events from a 28.1-acre townhouse development. Information on SWM_D_1420 can be found in Table 4-22.

**Table 4-22: Detention Pond Conversion - Colgate Creek**

| Site ID | Riser | Embank-ment | Vege-tation | Fence Condition | Gate Condition | Water Quality Potential | Access | Flow Path | Horizontal Expansion Potential | Vertical Expansion Potential |
|---|---|---|---|---|---|---|---|---|---|---|
| 1420 | Good | Trees | Wetland Veg. | Repairs Needed | Locked | N | Difficult | Long | N | N |

SWM_D_1420 is constrained both vertically and horizontally so no expansion capability was noted. Recommendations at the pond include removal of trees from the pond's embankment and invasive species management.

**Figure 4-9: Invasive Species and Vegetation at SWM_D_1420**

#### *4.3.1.9* Shoreline *Restoration*

Colgate Creek has 4.15 miles of shoreline of which 61% (30.1 acres) of the 100-foot shoreline buffer is classified as open, pervious area. In 2007, a shoreline enhancement project was conducted on 1,767 linear feet of shoreline at Fleming Park. No other shoreline enhancement projects were identified in EPS's Shoreline Enhancement Feasibility Study (EPS 1998). Planting of the open pervious shoreline buffer in Colgate Creek is recommended but may be limited due to the presence of the Dundalk Marine Terminal, BGE's Riverside Generating Station, and interstate 695 which all occupy a significant portion of the shoreline in this subwatershed.

#### *4.3.1.10* Subwatershed *Management* Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-17 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-17.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees.
4. Educate citizens about the benefits and importance of proper lawn care and pool maintenance techniques and bayscaping.
5. Educate residents of neighborhoods indicated in Table 4-17 about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments.
6. Educate residents on proper techniques for vehicle and boat storage and maintenance.

Municipal Actions

1. Work with the HSIs indicated in Table 4-18 and similar businesses to implement appropriate practices for vehicle operations, outdoor materials storage and waste management.
2. Investigate the potential to convert the existing concrete drainage channel at HSI_D_0102 to a vegetated swale to provide water quality treatment.
3. Conduct tree plantings and impervious cover removal at the institutional sites list in Table 4-19.
4. Investigate the potential for installation of stormwater retrofits and conduct programs to provide install storm drain markings at the facilities in Table 4-19.
5. Conduct tree plantings and impervious cover removal at PAA_D_0101.
6. Partner with the Maryland Port Administration to identify water quality improvement and stormwater management projects.
7. Work with MPA and adjacent property holders to determine feasibility of treatment of stormwater runoff from the two (2) storm sewers flowing onto the Dundalk Marine Terminal from off-site.
8. Work with the MPA to identify future off-site projects with the potential to meet TMDL reduction requirements imposed on the facility.
9. Look for opportunities to partner with the MPA to develop trash elimination strategies in the watershed.
10. Work with the MPA to educate port users on proper hazardous and solid waste disposal.
11. Participate with the MPA to conduct one community/waterway clean-up/year in the watershed.
12. Consider funding opportunities to partner with the MPA to implement environmental improvement projects that will meet a mitigation requirement to share mitigation credit.
13. Conduct vegetative maintenance at the detention pond on Villager Circle (SWM_D_1420).
14. Identify open pervious shoreline areas in Colgate Creek with the potential for reforestation and preservation, especially at ISI_D_0104.

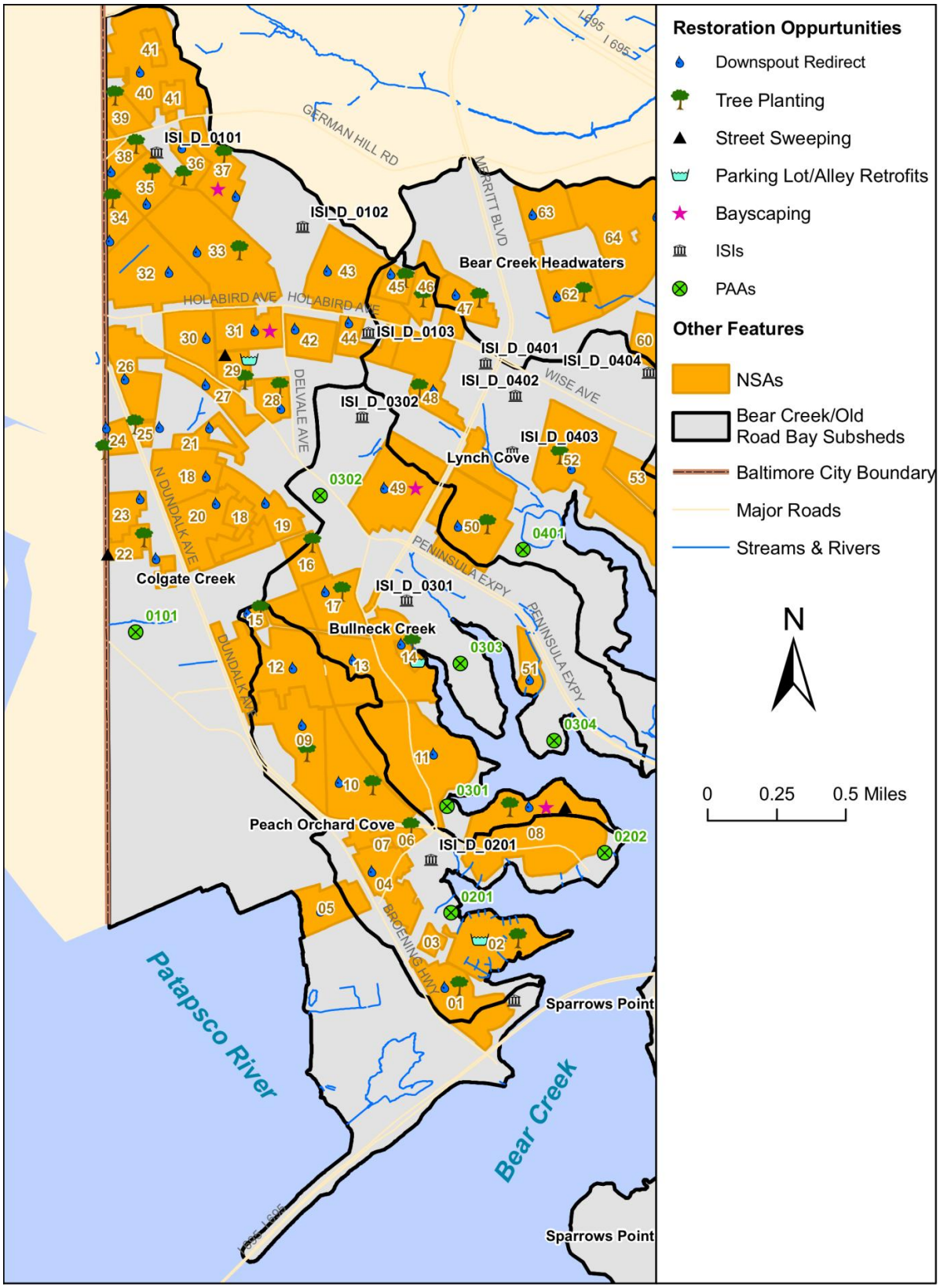


Figure 4-10: Restoration Opportunities in Colgate Creek

### 4.3.2 Peach Orchard Cove

Peach Orchard Cove is the fourth smallest subwatershed in the Bear Creek/Old Road Bay study area. 98% of Peach Orchard Cove is occupied by urban development including institutional, commercial, open urban and residential uses. The remaining subwatershed area is classified as water. Table 4-23 summarizes key subwatershed characteristics of Peach Orchard Cove.

**Table 4-23: Key Subwatershed Characteristics – Peach Orchard Cove**

| | | |
|---|---|---|
| **Drainage Area** | 450.2 acres (0.70 sq. mi.) | |
| **Stream Length** | 0.9 miles | |
| **Coastline Length** | 2.4 miles | |
| **Population** | 6,186 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 0.0% |
| | Medium Density Residential: | 8.0% |
| | High Density Residential: | 73.4% |
| | Commercial: | 3.6% |
| | Industrial: | 4.0% |
| | Institutional: | 2.3% |
| | Open Urban: | 7.0% |
| | Forest: | 0.0% |
| | Agriculture: | 0.0% |
| | Water/Wetlands: | 1.6% |
| | Transportation | 0.0% |
| **Impervious Cover** | 36.3% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.0% |
| | B Soils: | 36.4% |
| | C Soils: | 21.4% |
| | D Soils (high runoff potential): | 41.8% |
| | Water | 0.4% |

#### *4.3.2.1 Neighborhoods*

A total of eleven (11) distinct neighborhoods were identified and assessed within Peach Orchard Cove during the uplands assessment of Bear Creek/Old Road Bay. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, buffer improvement, tree planting, stormwater retrofits and public education (i.e., bayscaping, increasing lot tree canopy, trash management, and pool maintenance). Seven (7) NSAs fall into the area of high concern for environmental justice. Restoration opportunities at these neighborhoods should be prioritized highly. A summary of neighborhood recommended actions is presented in Table 4-24. Neighborhoods falling into the area of high concern for environmental justice are indicated with an asterisk beside their NSA ID.

**Table 4-24: NSA Recommendations – Peach Orchard Cove**

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marking | Bayscape | Increase Lot Canopy | Trash Management | Buffer Improvement | Parking Lot Retrofit | Alley Retrofit | Street Sweeping | # of Street Trees | # of Shade Trees | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_D_01* | <1/8 | X | X | X | X | | X | X | | | | | | 95 | |
| NSA_D_02* | <1/8 | | | | X | | X | X | | X | | | | 20 | |
| NSA_D_03* | <1/8 | | | | X | | X | X | | | X | | | | Blue alleys |
| NSA_D_04* | <1/4 | X | X | | X | | X | | | | | | | | |
| NSA_D_06* | <1/8 | | | | X | | X | X | | | X | | | 27 | Blue alleys |
| NSA_D_07* | <1/8 | | | | X | | X | | | | | | | | |
| NSA_D_08* | 1/4 | X | X | | X | X | X | X | X | | | 16.9 | 50 | 10 | Boat storage |
| NSA_D_09 | <1/8 | X | X | | | | X | X | | | X | | | 34 | Blue alleys, potential pavement removal at intersection of Dunhaven and Dunran Roads. |
| NSA_D_10 | <1/4 | X | X | X | X | | X | | | | | | | 27 | |
| NSA_D_12 | <1/4 | X | X | X | X | | X | | | | X | | | | Blue alleys |
| NSA_D_15 | <1/8 | X | X | X | | | X | | | | X | | | 11 | Blue alleys |

*NSAs that intersect the watershed's area of high concern for environmental justice.

Most of the neighborhoods in Peach Orchard Cove are recommended for downspout disconnection, public education related to trash management, increasing lot tree canopy, and storm drain marking. One (1) neighborhood, NSA_D_08, is recommended for bayscaping and buffer improvement that may be achieved through public education about the benefits of providing a stream and shoreline buffer by reducing the amount of mowed lawn through tree and vegetation planting. In addition, NSA_D_08, which is consists of almost 87 acres of single family detached dwellings was recommended for street sweeping, street trees, and shade trees. Several other neighborhoods in Peach Orchard Cove were also recommended for shade tree planting.

NSA_D_02 consists of a 39-acre neighborhood of multifamily townhomes. Drainage from the townhomes is conveyed through the use of concrete drainage channels shown in the image on the left in Figure 4-11. These channels either enter a storm drain in the common area between the townhomes or at the exterior of the property as seen in Figure 4-11. There is potential for either replacement of the concrete drainage channels with a vegetated bioswale to provide water quality treatment or the installation of bioretention areas at the existing storm drains to provide a central treatment area.

**Figure 4-11: Potential Stormwater Retrofits at Concrete Channels and Storm Drain Inlets in NSA_D_02**

Other issues encountered in Peach Orchard Cove include opportunity for education on proper vehicle and boat maintenance and storage. Also, the intersection of Dunhaven Rd and Dunran Rd in NSA_D_09 contains a large amount of impervious area, a portion of which could be removed to provide a vegetated island.

#### *4.3.2.2 Hotspots*

One (1) hotspot investigation was performed within Peach Orchard Cove on a commercial shopping center. Table 4-25 summarizes the potential pollution sources found at this site.

**Table 4-25: HSI Results Summary – Peach Orchard Cove**

| HSI_ID | HSI Status* | Description | Vehicle Operations | Outdoor Materials | Waste Management | Notes |
|---|---|---|---|---|---|---|
| HSI_D_0201 | Confirmed | Commercial-Shopping Center | X | X | X | Rear pavement breaking up. Downspouts and dumpster drain to alley inlet |

HSI_D_0201 is a 10.6-acre shopping center located off of Dundalk Avenue in Peach Orchard Cove. Potential pollution sources at this hotspot include vehicle operations, storage of outdoor materials, and management of waste. Specifically, the area is almost completely comprised of impervious surfaces for parking or commercial buildings. The parking lot showed evidence of stains and much of it was deteriorating due to its age of almost 20 years. In the rear of the facility, dumpsters were observed with open lids and any leaks were draining to an inlet at an adjacent residential alley. Downspouts at the rear of the commercial buildings were also observed to be discharging directly to pavement draining to an alley inlet. Recommendations at this site include future education on proper waste and materials management along with potential impervious cover removal or stormwater retrofits to mitigate the large impervious surface present here. Figure 4-12 illustrates the drainage pattern from the downspouts at the rear of HSI_D_0201 along with an example of a leaking dumpster.

**Figure 4-12: Downspout Drainage (left) and Leaking Dumpster (right) at HSI_D_0201**

### *4.3.2.3 Institutions*

One (1) public institutional site was assessed for retrofit opportunities in Peach Orchard Cove during the uplands assessment of Bear Creek/Old Road Bay. Table 4-26 summarizes recommendations for the institutional site assessed in Peach Orchard Cove.

**Table 4-26: ISI Recommendations – Peach Orchard Cove**

| Site ID | Name | Public/ Private | # Trees for Planting | Stormwater Retrofit | Trash Management | Storm Drain Marking | Notes |
|---|---|---|---|---|---|---|---|
| ISI_D_0201 | Sollers Point Technical High School | Public | 18 | X | X | X | Retrofit track inlets, tree planting, loose trash |

ISI_D_0201 is a public high school on Dundalk Avenue and is located in the area of high concern for environmental justice in Peach Orchard Cove. Recommendations for water quality projects at this institution include education on proper trash management and storm drain marking. In addition, several tree planting areas were noted around the parking and driveway area on the east side of the school. The potential stormwater retrofit identified at the southern end of the site could treat runoff from the impervious track surface. Currently, runoff from the track drains to an interior curb where 2" drain holes allow stormwater to enter storm drain inlets. Figure 4-13 provides view of this drainage conveyance system. A linear bioretention system could be installed along the interior of the track to treat the first inch of runoff where most pollutants are conveyed prior to entering the storm sewer network. In addition, the interior of the track is completely turf grass. It might be possible to conduct tree plantings on a portion of this area that isn't being used for athletics.

**Figure 4-13: Potential Stormwater Retrofit at Asphalt Track (left) and Open Pervious Area (right) at ISI_D_0201**

#### *4.3.2.4 Pervious Areas*

The two (2) pervious areas assessed for restoration potential in Peach Orchard Cove are summarized in Table 4-27.

**Table 4-27: PAA Descriptions – Peach Orchard Cove**

| Site_ID | Location | Name | Acres | Ownership |
|---|---|---|---|---|
| PAA_D_0201 | Rayme Rd. | Turner Station Park | 5.3 | Public |
| PAA_D_0202 | Bullneck Road at Murray Point | Watersedge Park | 12.6 | Public |

PAA_D_0201, Turner Station Park, is a 5.3-acre public park located on Rayme Road and maintained by Baltimore County Office of Budget and Finance, Property Management. The site is comprised of turf grass (70%) with approximately 25% forest cover, and 5% shrubbery. Recent tree plantings had been conducted at the site prior to the assessment. The parking lot at this PAA contained several vegetated islands that could be converted to bioretention areas to provide treatment to stormwater runoff from the impervious parking lot. Figure 4-14 provides a view of the potential retrofit areas at PAA_D_0201.

**Figure 4-14: Potential Stormwater Retrofits at Parking Lot Islands at PAA_D_0201**

PAA_D_0202, Watersedge Park, is a 12.6-acre public park located on Bullneck Road in the Peach Orchard Cove subwatershed and is partially located in the area of the study identified as having high EJ concerns. The park consists of athletic fields, athletic courts, and a public boat ramp. Localized reforestation, particularly along the shoreline is recommended for this PAA. The site would require minimal site preparation to supplement and enhance the shoreline buffer at the site. In addition, the boat launch at the site was noted as having significant erosion, delivering sediment directly into Bear Creek (see Figure 4-15). This area is recommended for resurfacing to stabilize the existing ramp and eliminate the erosion here.

**Figure 4-15: Erosion at Boat Launch (left) and Shoreline Planting Potential (right) at PAA_D_0202**

#### *4.3.2.5 Marinas*

No marinas were assessed in Peach Orchard Cove.

#### *4.3.2.6 Large Landowners*

Two (2) large landowners' properties bisect a portion of Peach Orchard Cove: the MPA's Dundalk Marine Terminal and BGE's Riverside Generating Station. Information on recommendations and potential restoration opportunities at these sites can be found in Section 4.3.1.6.

#### *4.3.2.7 Illicit Discharges*

Peach Orchard Cove contains one (1) Priority 1 outfall which indicates major or reoccurring problems that require either immediate action or close monitoring. This subwatershed also contains one (1) Priority 3 outfall. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

#### *4.3.2.8 Stormwater Conversions*

No dry detention pond assessments were conducted in Peach Orchard Cove.

#### *4.3.2.9 Shoreline Restoration*

Peach Orchard Cove has 2.40 miles of shoreline of which 68% (18.7 acres) of the 100-foot shoreline buffer is classified as open, pervious area. In 1990, a shoreline enhancement project was conducted on

480 linear feet of shoreline at Watersedge Park. Three (3) additional shoreline enhancement projects were identified in EPS's Shoreline Enhancement Feasibility Study (EPS 1998). The 600-foot shoreline reach at Turners Park was classified as stable. Reaches at Southeastern Tech Magnet (200-feet) and Peach Orchard Park (4,100-feet) were categorized has having low enhancement potential. All three were removed from further consideration for an enhancement project. Planting of the open pervious shoreline buffer in Peach Orchard is recommended as much of the shoreline consists of residential or park land and is fully contained in the area of high environmental justice concern.

#### *4.3.2.10 Subwatershed Management Strategy*

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-24 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-24.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees.
4. Educate citizens about the benefits and importance of proper lawn care and pool maintenance techniques and bayscaping.
5. Educate residents of neighborhoods indicated in Table 4-24 about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments.
6. Educate residents on proper techniques for boat storage and maintenance.
7. Conduct tree plantings and storm drain marking at ISI_D_0201.

Municipal Actions

1. Investigate the potential to convert concrete channels at NSA_D_02 to bioswales or to provide other stormwater retrofits at the neighborhood.
2. Work with the HSIs indicated in Table 4-25 and similar businesses to implement appropriate practices for vehicle operations, outdoor materials storage and waste management.
3. Investigate the potential for stormwater retrofits at PAA_D_0201.
4. Identify open pervious shoreline areas in Peach Orchard Cove with the potential for reforestation and preservation, especially at ISI_D_0104 and PAA_D_0202.

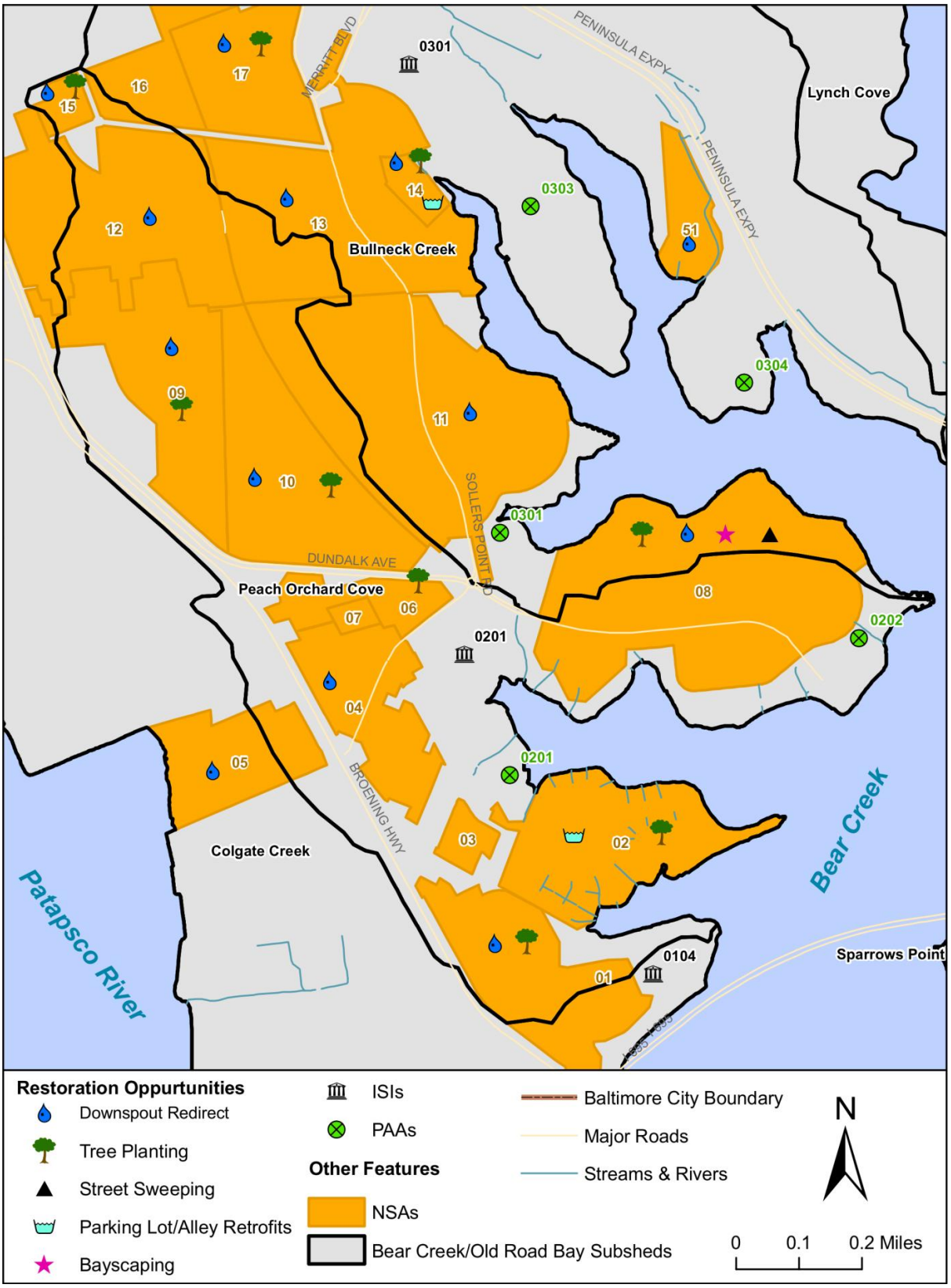


Figure 4-16: Restoration Opportunities in Peach Orchard Cove

### 4.3.3 Bullneck Creek

Bullneck Creek is the seventh largest subwatershed in the Bear Creek/Old Road Bay study area. 98% of Bullneck Creek is occupied by urban development including institutional, commercial, open urban and residential uses. The remaining subwatershed area is classified as wetlands/water. Table 4-28 summarizes key subwatershed characteristics of Bullneck Creek.

**Table 4-28: Key Subwatershed Characteristics – Bullneck Creek**

| | | |
|---|---|---|
| **Drainage Area** | 632.2 acres (0.99 sq. mi.) | |
| **Stream Length** | 0.8 miles | |
| **Coastline Length** | 4.3 miles | |
| **Population** | 4,967 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 2.3% |
| | Medium Density Residential: | 12.0% |
| | High Density Residential: | 38.3% |
| | Commercial: | 1.6% |
| | Industrial: | 5.7% |
| | Institutional: | 18.5% |
| | Open Urban: | 19.7% |
| | Forest: | 0.0% |
| | Agriculture: | 0.0% |
| | Water/Wetlands: | 2.0% |
| | Transportation | 0.0% |
| **Impervious Cover** | 29.7% of watershed | |
| **Soils** | A Soils (low runoff potential): | 1.7% |
| | B Soils: | 55.1% |
| | C Soils: | 16.3% |
| | D Soils (high runoff potential): | 26.9% |
| | Water | 0.0% |

#### *4.3.3.1 Neighborhoods*

A total of seven (7) distinct neighborhoods were identified and assessed within Bullneck Creek during the uplands assessment of Bear Creek/Old Road Bay. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, tree planting, stormwater retrofits and public education (i.e., bayscaping, increasing lot tree canopy and trash management). A summary of neighborhood recommended actions is presented in Table 4-29.

**Table 4-29: NSA Recommendations – Bullneck Creek**

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marking | Bayscape | Increase Lot Canopy | Trash Management | Parking Lot Retrofit | Alley Retrofit | # of Shade Trees | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_D_11 | <1/4 | X | X | | X | | X | | | | | |
| NSA_D_13 | <1/4 | X | X | | X | | X | X | | X | | Blue alleys |
| NSA_D_14 | <1/8 | X | X | X | | | X | | X | | 41 | |
| NSA_D_16 | <1/8 | | X | X | X | | X | | | X | 168 | Blue alleys |
| NSA_D_17 | <1/8 | X | X | | X | | X | X | | X | 31 | Blue alleys |
| NSA_D_49 | 1/4 | X | X | X | X | X | X | X | | | | |
| NSA_D_51 | <1/8 | X | X | | | | X | | | | | |

All but one (1) of the neighborhoods in Bullneck Creek were recommended for downspout disconnection, though because most of the lot sizes are 1/4-acre or below, disconnected downspouts were recommended to be connected to rain barrels. In addition, every NSA in this subwatershed was recommended for an increased lot canopy, and three (3) were specifically targeted for shade tree plantings in common areas. Several neighborhoods showed evidence of trash or debris in common areas and yards while one (1) neighborhood was recommended for education related to bayscaping.

NSA_D_14 is an apartment complex located on Four Seasons Court off of Mornington Road. The complex consists of six (6) apartment buildings with parking spaces along the driveway and in larger parking areas. A potential stormwater retrofit was identified in this area to treat runoff from the parking lots and downspouts of which approximately 50% are connected to the storm drain system. There is sufficient grassed area adjacent and at an elevation below the parking areas for the installation of bioretention areas that could provide treatment to runoff. Discharges from these areas could pass through a vegetated filter strip directly to Bullneck Creek. Figure 4-17 shows the potential stormwater retrofit location along with evidence of connected downspouts in NSA_D_14.

**Figure 4-17: Potential Stormwater Retrofit Area (left) and Connected Downspouts (right) at NSA_D_14**

#### 4.3.3.2 Hotspots

One (1) hotspot investigation was performed within Bullneck Creek on a residential construction site. Table 4-30 summarizes the potential pollution sources found at this site.

**Table 4-30: HSI Results Summary –Bullneck Creek**

| HSI_ID | HSI Status* | Description | Vehicle Operations | Outdoor Materials | Waste Management | Turf/Landscape Management | Storm Water | Notes |
|---|---|---|---|---|---|---|---|---|
| HSI_D_0301 | Confirmed | Construction | X | X | X | X | X | Severe erosion from site to adjacent vegetated areas |

HSI_D_0301 is a 20-acre residential, construction site located on the boundary of Bullneck Creek and Lynch Cove and near Stansbury Road. Activities present at the site included operations of construction vehicles, storage of construction materials, management of construction waste and debris, turf/landscape management, and stormwater management. At construction sites, a major environmental concern is the potential for disturbed soil without vegetation to be washed into nearby storm drains or surface waters during storm events. At HSI_D_0301, there were numerous instances where insufficient erosion and sediment control practices were allowing the transport of sediment from the construction site. Figure 4-18 shows two areas of the site where erosion and sediment control practices failed to prevent sediment from washing into sensitive areas and storm drain inlets. The major recommendation stemming from the assessment at HSI_D_0301 is the continued inspection of erosion and sediment control practices at construction sites to ensure that practices are in place and are functioning as intended.

**Figure 4-18: Sediment Washing to Adjacent Wetlands (left) and to Storm Drain Inlets (right) at HSI_D_0301**

#### 4.3.3.3 Institutions

Two (2) public institutional sites were assessed for retrofit opportunities in Bullneck Creek during the uplands assessment of Bear Creek/Old Road Bay. Table 4-31 summarizes recommendations for the institutional sites assessed in Bullneck Creek.

**Table 4-31: ISI Recommendations – Bullneck Creek**

| Site ID | Name | Public/ Private | Nutrient Management | # Trees for Planting | Downspout Disconnection | Impervious Cover Removal | Trash Management | Storm Drain Marking | Buffer Improvement | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| ISI_D_0301 | Logan Elementary School | Public | | 119 | | | X | | | Street tree and shade tree planting |
| ISI_D_0302 | Community College Of Baltimore County Dundalk | Public | X | 1,026 | X | X | X | X | X | Lots of parking could be converted to pervious/ reforestation potential |

ISI_D_0301 is a 12.2-acre public, elementary school located on Merritt Boulevard in the Bullneck Creek subwatershed. The site was recommended for tree planting and education related to trash management. The exterior of the site along the public right of way has some street trees but vacant areas were present which provide an opportunity for more street trees to be planted. In addition, several open areas of the site were noted as having the potential for shade trees if not used by the school for recreation or athletics. The presence of trees here along with the elevations of the impervious parking surface made the institution unfavorable for stormwater management retrofits.

ISI_D_0302, the Community College of Baltimore County's Dundalk Campus, is a 67-acre site located on Sollers Point Road and along Merritt Boulevard. Recommendations for water quality improvements at this site are discussed in Section 4.3.3.6.

#### *4.3.3.4 Pervious Areas*

The four (4) pervious areas assessed for restoration potential in Bullneck Creek are summarized in Table 4-32.

**Table 4-32: PAA Descriptions – Bullneck Creek**

| Site_ID | Location | Name | Acres | Ownership |
|---|---|---|---|---|
| PAA_D_0301 | 7894 Dundalk Ave. | Concrete Homes Park | 11.6 | Public |
| PAA_D_0302 | Sollers Point Rd. | Dundalk Middle School Fields | 13.2 | Public |
| PAA_D_0303 | Dunmanway Rd. | Merritt Point Park | 40.8 | Public |
| PAA_D_0304 | Chesterwood Rd | Chesterwood Park | 20.7 | Public |

PAA_D_0301, Concrete Homes Park, is an 11.6-acre public park located on Dundalk Avenue and maintained by the Baltimore County Office of Budget and Finance, Property Management. The site is mostly comprised of turf grass (60%) with approximately 25% forest cover, and 15% shrubbery. There is an opportunity for shoreline plantings with minimum site preparation needed and easy access for vehicles. Constraints at this site include a set of large transmission lines that bisect the site. Accounting for a 100-foot offset from the electric lines, there is still potential for almost two (2) acres of reforestation here, mostly in the southern half of the site. The other potential difficulty with reforestation at this site would be the elimination of scenic water views from much of the residential area behind the site. In addition, grass clippings from turf mowing were covering much of the site and

susceptible to being carried into surface waters by runoff. It was recommended that maintenance staff be educated on proper turf management.

**Figure 4-19: Reforestation Potential Limited by Overhead Transmission Lines at PAA_D_0301**

PAA_D_0302, Dundalk Middle School Fields, is a 13.2-acre public park located off Sollers Point Road. The property is maintained by the Baltimore County Office of Budget and Finance, Property Management and consists of four (4) baseball fields that appear to be used occasionally by Dundalk Middle School, which is located on the other side of a set of train tracks from the park. Tree planting potential was identified on the periphery of the park and along Sollers Point Road as trees in these locations would not affect the athletic fields. The field on the southeast end of the park was noted as appearing under-used and not maintained and could also be reforested. Minimal site preparation would be needed and the site is easily accessible by foot or vehicle. A 1,200-foot concrete channel that traverses the exterior of the site and discharges to an inlet was recommended to be retrofitted into a vegetated swale to treat runoff from Sollers Point Road. Figure 4-20 provides a view of the reforestation potential and potential stormwater retrofit at PAA_D_0302.

**Figure 4-20: Reforestation Potential (left) and a Concrete Drainage Channel (right) at PAA_D_0302**

PAA_D_0303, Merritt Point Park, is a 40.8-acre public park located at the end of Dunmanway Road in the Bullneck Creek subwatershed. The park is maintained by the Baltimore County Office of Budget and Finance, Property Management and is located on a peninsula protruding into Bullneck Creek. At the

northern portion of the site, a large demolition site was observed which should be investigated to determine if reforestation is possible in this area. Shade tree plantings were recommended for this site as well as the potential replacement of impervious parking areas with permeable pavement. Planning has occurred in the past for possible expansion and renovation of the park in which community input was solicited. Any input provided at public meetings should be taken into account prior to the implementation of restoration actions.

PAA_D_0304, Chesterwood Park, is a 20.7-acre park located on Chesterwood Road off the Peninsula Expressway in the Bullneck Creek subwatershed. The site consists of a large parking area and a soccer/football field, but the majority is natural forests and wetlands along the boundary of the site. "No-mow" buffer signs were seen along the perimeter of the site. The site was recommended for shade tree plantings in open pervious areas. In addition, evidence of the dumping of bleachers, fencing, and other materials was seen on site.

#### *4.3.3.5 Marinas*

No marinas were assessed in Bullneck Creek.

#### *4.3.3.6 Large Landowners*

One (1) large landowner property was assessed in the Bullneck Creek subwatershed, the Community College of Baltimore County's Dundalk Campus (CCBC), as detailed in Table 4-33.

**Table 4-33: Large Landowners – Bullneck Creek**

| Site ID | Name | Acres |
|---|---|---|
| LLO_D_0301 | Community College Of Baltimore County-Dundalk | 67 |

CCBC is located off of Delvale Avenue and encompasses portions of the Bullneck Creek, Lynch Cove, and Colgate Creek subwatersheds. The facility was assessed as an ISI and operates under a NPDES General Stormwater Discharge Permit. Consequently, the facility has a Pollution Prevention Plan and an associated Spill Prevention and Control Plan.

Recommendations made during the assessment of CCBC include working with Baltimore County Board of Education to determine the feasibility of tree plantings, determine the feasibility of replacing impervious pavement with porous pavement, and education on proper waste management and vehicle operations procedures.

#### *4.3.3.7 Illicit Discharges*

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

#### *4.3.3.8 Stormwater Conversions*

One (1) detention pond was assessed in Bullneck Creek and is summarized in Table 4-34.

**Table 4-34: Detention Pond Conversion - Bullneck Creek**

| Site ID | Riser | Embank-ment | Vege-tation | Fence Condition | Gate Condition | Water Quality Potential | Access | Flow Path | Horizontal Expansion Potential | Vertical Expansion Potential |
|---|---|---|---|---|---|---|---|---|---|---|
| 463 | Good | Trees | Turf | None | None | Y | Easy | Long | Y | Y |

SWM_D_463 is designed to handle runoff from the 2, 10, and 100-year events from a 42.49-acre community college campus and parking lots. There is potential for both horizontal and vertical expansion at the pond. Key recommendations at the pond include removing trees from the pond's embankment and invasive species management. In addition, the concrete along the emergency spillway is starting to deteriorate and should be repaired. Several flow paths (shown in Figure 4-21) were observed at the pond. These flow paths are recommended to be converted into vegetative swales to provide water quality treatment to smaller storms which contain the majority of pollutants from the drainage area.

**Figure 4-21: Channelized Inflow Path (left) and Potential Expansion Area (right) at Detention Pond SWM_D_463**

### *4.3.3.9 Shoreline Restoration*

Bullneck Creek has 4.35 miles of shoreline of which 51% (25.8 acres) of the 100-foot shoreline buffer is classified as open, pervious area. In 1990, two (2) shoreline enhancement projects were conducted on 1,880 linear feet of shoreline at Merritt Point Park and 430 linear feet of shoreline at Concrete Homes Park. EPS's Shoreline Enhancement Feasibility Study recommended that the reach at Concrete Homes Park be retrofitted for shoreline enhancement and ecological enhancement. One (1) additional shoreline enhancement project was identified in EPS's Shoreline Enhancement Feasibility Study (EPS 1998). During the time of the study, Chesterwood Park was under design for waterside improvements including derelict boat removal facilities and was removed from further study. Planting of the open pervious shoreline buffer in Bullneck Creek is recommended as much of the shoreline consists of residential or park land.

#### *4.3.3.10 Subwatershed Management Strategy*

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-29 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-29.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees.
4. Educate citizens about the benefits and importance of bayscaping and proper trash management.
5. Conduct tree plantings and storm drain marking at ISI_D_0201.

Municipal Actions

1. Investigate the potential for stormwater retrofits at NSA_D_14 to treat runoff from the impervious driveway and parking areas.
2. Work with the HSI indicated in Table 4-30 and similar businesses to implement appropriate practices for vehicle operations, outdoor materials storage, waste management, turf/landscape management, and stormwater.
3. Work with CCBC to investigate the potential for tree planting and porous pavement installation at its Dundalk Campus.
4. Conduct tree plantings at the PAAs identified in Table 4-32.
5. Investigate the potential for stormwater retrofits at PAA_D_0302.
6. Complete recommended improvements to dry detention pond SWM_D_463 located at CCBC's Dundalk Campus.
7. Investigate the potential for shoreline enhancement and ecological enhancement at Concrete Homes Park.
8. Identify open pervious shoreline areas in Bullneck Creek with the potential for reforestation and preservation.

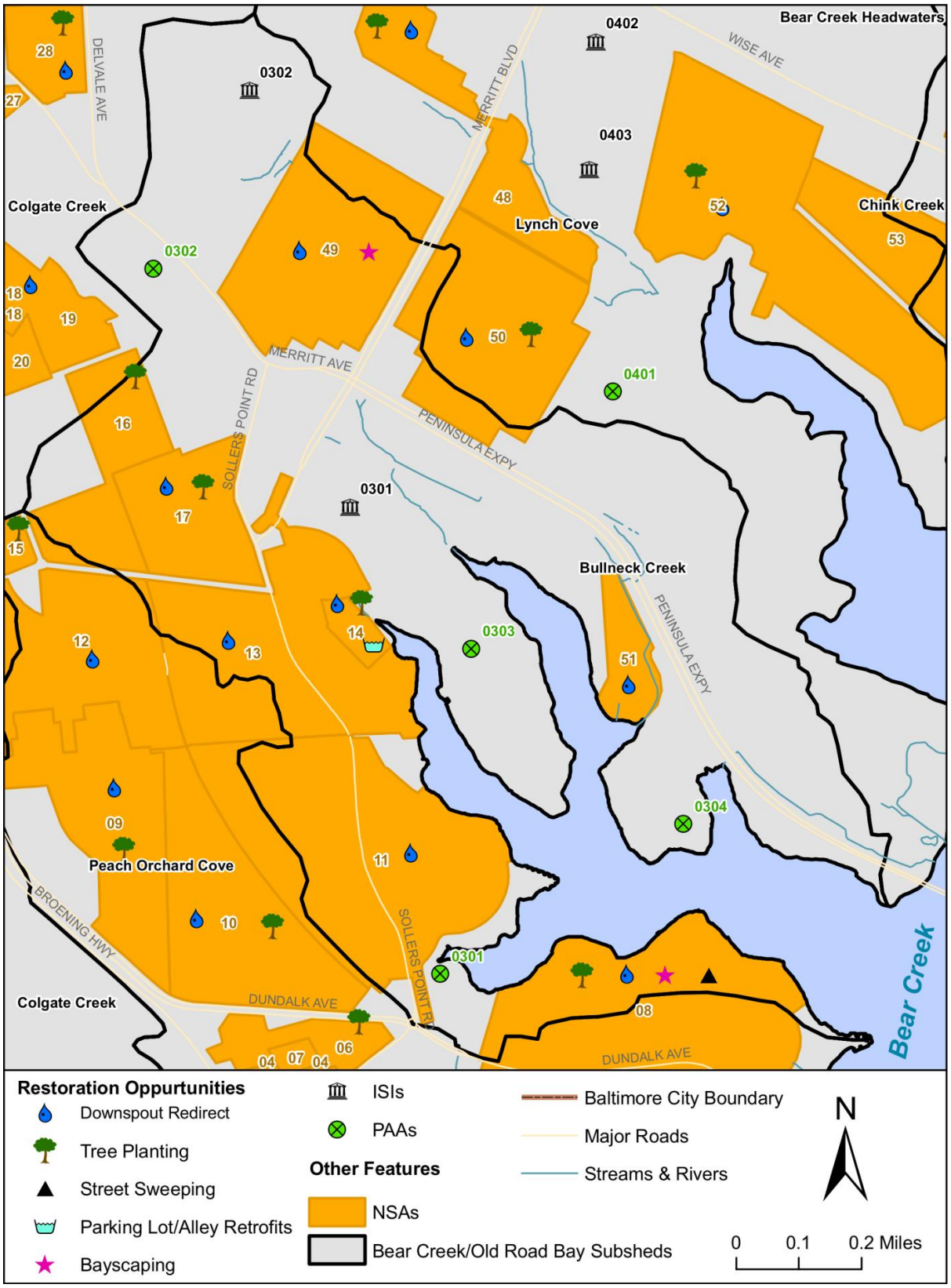


Figure 4-22: Restoration Opportunities in Bullneck Creek

### 4.3.4 Lynch Cove

Lynch Cove is the sixth largest subwatershed in the Bear Creek/Old Road Bay study area. Encompassing a large amount of residential and industrial area, Lynch Cove is almost entirely occupied by urban development (nearly 99%) including industrial, institutional, commercial, open urban, and residential uses. The remaining subwatershed area is classified as wetlands and water. Table 4-35 summarizes key subwatershed characteristics of Lynch Cove.

**Table 4-35: Key Subwatershed Characteristics – Lynch Cove**

| | | |
|---|---|---|
| **Drainage Area** | 648.4 acres (1.01 sq. mi.) | |
| **Stream Length** | 0.8 miles | |
| **Coastline Length** | 3.1 miles | |
| **Population** | 8,010 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 0.5% |
| | Medium Density Residential: | 15.2% |
| | High Density Residential: | 40.4% |
| | Commercial: | 9.4% |
| | Industrial: | 3.5% |
| | Institutional: | 18.1% |
| | Open Urban: | 11.6% |
| | Forest: | 0.0% |
| | Agriculture: | 0.0% |
| | Water/Wetlands: | 1.4% |
| | Transportation | 0.0% |
| **Impervious Cover** | 36.1% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.0% |
| | B Soils: | 21.5% |
| | C Soils: | 17.5% |
| | D Soils (high runoff potential): | 59.5% |
| | Water | 1.5% |

#### *4.3.4.1 Neighborhoods*

A total of eight (8) distinct neighborhoods were identified and assessed within Lynch Cove during the uplands assessment of Bear Creek/Old Road Bay. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, tree planting, and public education (i.e., bayscaping, increasing lot tree canopy and trash management). A summary of neighborhood recommended actions is presented in Table 4-36.

**Table 4-36: NSA Recommendations – Lynch Cove**

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marking | Increase Lot Canopy | Trash Management | Buffer Improvement | Alley Retrofit | # of Street Trees | # of Shade Trees | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_D_44 | 1/8 | X | X | | X | X | | | X | | | Potential blue alley opportunity |
| NSA_D_45 | <1/8 | X | X | | X | X | X | | | 3 | | |
| NSA_D_46 | <1/8 | | X | X | X | X | X | X | | 16 | 68 | Uncovered dumpsters should be covered |
| NSA_D_48 | <1/8 | X | X | | X | X | X | | X | 165 | | Blue alleys, good street tree planting opportunity |
| NSA_D_50 | <1/8 | X | X | | | X | X | | X | 120 | | Blue alleys |
| NSA_D_52 | <1/8 | X | X | | X | X | X | | X | 150 | | Blue alleys |
| NSA_D_54 | <1/8 | | X | | X | X | X | | | 148 | | |
| NSA_D_55 | <1/8 | X | X | X | X | X | | | | | | Small bioretention ponds at end of parking lot |

Most of the NSAs in Lynch Cove were recommended for downspout disconnection but because of the small lot sizes, the most feasible disconnection method would be through the use of rain barrels to capture rooftop runoff. Increasing tree cover is the major focus for neighborhoods in Lynch Cove as all of the neighborhoods were recommended for an increase in lot canopy and most were good candidates for street tree planting. Figure 4-23 illustrates the potential for increased street tree plantings and lot canopies in the neighborhoods of Lynch Cove.

**Figure 4-23: Street Tree Planting and Increased Lot Canopy Potential at NSA_D_48 (left) and NSA_D_52 (right)**

#### 4.3.4.2 Hotspots

Two (2) hotspot investigations were performed within Lynch Cove on a commercial shopping center and an industrial metals recycling facility. Table 4-37 summarizes the potential pollution sources found at each of the sites.

**Table 4-37: HSI Results Summary – Lynch Cove**

| HSI_ID | HSI Status* | Description | Vehicle Operations | Outdoor Materials | Waste Management | Physical Plant | Storm Water | Notes |
|---|---|---|---|---|---|---|---|---|
| HSI_D_0401 | Confirmed | Commercial-Shopping Center | X | X | X | X | X | Sediment in lot/poor waste practices/ gas, carwash, tires |
| HSI_D_0402 | Industrial – Recycling | Commercial-Construction | X | X | | X | | Metals recycling drop-off; stains and liquid exiting site |

HSI_D_0402 is a commercial shopping center located along Merritt Boulevard in Lynch Cove. The area contained a variety of businesses including a gas station, retail stores, and a car repair facility. Subsequently, this hotspot contained a variety of potential pollution activities including vehicle operations, storage of outdoor materials, waste management, wear and tear of the physical plant or lot of the hotspot, and stormwater management. Assessments at the site revealed a multitude of sediment build-up at curbs due to deterioration of the asphalt paving. In addition, poor waste practices including overflowing dumpsters and uncovered trash receptacles were observed. After the assessment at this hotspot was performed, the property containing HSI_D_0401 began a redevelopment process at the site. Because the Bear Creek/Old Road Bay planning area is mostly developed, beneficial redevelopment can be a valuable way to convert properties to a more environmentally sensitive state. The ultimate recommendation stemming from HSI_D_0401 is that potential redevelopment properties in the SWAP planning area should be identified, and appropriate redevelopment standards should be implemented at these properties in the future.

HSI_D_0402 is an industrial recycling facility in Lynch Cove which processes recycled metals that are collected from residential collection as well as commercial and industrial sources. The facility is frequented by vehicles transporting the recyclable metal as well as other industrial vehicles to assist in processing within the facility. The major environmental concern from this site involved how the metals were processed and the potential pollution that could occur as a result. Metals arriving at the facility were stored without cover and liquids from the metals were draining from the site as seen in Figure 4-24. The recommendation at this site and other similar industrial facilities is to ensure that contaminated liquids from industrial process are directed to appropriate conveyance or impoundment systems such as the sanitary sewer as opposed to utilizing storm drains and curb which would contribute pollution to surface waters.

**Figure 4-24: Evidence of Outdoor Materials Storage and Staining at the Paved Entrance at HSI_D_0402**

### *4.3.4.3 Institutions*

Three (3) public and one (1) private institutional site were assessed for retrofit opportunities in Lynch Cove during the uplands assessment of Bear Creek/Old Road Bay. Table 4-38 summarizes recommendations for the institutional sites assessed in Lynch Cove.

**Table 4-38: ISI Recommendations – Lynch Cove**

| Site ID | Name | Public/ Private | Nutrient Management | # Trees for Planting | Stormwater Retrofit | Downspout Disconnection | Impervious Cover Removal | Trash Management | Storm Drain Marking | Buffer Improvement | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ISI_D_0401 | North Point Library | Public | | 3 | | | | X | X | | Recently planted with trees. Space for few more |
| ISI_D_0402 | North Point Government Center | Public | X | 160 | | | X | X | X | X | Retrofit existing pond with low flow planting |
| ISI_D_0403 | Grange Elementary School | Public | | 343 | X | | X | X | X | X | Stream erosion/retrofit swale for front circle |
| ISI_D_0404 | Our Lady Of Hope Catholic Church | Private | X | 310 | X | X | X | | X | | Potential parking lot retrofit in islands |

ISI_D_0104 is a public library located on a 1.8-acre property at the intersection of Merritt Boulevard and Holabird Avenue. The elevations of the site are not conducive to stormwater management retrofits and a recent tree planting project had been completed at the site. There is sufficient space for a few more

trees at the site, and the site is also recommended for storm drain marking. As the site is located directly adjacent to HSI_D_0401, there might be an opportunity to provide stormwater management for shared parking areas between ISI_D_0401 and the currently redeveloping hotspot site.

ISI_D_0402 is a public government center located at the corner of Merritt Boulevard and Wise Avenue. This 28-acre site contains a large public building and associated parking along with athletic fields on the southern end of the site. Impervious area on the site is treated by a dry detention pond. Recommendations for improvements to the stormwater management pond can be found in Section 4.3.4.8. The site appeared to have recent tree plantings that were conducted although there was sufficient room for additional trees at the northwest corner of the property (Figure 4-25). A small stream leading to surface waters of Lynch Cove was observed at the southwest corner of the site, and buffer plantings are recommended for this area. In addition, impervious cover removal was recommended to be conducted at an area with deteriorating asphalt on the eastern side of the site.

**Figure 4-25: Open Pervious Area Recommended for Planting at ISI_D_0402**

ISI_D_0403 is a 20.7-acre public, elementary school on Church Road in the Lynch Cove subwatershed. The school was recommended for tree plantings, stormwater retrofits, potential stream restoration, storm drain marking and education related to trash management and the benefits of stream buffers. With a stream running along the western property boundary, plantings in this area would provide a beneficial stream buffer. In addition, preliminary investigations of the stream at this location revealed the presence of erosion. As one of the few true streams in the planning area, this site was recommended for a stream restoration project. Figure 4-26 provides photographs that illustrate the condition of the stream and stream buffer at ISI_D_0403.

At the rear of the school building at ISI_D_0403, an asphalt area was observed. If permitted by the school, this area could be classified as an impervious cover removal area. In addition, a stormwater retrofit was identified at the front of the school. The driveway and front parking area currently drain to a stormwater inlet which conveys stormwater runoff to the stream leading to Lynch Cove. There is potential to direct drainage reaching the inlet to a bioswale or bioretention area for water quality treatment. The elevation change appears sufficient for the installation of a shallow pipe to outlet in the grass field below the parking area. Figure 4-27 provides a view of the proposed impervious cover removal along with the area recommended for a stormwater retrofit BMP.

**Figure 4-26: Eroded Stream (left) and Open Pervious Stream Buffer (right) at ISI_D_0403**

**Figure 4-27: Potential Impervious Cover Removal Area (left) and Stormwater Retrofit Site (right) at ISI_D_0403**

ISI_D_0404 is a 21-acre private, faith-based institution located along Lynch Road in the Lynch Cove subwatershed. This site was recommended for storm drain marking, disconnection of rooftop downspouts, and inclusion in future education efforts on nutrient management. Along the northern boundary of the property, the potential for street tree planting was indicated. In addition, impervious cover removal at the rear parking area and stormwater retrofits of the grassed islands in the front parking area are recommended. Because this private institution is used as a church and school, parking requirements might eliminate the impervious cover removal opportunity. Figure 4-28 shows the potential impervious cover removal and stormwater retrofit areas at ISI_D_0404.

**Figure 4-28: Potential Impervious Cover Removal (left) and Stormwater Retrofit (right) Areas at ISI_D_0404**

#### *4.3.4.4 Pervious Areas*

The two (2) pervious areas assessed for restoration potential in Lynch Cove are summarized in Table 4-39.

**Table 4-39: PAA Descriptions – Lynch Cove**

| Site_ID | Location | Name | Acres | Ownership |
|---|---|---|---|---|
| PAA_D_0401 | Stansbury Lane | Stansbury Park | 37.8 | Public |
| PAA_D_0402 | 2057 Inverton Rd. | Inverness Park | 24.4 | Public |

PAA_D_0401, Stansbury Park, is a 37.8-acre public park located on Stansbury Lane in the Lynch Cove subwatershed. Maintained by the Baltimore County Office of Budget and Finance, Property Management, the park consists of a series of athletic fields, an asphalt driveway and parking area, and a 10-acre pond. The park is recommended for shade tree plantings along the driveway and the eastern boundary of the property. Transmission lines that bisect the site limit the planting opportunities in other areas.

The pond on the site is experiencing erosion and the northwest side of the pond contains historic chromium contamination which has been capped to prevent contaminant transport. It is recommended that stabilization of the shoreline at the pond be investigated to prevent failures of the pond slope. Figure 4-29 provides photographs showing the erosive conditions currently seen at the pond. Additionally, this site is recommended for stormwater retrofits to treat runoff from the parking lot. Currently, drainage is directed towards a grassed strip adjacent to the parking lot which could be converted to a bioretention area or rain gardens to provide water quality treatment.

**Figure 4-29: Evidence of Eroding Shoreline at the Pond at PAA_D_0401**

PAA_D_0402, Inverness Park, is a 24.4-acre public park located on Inverton Road in the Lynch Cove subwatershed. The park is sited along the shoreline in Lynch Cove and contains athletic fields and a recreation center which is maintained by the Baltimore County Office of Budget and Finance, Property Management. Recommendations here include street tree planting along Lynch Road, reforestation around the recreation center and portions of the shoreline where fields are not currently sited, and the establishment of a "no-mow" buffer along the shoreline.

### *4.3.4.5 Marinas*

Two (2) marinas were assessed in Lynch Cove and are summarized in Table 4-40.

**Table 4-40: Marina Recommendations – Lynch Cove**

| Site ID | Type | Clean Marina | Maintenance/ Repair | Petroleum | Sewage | Waste Management | Marina Management | Stormwater Management | Turf | Total Score | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MAR_D_0401 | Marina/ Boatyard | Y | 80 | 75 | 75 | 60 | 100 | 83 | 0 | 81 | 1st MD clean marina; quarterly staff environmental training |
| MAR_D_0402 | Marina/ Boatyard | N | 100 | 0 | 75 | 25 | 0 | 40 | 67 | 43 | No SW discharge permit; Approved residential development plans; to be redeveloped |

MAR_D_0401 is a marina and boatyard which provides boat slips, long term storage, and boat repairs. The facility is the first marina certified as a Maryland Clean Marina and has a number of positive environmental features. All maintenance and repair activities are restricted to an indoor work area. Fueling areas at the dock are covered, staffed, and equipped with shut-off nozzles and spill cleanup kits. There are numerous signs educating the public about clean boating practices and the facility has an

appropriate NDPES for operation of a marina. The management also conducts quarterly environmental training with the staff. The facility is recommended for education on proper boat washing procedures as boats are currently washed in the gravel parking lot without runoff diversions.

MAR_D_0402 is a marina and boatyard facility located on Stansbury Road in the Lynch Cove subwatershed. Maintenance activities at this marina were all conducted indoors and no fueling operations were present. The pump-out system was located out of the water and appeared to be in good working order. The facility did lack a spill prevention control plan and is recommended for education. In addition, a follow-up should be made here to ensure that appropriate NDPES permits are applied for by the marina. The marina owner indicated that the area was currently being permitted for a residential redevelopment.

#### *4.3.4.6 Large Landowners*

One (1) large landowner's property bisects a portion of Lynch Cove: the CCBC – Dundalk Campus. Information on recommendations and potential restoration opportunities at this site can be found in Section 4.3.3.6.

#### *4.3.4.7 Illicit Discharges*

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

#### *4.3.4.8 Stormwater Conversions*

One (1) detention pond was assessed in Lynch Cove and is summarized in Table 4-41.

**Table 4-41: Detention Pond Conversion - Lynch Cove**

| Site ID | Riser | Embank-ment | Vege-tation | Fence Condition | Gate Condition | Water Quality Potential | Access | Flow Path | Horizontal Expansion Potential | Vertical Expansion Potential |
|---|---|---|---|---|---|---|---|---|---|---|
| 726 | Good | Trees | Turf | None | None | Y | Easy | Long | Y | Y |

SWM_D_726 is a publicly owned facility located within ISI_D_0402. This pond is designed to handle runoff from the 2 and 10-year events from a 7.28-acre police station and county park. The facility has potential for both horizontal and vertical expansion. In addition, the pond is recommended for tree removal on the embankment as well as the cleaning of sediment around the pond inflow structures. Several flow paths (shown in Figure 4-30) were observed at the pond. These flow paths are recommended to be converted into vegetative swales to provide water quality treatment to smaller storms which contain the majority of pollutants from the drainage area.

**Figure 4-30: Low-Flow Paths and Outlet Structure at SWM_D_726**

#### *4.3.4.9 Shoreline Restoration*

Lynch Cove has 3.06 miles of shoreline of which 42% (15.4 acres) of the 100-foot shoreline buffer is classified as open, pervious area. One (1) shoreline enhancement project was completed in Lynch Cove in 1990, a 230 linear foot reach at West Inverness. EPS's Shoreline Enhancement Feasibility Study analyzed three reaches in the subwatershed. The reach at Lynch Cove Park was deemed stable while a shoreline protection expansion and ecological enhancement project was recommended at West Inverness Park. Additionally, a habitat enhancement project was recommended at the shoreline reach at Stansbury Park. Planting of the open pervious shoreline buffer in Lynch Cove is recommended as much of the shoreline consists of residential or park land.

#### *4.3.4.10 Subwatershed Management Strategy*

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-36 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-36.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees.
4. Educate citizens about the benefits and importance of bayscaping and proper trash management.
5. Educate residents of NSA_D_46 about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments.
6. Conduct street tree plantings and shade tree plantings at the neighborhoods identified in Table 4-36.
7. Educate residents of the neighborhoods indicated in Table 4-36 on proper trash management.
8. Conduct tree plantings and storm drain marking at ISI_D_0201.
9. Educate the ISIs indicated in Table 4-38 on proper nutrient management, trash management, and stream and shoreline buffers.

Municipal Actions

1. Work with the HSI indicated in Table 4-37 and similar businesses to implement appropriate practices for vehicle operations, outdoor materials storage, waste management, physical plant management, and stormwater.
2. Investigate the potential for impervious cover removal and stormwater retrofits at ISI_D_0402 and ISI_D_0403.
3. Investigate the potential for stream restoration at ISI_D_0403.
4. Conduct tree plantings at the PAAs identified in Table 4-39.
5. Investigate the potential for corrective action to the eroding shoreline around Stansbury Pond in PAA_D_0401.
6. Ensure marinas have appropriate NDPES discharge permits.
7. Complete recommended improvements to dry detention pond SWM_D_726 located at ISI_D_0402.
8. Investigate the potential for a shoreline protection expansion and ecological enhancement project at West Inverness Park.
9. Investigate the potential for a habitat enhancement project at the shoreline reach at Stansbury Park.
10. Identify open pervious shoreline areas in Lynch Cove with the potential for reforestation and preservation.

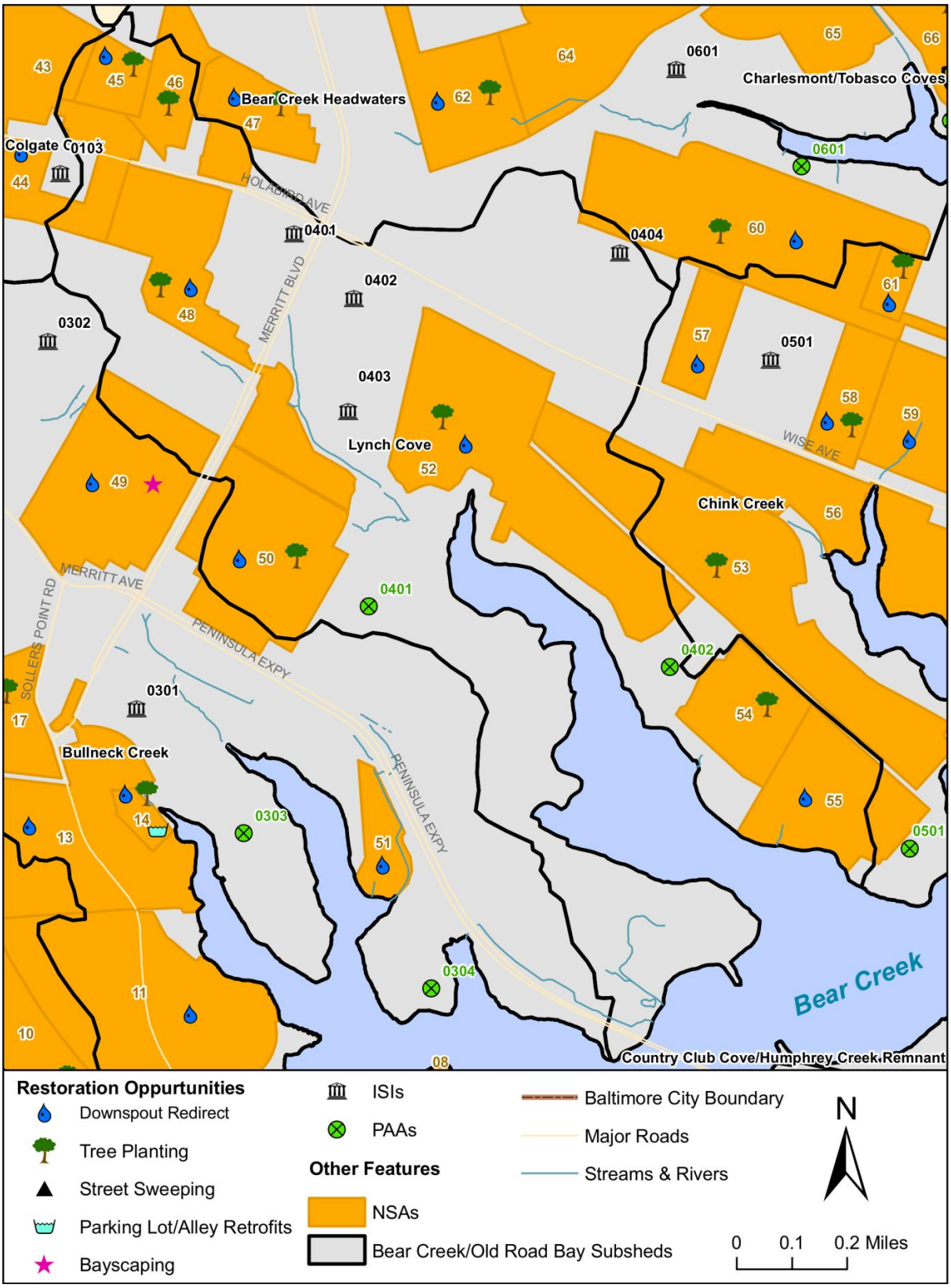


Figure 4-31: Restoration Opportunities in Lynch Cove

### 4.3.5 Chink Creek

Chink Creek is the second smallest subwatershed in the Bear Creek/Old Road Bay study area and is mostly comprised of residential area (78%). Institutional and commercial land uses are also present here, bringing the total urban coverage of Chink Creek to 97%. The remaining subwatershed area is classified as wetlands and water. Table 4-42 summarizes key subwatershed characteristics of Chink Creek.

**Table 4-42: Key Subwatershed Characteristics – Chink Creek**

| | | |
|---|---|---|
| **Drainage Area** | 364.8 acres (0.57 sq. mi.) | |
| **Stream Length** | 0.3 miles | |
| **Coastline Length** | 3.3 miles | |
| **Population** | 5,794 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 2.3% |
| | Medium Density Residential: | 28.3% |
| | High Density Residential: | 47.5% |
| | Commercial: | 1.9% |
| | Industrial: | 0.0% |
| | Institutional: | 16.4% |
| | Open Urban: | 1.0% |
| | Forest: | 0.0% |
| | Agriculture: | 0.0% |
| | Water/Wetlands: | 2.6% |
| | Transportation | 0.0% |
| **Impervious Cover** | 35.3% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.0% |
| | B Soils: | 35.0% |
| | C Soils: | 12.7% |
| | D Soils (high runoff potential): | 52.2% |
| | Water | 0.0% |

#### *4.3.5.1 Neighborhoods*

A total of six (6) distinct neighborhoods were identified and assessed within Chink Creek during the uplands assessment of Bear Creek/Old Road Bay. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, street sweeping, tree planting, and public education (i.e., bayscaping, buffer improvement, increasing lot tree canopy, and trash management). A summary of neighborhood recommended actions is presented in Table 4-43.

**Table 4-43: NSA Recommendations – Chink Creek**

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marking | Bayscape | Increase Lot Canopy | Trash Management | Buffer Improvement | Alley Retrofit | Street Sweeping | # of Street Trees | # of Shade Trees | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_D_53 | <1/8 | | X | | X | | X | X | | X | | 485 | | Blue alleys (Lynch Rd) |
| NSA_D_56 | 1/8 | X | X | X | | | X | | | | | | | Clean out storm drains near Chink Creek |
| NSA_D_57 | <1/8 | X | X | | X | | X | | | X | | | | Blue alleys |
| NSA_D_58 | <1/8 | X | X | | X | | X | | | X | | 92 | | Blue alleys |
| NSA_D_59 | 1/3 | X | X | X | X | X | X | X | X | | 8.1 | | | |
| NSA_D_61 | <1/8 | X | X | X | X | | X | | | | | 56 | 36 | |

All but one of the neighborhoods in Chink Creek were recommended for downspout disconnection, and all NSAs were recommended for education related to the improvement of buffer plantings. NSA_D_53 and NSA_D_59 were recommended for education on trash management as evidence of debris and litter were seen in at least 15% of yards in these neighborhoods. Additionally, NSA_D_59 was recommended for 8.1 miles of street sweeping. NSA_D_56 was specifically noted for storm drain cleaning as sediment and debris was found to have accumulated inside of storm drains.

### *4.3.5.2 Hotspots*

One (1) hotspot investigation was performed within Chink Creek on a commercial gas station. Table 4-44 summarizes the potential pollution sources found at this site.

**Table 4-44: HSI Results Summary – Chink Creek**

| HSI_ID | HSI Status* | Description | Vehicle Operations | Waste Management | Physical Plant | Storm Water | Notes |
|---|---|---|---|---|---|---|---|
| HSI_D_0501 | Potential | Commercial-Gas Station | X | X | X | X | Water leaking to street from car wash |

HSI_D_0501 is a 0.7-acre gas station facility located on Wise Avenue in the Chink Creek subwatershed. Potential pollution activities at the site include vehicle operations, waste management, physical plant, and stormwater management. Vehicle operations at the site include fueling stations, which are covered, as well as a covered car wash area. A portion of the wash water from the car wash was seen draining to the adjacent curb on Wise Avenue as seen in Figure 4-32. The dumpster at the site appeared to be leaking and was located adjacent to a storm drain inlet. Recommendations from the assessment of HSI_D_0501 include ensuring that car washes in the Bear Creek/Old Road Bay planning area appropriately direct wash water to on-site treatment or the sanitary sewer system.

**Figure 4-32: Wash Water Leaking from Car Wash (left) and Leaking Dumpster (right) at HSI_D_0501**

### *4.3.5.3 Institutions*

One (1) public institutional site was assessed for retrofit opportunities in Chink Creek during the uplands assessment of Bear Creek/Old Road Bay. Table 4-45 summarizes recommendations for the institutional site assessed in Chink Creek.

**Table 4-45: ISI Recommendations – Chink Creek**

| Site ID | Name | Public/ Private | # Trees for Planting | Stormwater Retrofit | Trash Management | Storm Drain Marking | Notes |
|---|---|---|---|---|---|---|---|
| ISI_D_0501 | Patapsco High School | Public | 180 | X | X | X | Street trees/ bioretention parking/ swale courts |

ISI_D_0501 is a 29-acre public high school located on Wise Avenue in the Chink Creek subwatershed. Recommendations at the site include street tree planting around the entire exterior of the site along with storm drain marking and education on trash management. A number of potential stormwater retrofits were identified at the southeast corner of the lot. At the tennis court and basketball courts, drainage sheet flows to a concrete channel which conveys flow to a storm drain inlet. Either these flows could be redirected to a bioretention area or the existing concrete swale could be converted to a vegetated swale. In addition, an asphalt area adjacent to the tennis court drains to a storm drain inlet. At this location, a bioretention area could be installed at a lower elevation than the storm drain inlet. The inlet could then be utilized as an overflow structure within the BMP and also could collect drainage from the bioretention underdrain system. Figure 4-33 provides photographs of these two potential stormwater retrofit areas.

**Figure 4-33: Potential Tennis Court (left) and Asphalt Pad (right) Stormwater Retrofit Areas**

In addition to the areas shown in Figure 4-33, another stormwater retrofit was identified at ISI_D_0501. The parking lot on the eastern boundary of the school drains to curb inlets that are adjacent to a grassed area. If these inlets were removed, curb cuts could be installed that could be connected to a bioretention area in the grassed area to treat runoff from the parking lots. Figure 4-34 provides a photograph of the current configuration of this area.

**Figure 4-34: Potential Stormwater Retrofit at Parking Lot in ISI_D_0501**

### *4.3.5.4 Pervious Areas*

The one (1) pervious area assessed for restoration potential in Chink Creek is summarized in Table 4-46.

**Table 4-46: PAA Descriptions – Chink Creek**

| Site_ID | Location | Name | Acres | Ownership |
|---|---|---|---|---|
| PAA_D_0501 | Lynch Road | Bear Creek Town LLC | 11.2 | Private |

PAA_D_0501 is an 11.2-acre private parcel on Lynch Road in the Chink Creek subwatershed. The parcel appeared to be sparsely vegetated with bare soil on much of the area as seen in Figure 4-35. It appears the area was recently cleared for construction at the time of the assessment and activities were present

which indicated that sanitary sewer was being installed at the site. Because the site is private, opportunities for reforestation appear to be limited, but it is recommended that the site be inspected to ensure that proper erosion and sediment control practices are in place to prevent the transport of sediment to surface waters.

**Figure 4-35: Bare Earth at PAA_D_0501**

#### *4.3.5.5 Marinas*

No marinas were assessed in Chink Creek.

#### *4.3.5.6 Large Landowners*

None of the large landowners are present in Chink Creek.

#### *4.3.5.7 Illicit Discharges*

Chink Creek contains one (1) Priority 2 outfall and one (1) Priority 3 outfall. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

#### *4.3.5.8 Stormwater Conversions*

No dry detention pond assessments were conducted in Chink Creek.

#### *4.3.5.9 Shoreline Restoration*

Chink Creek has 3.32 miles of shoreline of which 43% (16.5 acres) of the 100-foot shoreline buffer is classified as open, pervious area. EPS's Shoreline Enhancement Feasibility Study recommended one shoreline enhancement project for the 380 linear foot reach at Sandy Plains Elementary which was completed in 1998. Planting of the open pervious shoreline buffer in Chink Creek is recommended as much of the shoreline consists of residential or park land.

#### *4.3.5.10 Subwatershed Management Strategy*

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-43 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-43.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees.
4. Educate citizens about the benefits and importance of bayscaping and proper trash management.
5. Educate residents of NSA_D_59 about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments.
6. Include NSA_D_59 in the County's routine street sweeping program.
7. Conduct street tree plantings and shade tree plantings at the neighborhoods identified in Table 4-43.
8. Conduct tree plantings and storm drain marking at ISI_D_0501.
9. Educate the ISIs indicated in Table 4-38 on proper trash management.

Municipal Actions

1. Work with the HSI indicated in Table 4-44 and similar businesses to implement appropriate practices for vehicle operations, waste management, physical plant management, and stormwater.
2. Investigate the potential for stormwater retrofits at ISI_D_0501.
3. Investigate PAA_D_0501 to determine if redevelopment activities are occurring here, and if so, if appropriate sediment and erosion control measures are in place.
4. Identify open pervious shoreline areas in Chink Creek with the potential for reforestation and preservation.

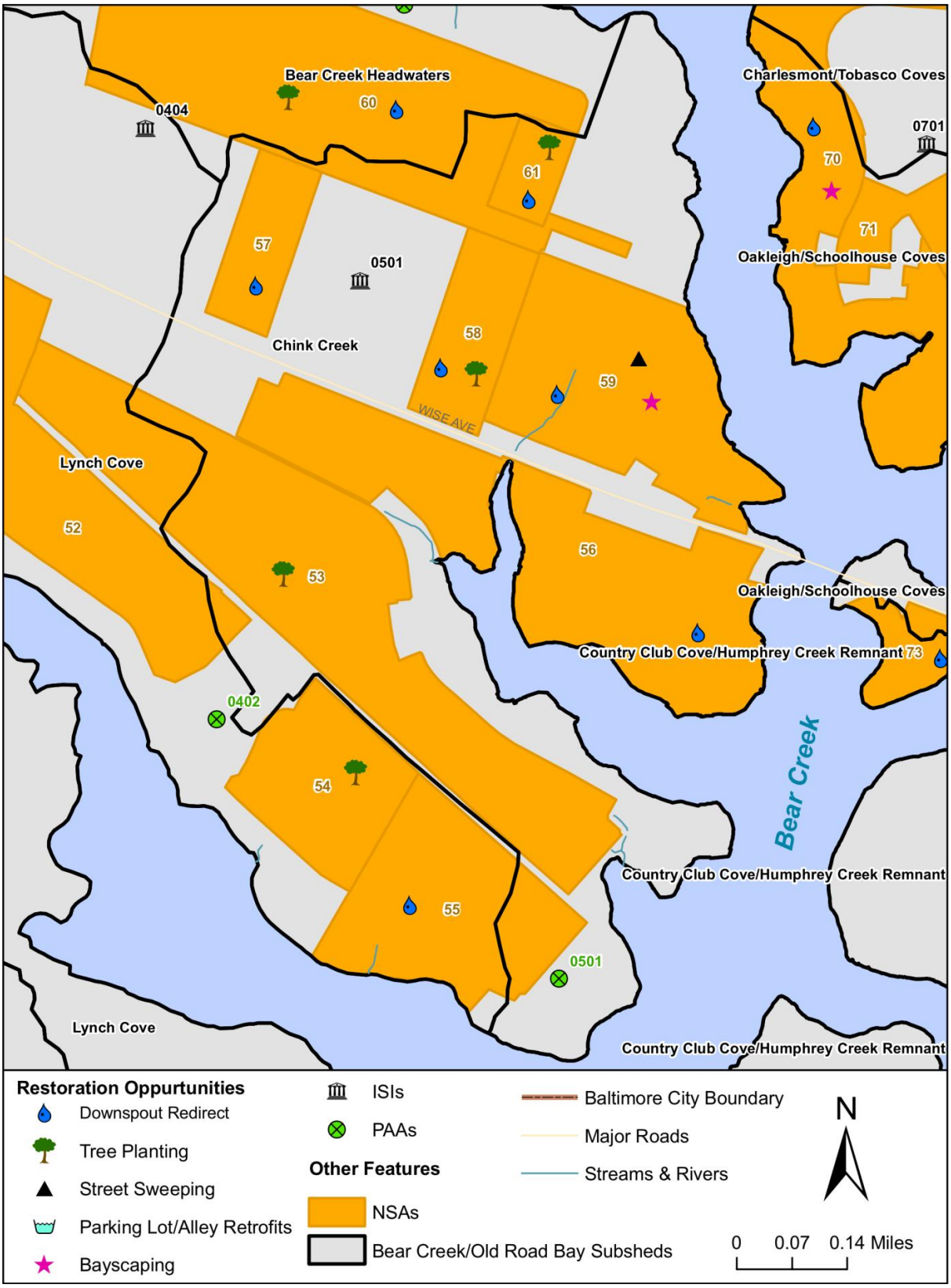


Figure 4-36: Restoration Opportunities in Chink Creek

### 4.3.6 Bear Creek Headwaters

Bear Creek Headwaters is the seventh smallest subwatershed in the Bear Creek/Old Road Bay study area. Residential areas (60%) and commercial areas (21%) comprise the majority of the subwatershed, which along with institutional and open urban land uses brings the total urban makeup of the area to 99%. The remaining subwatershed area is classified as mixed forest and water. Table 4-47 summarizes key subwatershed characteristics of Bear Creek Headwaters.

**Table 4-47: Key Subwatershed Characteristics – Bear Creek Headwaters**

| | | |
|---|---|---|
| **Drainage Area** | 592 acres (0.92 sq. mi.) | |
| **Stream Length** | 0.7 miles | |
| **Coastline Length** | 1.3 miles | |
| **Population** | 7,589 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 0.0% |
| | Medium Density Residential: | 24.5% |
| | High Density Residential: | 35.4% |
| | Commercial: | 20.6% |
| | Industrial: | 0.0% |
| | Institutional: | 6.7% |
| | Open Urban: | 11.6% |
| | Forest: | 1.1% |
| | Agriculture: | 0.0% |
| | Water/Wetlands: | 0.1% |
| | Transportation | 0.0% |
| **Impervious Cover** | 37.3% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.0% |
| | B Soils: | 18.4% |
| | C Soils: | 76.9% |
| | D Soils (high runoff potential): | 4.7% |
| | Water | 0.0% |

#### *4.3.6.1 Neighborhoods*

A total of seven (7) distinct neighborhoods were identified and assessed within Bear Creek Headwaters during the uplands assessment of Bear Creek/Old Road Bay. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, tree planting, and public education (i.e., increasing lot tree canopy). A summary of neighborhood recommended actions is presented in Table 4-48.

**Table 4-48: NSA Recommendations – Bear Creek Headwaters**

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marking | Increase Lot Canopy | Alley Retrofit | # of Street Trees | # of Shade Trees | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| NSA_D_47 | <1/8 | X | X | | X | X | X | 300 | | Blue alleys |
| NSA_D_60 | <1/8 | X | X | | X | | X | 800 | 23 | Blue alleys |
| NSA_D_62 | <1/8 | X | X | | X | X | X | 370 | | Blue alleys |
| NSA_D_63 | <1/4 | X | X | X | X | X | | | | |
| NSA_D_64 | <1/4 | X | X | | X | X | | | | |
| NSA_D_65 | <1/8 | X | X | X | X | X | | 216 | | |
| NSA_D_66 | <1/8 | X | X | | X | X | X | 600 | | Blue alleys |

All of the neighborhoods in Bear Creek Headwaters are recommended for downspout disconnection.Specifically, connection to rain barrels would be the most feasible disconnection option suitable to the small lot sizes in the subwatershed. Additionally, all of the NSAs are recommended for storm drain marking, and the majority of neighborhoods are recommended for street tree planting and education on increased lot canopies. NSA_D_60 consists of row homes, and shade tree plantings were recommended in common areas along the alleys.

### *4.3.6.2 Hotspots*

Two (2) hotspot investigations were performed within Bear Creek Headwaters on a commercial shopping center and a commercial car wash. Table 4-49 summarizes the potential pollution sources found at each of the sites.

**Table 4-49: HSI Results Summary – Bear Creek Headwaters**

| HSI_ID | HSI Status* | Description | Vehicle Operations | Waste Management | Physical Plant | Turf/Landscape Management | Storm Water | Notes |
|---|---|---|---|---|---|---|---|---|
| HSI_D_0601 | Confirmed | Commercial-Shopping Center | X | X | X | X | X | Restaurant and car facility area primary pollution sources |
| HSI_D_0602 | Confirmed | Commercial-Car Wash | X | X | X | X | X | Observed wash water draining to street and inlet |

During assessments for HSI_D_0601 and HSI_D_0602, both were noted as having potential pollution activities related to vehicle operations, waste management, physical plant, turf/landscape management, and stormwater management. HSI_D_0601 is a commercial shopping center located along Merritt Boulevard in the Bear Creek Headwaters subwatershed and contains a variety of businesses such as a restaurant, commercial retail, and automobile repair. At the restaurant facility within this hotspot, a

receptacle in the rear that appeared to be used to hold grease was leaking, and grease stains were seen draining to a storm drain inlet. In addition, turf islands and landscaping in the parking lot appeared to be highly maintained with signs indicating the application of pesticides and fertilizers. This hotspot is recommended for education on proper waste management as well as education on low-maintenance landscaping and its benefits to the environment.

HSI_D_0602 is a car wash facility off of Merritt Boulevard. At this hotspot, wash water from the car bays was draining out of the facility and directly to the curbed street where it eventually washed to the nearby storm drain. This facility and other car washes should be inspected to ensure that illicit discharges such as wash water are contained and appropriately directed to the sanitary sewer as opposed to the storm sewer network.

Figure 4-37 provides examples of specific activities at hotspots assessed in Bear Creek Headwaters that lead to pollutants entering directly into the storm sewer networks in their locations.

**Figure 4-37: Leaking Grease Dumpster (left) and Wash Water (right) Draining to Storm Drains in Bear Creek Headwaters**

### *4.3.6.3 Institutions*

One (1) public institutional site was assessed for retrofit opportunities in Bear Creek Headwaters during the uplands assessment of Bear Creek/Old Road Bay. Table 4-50 summarizes recommendations for the institutional site assessed in Bear Creek Headwaters.

**Table 4-50: ISI Recommendations – Bear Creek Headwaters**

| Site ID | Name | Public/ Private | # Trees for Planting | Stormwater Retrofit | Impervious Cover Removal | Trash Management | Storm Drain Marking | Buffer Improvement | Notes |
|---|---|---|---|---|---|---|---|---|---|
| ISI_D_0601 | General John Stricker Middle School | Public | 161 | X | X | X | X | X | Stream erosion / buffer / swale retrofits/ bioretention |

ISI_D_0601 is a public middle school located on 20.7 acres of land at the intersection of Lynch Road and Trappe Road and adjacent to the headwaters of Bear Creek. Several restoration opportunities were identified at this site including the need for storm drain marking and education on trash management. Shade tree plantings were identified on much of the site, but the major reforestation project identified at ISI_D_0601 is along the stream at the south side of the project. As much of this land is currently comprised of turf grass, tree plantings would serve to expand the narrow existing buffer that was observed. In addition, several deteriorated patches of asphalt were observed along the potential stream buffer and were identified for removal. Figure 4-38 provides an aerial view of the configuration of the property along with potential stream buffer planting areas.

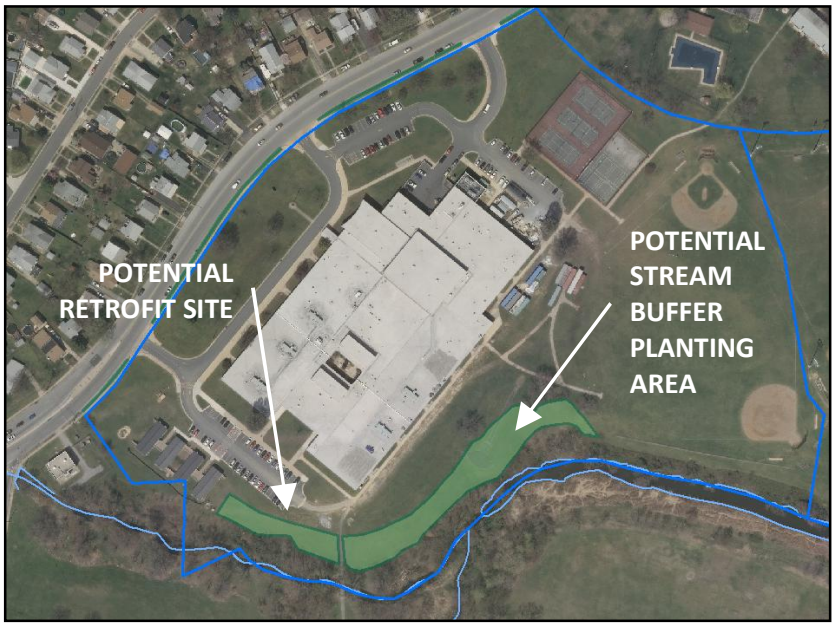


**Figure 4-38: Aerial View of Potential Stream Buffer Plantings**

A preliminary assessment of the stream at ISI_D_0601 revealed the presence of large amounts of asphalt, concrete and other debris in the stream where previously, a pedestrian bridge was present. Additionally, several fallen trees were observed in the area which could act as impediments to high flows. Figure 4-39 shows the condition of the stream at this location.

**Figure 4-39: Asphalt, Debris, and Downed Trees in Stream at ISI_D_0601**

One stormwater retrofit was also identified at this institution to treat runoff from the parking lot at the southwestern end of the school. Currently, runoff drains to a storm drain inlet at the southern end of the parking lot, and it was assumed that the storm pipe from the inlet carries flow to the adjacent stream. If the inlet was removed, a curb cut could be installed to direct runoff to a bioswale which could provide treatment while conveying flow to the nearby stream. Figure 4-40 shows a photograph at the top of the parking lot, and Figure 4-38 shows the location of the retrofit site in an aerial view.

**Figure 4-40: Potential Stormwater Retrofit Site at Parking Lot in ISI_D_0601**

### *4.3.6.4 Pervious Areas*

The three (3) pervious areas assessed for restoration potential in Bear Creek Headwaters are summarized in Table 4-51.

**Table 4-51: PAA Descriptions – Bear Creek Headwaters**

| Site_ID | Location | Name | Acres | Ownership |
|---|---|---|---|---|
| PAA_D_0601 | Park Haven Road | Bear Creek Park | 22.5 | Public |
| PAA_D_0602 | Trappe Rd. & North Point Rd. | Unknown | 8.9 | Public |
| PAA_D_0603 | Charlesmont Rd. | Charlesmont Park | 5.8 | Public |

PAA_D_0601, Bear Creek Park, is a 22.5-acre public park located along the shoreline of the Bear Creek Headwaters subwatershed. The park is maintained by the Baltimore County Office of Budget and Finance, Property Management and contains an athletic field and a playground, but the majority is open turf. This park is recommended for shoreline buffer plantings in areas where there are no athletic field footprints. Additionally, the park is situated adjacent to an eroded stream recommended for restoration in Section 4.3.6.3.

PAA_D_0602, shown in Figure 4-41, is a public park located on an 8.9-acre parcel along North Point Road in the Bear Creek Headwaters subwatershed. Owned and maintained by the Maryland DNR, PAA_D_0602 is known as the North Point Battlefield Monument, commemorating the historic Battle of North Point that took place in the area during the War of 1812. Currently, the site is comprised mostly of turf (65%) with 30% forest cover and the remaining areas shrubs (5%). With a turf height of 5-6 inches, this site is not mowed frequently. Its status as a historic preservation site might be an obstacle to reforestation but there is potential for small-scale shade tree planting in the area which would need minimal preparation.

**Figure 4-41: Potential for Shade Tree Planting at PAA_D_0602**

PAA_D_0603, Charlesmont Park, is a 5.8-acre park located off of Charlesmont Road located mostly in the Bear Creek Headwaters subwatershed with a sliver in the Charlesmont/Tobasco Cove subwatershed. The park is classified as open space and is maintained by the Baltimore County Office of Budget and Finance, Property Management. A small portion of the site was turf grass, although the presence of underground and overhead utilities eliminated the possibilities of tree planting in this area. The eastern and western portions of the park are classified as wetlands. The vegetated buffer to the shoreline is recommended to be extended in these locations. In turn, residents that use this area for parking would be forced to find other vehicle storage accommodations.

#### *4.3.6.5 Marinas*

No marinas were assessed in Bear Creek Headwaters.

#### *4.3.6.6 Large Landowners*

None of the large landowners are present in Bear Creek Headwaters.

#### 4.3.6.7 Illicit Discharges

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

#### 4.3.6.8 Stormwater Conversions

Two (2) detention ponds were assessed in Bear Creek Headwaters and are summarized in Table 4-52.

**Table 4-52: Detention Pond Conversion - Bear Creek Headwaters**

| Site ID | Riser | Embank-ment | Vege-tation | Fence Condition | Gate Condition | Water Quality Potential | Access | Flow Path | Horizontal Expansion Potential | Vertical Expansion Potential |
|---|---|---|---|---|---|---|---|---|---|---|
| 926 | Good | No Problems | Wetland Veg. | Good | Unlocked | N | Easy | Long | N | N |
| 927 | Good | No Problems | Wetland Veg. | Good | Unlocked | N | Easy | Long | N | N |

SWM_D_926 and SWM_D_927 are two (2) hydraulically connected detention ponds off of Merritt Boulevard in the Bear Creek Headwaters subwatershed. The ponds are privately owned, and treat flows from approximately 68 acres of commercial development combined. Both facilities are constrained vertically by the steep side slopes, so there is no potential for excavation for water quality treatment. In addition, the facilities are constrained horizontally on all sides. The only recommendations here are for invasive species management to be conducted at both ponds due to the overgrowth of phragmites as seen in Figure 4-42.

**Figure 4-42: Phragmites Growth in SWM_D_926 (left) and SWM_D_927 (right)**

#### 4.3.6.9 Shoreline Restoration

Bear Creek Headwaters has 1.35 miles of shoreline of which 52% (8.5 acres) of the 100-foot shoreline buffer is classified as open, pervious area. EPS's Shoreline Enhancement Feasibility Study identified five (5) potential shoreline enhancement projects in the watershed. In 1990, a 475 linear foot shoreline

enhancement project was completed, and an additional 700 linear feet was completed here in 1999. Additionally, in 1993, a 750 linear foot shoreline enhancement project was completed at Charlesmont Park. The other three projects at Bear Creek Elementary, Charlesmont Elementary, and Battle Monument School were eliminated from consideration for an enhancement. Planting of the open pervious shoreline buffer in Bear Creek Headwaters is recommended as much of the shoreline consists of residential or park land.

#### *4.3.6.10 Subwatershed Management Strategy*

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-48 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-48.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees.
4. Conduct street tree plantings and shade tree plantings at the neighborhoods identified in Table 4-48.
5. Conduct tree plantings and storm drain marking at ISI_D_0601.
6. Educate the ISIs indicated in Table 4-50 on proper trash management and the importance of stream and shoreline buffers.

Municipal Actions

1. Work with the HSI indicated in Table 4-49 and similar businesses to implement appropriate practices for vehicle operations, waste management, physical plant management, turf/landscape management, and stormwater.
2. Investigate the potential for impervious cover removal and stormwater retrofits at ISI_D_0601.
3. Investigate the potential for a stream restoration project on the stream located between ISI_D_0601 and PAA_D_0601.
4. Conduct tree plantings at the PAAs identified in Table 4-51.
5. Conduct invasive species management at SWM_D_926 and SWM_D_927.
6. Identify open pervious shoreline areas in Bear Creek Headwaters with the potential for reforestation and preservation.

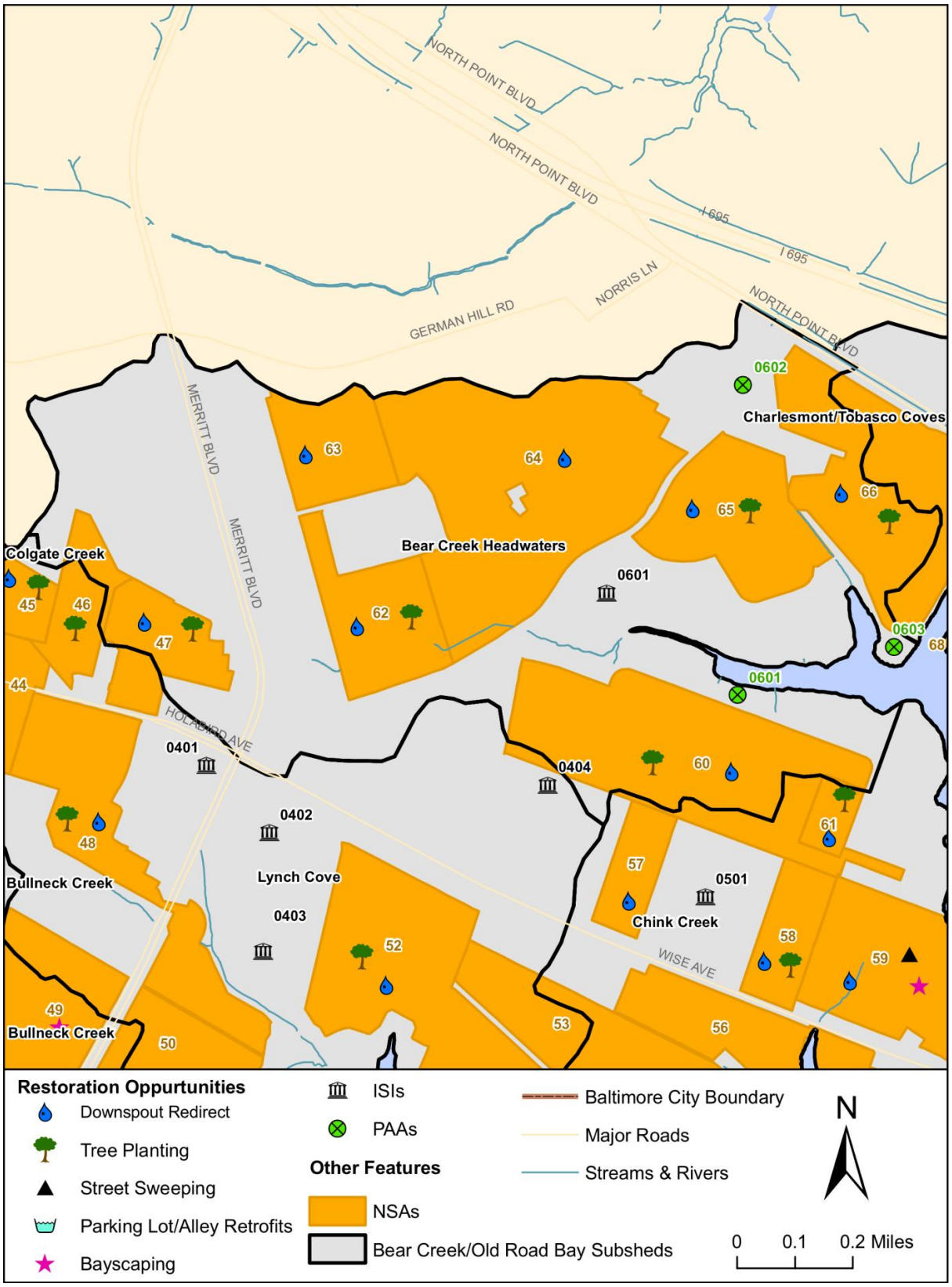


Figure 4-43: Restoration Opportunities in Bear Creek Headwaters

### 4.3.7 Charlesmont/Tobasco Coves

Charlesmont/Tobasco Coves is the third smallest subwatershed in the Bear Creek/Old Road Bay study area. Residential (25%), commercial (28%), and industrial land uses comprise the majority of the subwatershed, which along with institutional and open urban land uses brings the total urban makeup of the area to 88%. The remaining subwatershed area is classified as forest and water. Table 4-53 summarizes key subwatershed characteristics of Charlesmont/Tobasco Coves.

**Table 4-53: Key Subwatershed Characteristics – Charlesmont/Tobasco Coves**

| | | |
|---|---|---|
| **Drainage Area** | 417.4 acres (0.65 sq. mi.) | |
| **Stream Length** | 2.6 miles | |
| **Coastline Length** | 1.2 miles | |
| **Population** | 1,511 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 0.0% |
| | Medium Density Residential: | 17.1% |
| | High Density Residential: | 8.4% |
| | Commercial: | 27.9% |
| | Industrial: | 21.4% |
| | Institutional: | 4.8% |
| | Open Urban: | 1.6% |
| | Forest: | 11.8% |
| | Agriculture: | 0.0% |
| | Water/Wetlands: | 0.6% |
| | Transportation | 6.4% |
| **Impervious Cover** | 44.3% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.0% |
| | B Soils: | 0.0% |
| | C Soils: | 67.8% |
| | D Soils (high runoff potential): | 32.1% |
| | Water | 0.1% |

#### *4.3.7.1 Neighborhoods*

A total of three (3) distinct neighborhoods were identified and assessed within Charlesmont/Tobasco Coves during the uplands assessment of Bear Creek/Old Road Bay. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection and public education (i.e., increasing lot tree canopy). A summary of neighborhood recommended actions is presented in Table 4-54.

**Table 4-54: NSA Recommendations – Charlesmont/Tobasco Coves**

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Bayscape | Increase Lot Canopy | Notes |
|---|---|---|---|---|---|---|---|
| NSA_D_67 | <1/8 | | X | | | X | |
| NSA_D_68 | 1/4 | X | X | X | X | X | |
| NSA_D_69 | <1/4 | X | X | X | | X | Possibly pave Raymond Ave. |

Two of the three neighborhoods in Charlesmont/Tobasco Coves were recommended for downspout disconnections, and all of the NSAs were recommended for increased lot canopies. Also, NSA_D_68 was recommended for education on converting turf lawns to a more beneficial state for water quality through bayscaping. In NSA_D_69, Raymond Avenue (Figure 4-44) is currently unpaved and consists of a gravel surface, which contributes sediment to stormwater runoff. This presents a potential paving project which would decrease the amount of sedimentation that is currently occurring.

**Figure 4-44: Potential Paving to Decrease Sedimentation at Raymond Avenue in NSA_D_69**

### *4.3.7.2 Hotspots*

Two (2) hotspot investigations were performed within Charlesmont/Tobasco Coves on an industrial storage facility and an industrial manufacturing facility. Table 4-55 summarizes the potential pollution sources found at each of the sites.

**Table 4-55: HSI Results Summary – Charlesmont/Tobasco Coves**

| HSI_ID | HSI Status* | Description | Vehicle Operations | Outdoor Materials | Waste Management | Physical Plant | Notes |
|---|---|---|---|---|---|---|---|
| HSI_D_0701 | Severe | Industrial – Storage Facility | X | X | X | X | Open waste oil container; sediment & debris |
| HSI_D_0702 | Potential | Industrial – Manufacturing Facility | | X | | | Significant # of drums |

Over 21% of land use in Charlesmont/Tobasco Coves is classified as industrial. The two hotspots assessed in this subwatershed are industrial facilities and potential pollution activities occurring there ranged from vehicle operations, storage of outdoor materials, waste management, and physical plants.

HSI_D_0701 was an industrial storage area used to store large vehicle equipment and other industrial materials. As seen in Figure 4-45, vehicles and materials were stored in this location without cover and exposed to the elements. Additionally, the site appeared to be in a general state of disrepair and pollutant laden runoff was allowed to pond at the entrance of the site. This site was immediately recommended for enforcement due to the high potential of contaminants exiting the site and polluting nearby surface waters.

**Figure 4-45: Outdoor Storage (left), Exposed Oil Drums (center), and Ponding Runoff (right) at HSI_D_0701**

HSI_D_0702 is an industrial manufacturing facility where the storage of outdoor materials such as drums and material stockpiles was occurring. Figure 4-46 shows that these materials were being stored without cover and many times without proper labeling. This site and similar industrial manufacturing facilities are recommended for inspection to ensure that the requirements of NPDES permits are being met and materials are stored properly.

Figure 4-46: Outdoor Storage of Drums (left) and Material Stockpiles (right) at HSI_D_0701

### *4.3.7.3 Institutions*

One (1) public institutional site was assessed for retrofit opportunities in Charlesmont/Tobasco Coves during the uplands assessment of Bear Creek/Old Road Bay. Table 4-56 summarizes recommendations for the institutional site assessed in Charlesmont/Tobasco Coves.

Table 4-56: ISI Recommendations – Charlesmont/Tobasco Coves

| Site ID | Name | Public/ Private | # Trees for Planting | Stormwater Retrofit | Impervious Cover Removal | Trash Management | Storm Drain Marking | Notes |
|---|---|---|---|---|---|---|---|---|
| ISI_D_0701 | Battle Grove Elementary School | Public | 285 | X | X | X | X | Planting at NE/S of school; retrofit inlet in NE parking lot |

ISI_D_0701 is a public elementary school located off of Saint Patricia Lane in the Charlesmont/Tobasco Coves subwatershed. Proposed water quality recommendations made at this site include storm drain marking, education on proper trash management, tree planting, stormwater retrofit, and impervious cover removal. Tree planting areas identified at this site include the area adjacent to the northeast parking lot and on the southwest side of the school. An impervious and deteriorating tennis court (shown in Figure 4-47) was also observed on site and was recommended for impervious cover removal. This would involve either replacement of the court with a permeable court or complete elimination of the court. Currently the court drains to a storm drain inlet where a stormwater retrofit site was proposed. Flow to this drain could be redirected to a bioretention area to provide water quality treatment prior to outlet to the existing storm drain system.

**Figure 4-47: Impervious Tennis Court Identified for Impervious Cover Removal and/or Stormwater Retrofit**

#### *4.3.7.4 Pervious Areas*

No pervious areas were assessed in Charlesmont/Tobasco Coves.

#### *4.3.7.5 Marinas*

No marinas were assessed in Charlesmont/Tobasco Coves.

#### *4.3.7.6 Large Landowners*

None of the large landowners are present in Charlesmont/Tobasco Coves.

#### *4.3.7.7 Illicit Discharges*

Charlesmont/Tobasco Coves contains one (1) Priority 2 outfall. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

#### *4.3.7.8 Stormwater Conversions*

One (1) detention pond was assessed in Charlesmont/Tobasco Coves and is summarized in Table 4-57.

**Table 4-57: Detention Pond Conversion - Charlesmont/Tobasco Coves**

| Site ID | Riser | Embank-ment | Vege-tation | Fence Condition | Gate Condition | Water Quality Potential | Access | Flow Path | Horizontal Expansion Potential | Vertical Expansion Potential |
|---|---|---|---|---|---|---|---|---|---|---|
| 722 | Good | Holes | Turf | Good | Locked | Y | Easy | Short | Y | Y |

SWM_D_722 is a privately-owned facility, located in the Charlesmont/Tobasco Cove subwatershed at the end of Fischer Road. This pond is designed to handle runoff from the 2, 10, and 100-year events from a 12.4-acre industrial facility. The pond has both horizontal and vertical expansion capability. In addition, repairs should be made to the pond embankment from damage caused by burrowing animals. The existing inflow pipe appeared to be clogged with sediment from the adjacent gravel lot and should

be cleaned. Retrofit recommendations at the pond include extending the short flow path from the inflows to the outfall by constructing small swales along the perimeter of the pond and the berm in the center of the pond. Additionally, decreasing the size of the low-flow orifice should be investigated because longer detention times could be created.

**Figure 4-48: Riser Structure in SWM_D_722**

#### *4.3.7.9 Shoreline Restoration*

Charlesmont/Tobasco Coves has 1.22 miles of shoreline of which 49% (7.0 acres) of the 100-foot shoreline buffer is classified as open, pervious area. No shoreline enhancement projects were identified in EPS's Shoreline Enhancement Feasibility Study (EPS 1998). Planting of the open pervious shoreline buffer in Charlesmont/Tobasco Coves is recommended as much of the shoreline consists of residential land.

#### *4.3.7.10 Subwatershed Management Strategy*

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-54 and educate citizens on the benefits of rain barrels and rain gardens.
2. Increase tree canopies on private lots by educating citizens on the benefits of trees.
3. Educate citizens about the benefits and importance of bayscaping.
4. Conduct tree plantings and storm drain marking at ISI_D_0701.
5. Educate the ISIs indicated in Table 4-56 on proper trash management and the importance of stream and shoreline buffers.

Municipal Actions

1. Work with the HSI indicated in Table 4-55 and similar businesses to implement appropriate practices for vehicle operations, storage of outdoor materials, waste management, and physical plant management.
2. Investigate the potential for impervious cover removal and stormwater retrofits at ISI_D_0701.
3. Investigate the feasibility of expanding SWM_D_722 and implementing recommendations to convert the dry detention pond to an extended detention pond.
4. Identify open pervious shoreline areas in Charlesmont/Tobasco Coves with the potential for reforestation and preservation.

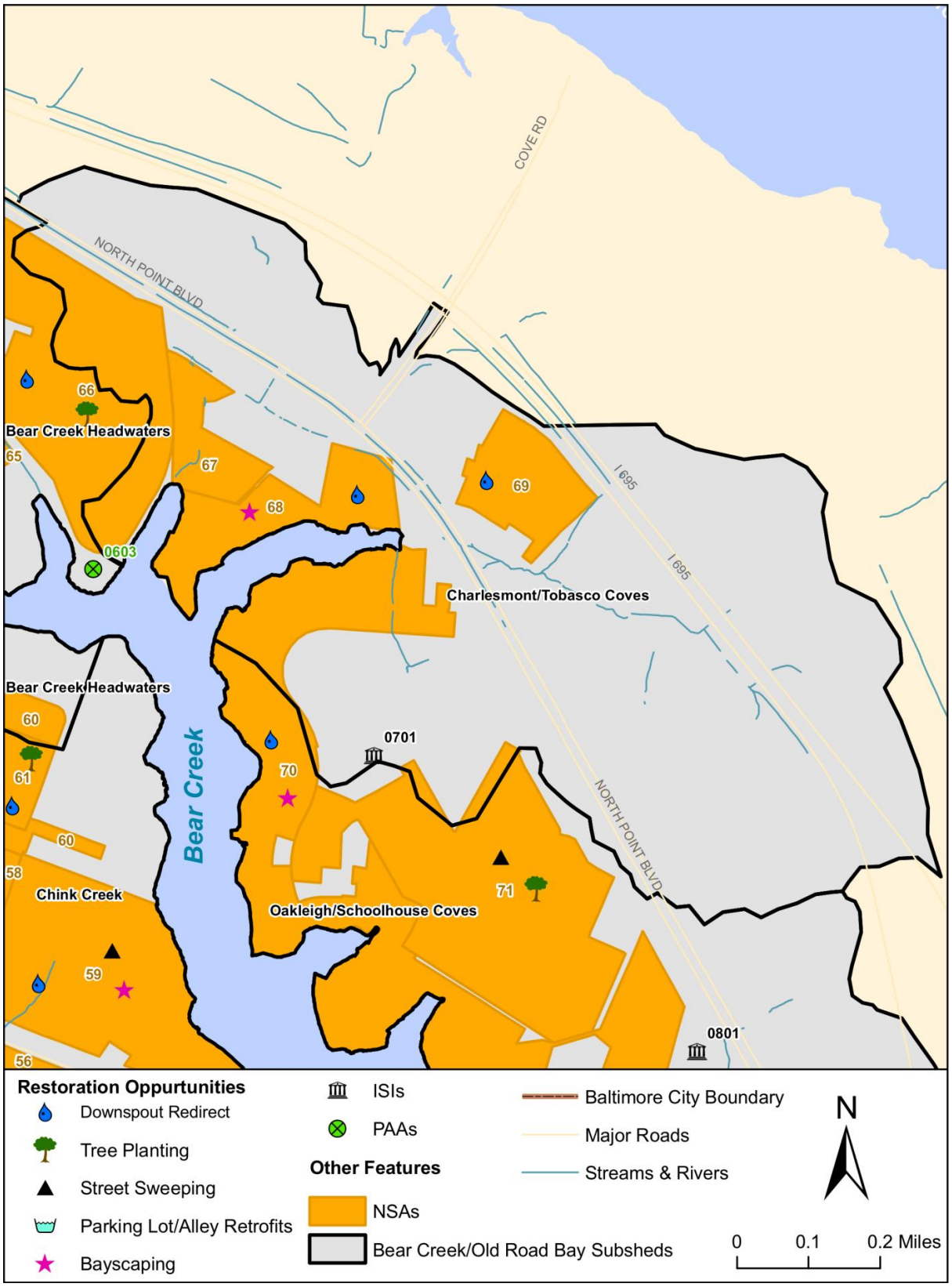


Figure 4-49: Restoration Opportunities in Charlesmont/Tobasco Coves

### 4.3.8 Oakleigh/Schoolhouse Coves

Oakleigh/Schoolhouse Coves is the smallest subwatershed in the Bear Creek/Old Road Bay study area. Encompassing a large amount of residential (58%) and commercial (30%) land uses, Oakleigh/Schoolhouse Coves is almost entirely occupied by urban development (nearly 98%) including industrial, institutional, and open urban uses. The remaining subwatershed area is classified as forests and water. Table 4-58 summarizes key subwatershed characteristics of Oakleigh/Schoolhouse Coves.

**Table 4-58: Key Subwatershed Characteristics – Oakleigh/Schoolhouse Coves**

| | | |
|---|---|---|
| **Drainage Area** | 328.8 acres (0.51 sq. mi.) | |
| **Stream Length** | 0.3 miles | |
| **Coastline Length** | 2.4 miles | |
| **Population** | 3,246 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 2.2% |
| | Medium Density Residential: | 36.8% |
| | High Density Residential: | 18.8% |
| | Commercial: | 30.2% |
| | Industrial: | 6.9% |
| | Institutional: | 0.4% |
| | Open Urban: | 1.3% |
| | Forest: | 1.2% |
| | Agriculture: | 0.0% |
| | Water/Wetlands: | 1.1% |
| | Transportation | 1.2% |
| **Impervious Cover** | 40.4% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.0% |
| | B Soils: | 0.0% |
| | C Soils: | 83.6% |
| | D Soils (high runoff potential): | 3.1% |
| | Water | 13.3% |

#### *4.3.8.1 Neighborhoods*

A total of four (4) distinct neighborhoods were identified and assessed within Oakleigh/Schoolhouse Coves during the uplands assessment of Bear Creek/Old Road Bay. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, tree planting, and public education (i.e., bayscaping, increasing lot tree canopy, buffer improvements, and trash management). A summary of neighborhood recommended actions is presented in Table 4-59.

**Table 4-59: NSA Recommendations – Oakleigh/Schoolhouse Coves**

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marking | Bayscape | Increase Lot Canopy | Buffer Improvement | Alley Retrofit | Street Sweeping | # of Street Trees | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_D_70 | 1/4 | X | X | X | X | X | X | X | | | | |
| NSA_D_71 | <1/8 | | X | | X | | X | | X | 16.4 | 181 | Blue alleys |
| NSA_D_72 | 1/4 | X | X | X | X | X | X | | | | | |
| NSA_D_74 | <1/4 | X | X | X | X | | X | | | | | |

All of the NSAs assessed in Oakleigh/Schoolhouse Coves are recommended for storm drain marking as well as education on the benefits of increased lot canopies. At NSA_D_71, which consists of row homes with rear alleys, 16.4 miles of street sweeping was recommended along with street tree planting.

### *4.3.8.2 Hotspots*

Two (2) hotspot investigations were performed within Oakleigh/Schoolhouse Coves on a commercial gas station and a container transport facility. Table 4-55 summarizes the potential pollution sources found at each of the sites.

**Table 4-60: HSI Results Summary – Oakleigh/Schoolhouse Coves**

| HSI_ID | HSI Status* | Description | Vehicle Operations | Outdoor Materials | Waste Management | Physical Plant | Turf/Landscape Management | Storm Water | Notes |
|---|---|---|---|---|---|---|---|---|---|
| HSI_D_0801 | Confirmed | Commercial – Gas Station | X | | X | X | | | Stains from repair bays into lot/ lot cracking |
| HSI_D_0802 | Confirmed | Transport-Containers | X | X | X | X | X | X | Stockpiles/ sediment issues; lot cracking; wet pond |

HSI_D_0801 is a gas station facility located in the Oakleigh/Schoolhouse Coves subwatershed. Potential pollution activities here include vehicle operations, waste management, and operation of the physical plant. Specific observations made at this site include waste receptacles that were uncovered as well as liquids leaking from car repair bays. Facilities that conduct car repairs are recommended to be educated on proper containment of pollutants used during its physical processes to prevent leaks from reaching storm drain networks and surface waters.

HSI_D_0802 is a container-transport facility located off of North Point Boulevard. At this facility, stockpiles of materials such as mulch and old pavement were observed outdoors without cover and draining to storm drains as seen in Figure 4-50. In addition, large dumpsters at the site were overly full and uncovered which could cause a build-up of contaminated leachate that could leak from the facility. Stormwater runoff from the site was directed to a wet pond for water quantity control. This site is recommended for education about proper materials storage and waste management.

Figure 4-50: Sediment and Mulch Stockpiles at HSI_D_0802

### 4.3.8.3 Institutions

One (1) private institutional site was assessed for retrofit opportunities in Oakleigh/Schoolhouse Coves during the uplands assessment of Bear Creek/Old Road Bay. Table 4-61 summarizes recommendations for the institutional site assessed in Oakleigh/Schoolhouse Coves.

Table 4-61: ISI Recommendations – Oakleigh/Schoolhouse Coves

| Site ID | Name | Public/ Private | Nutrient Management | # Trees for Planting | Stormwater Retrofit | Trash Management | Storm Drain Marking | Buffer Improvement | Notes |
|---|---|---|---|---|---|---|---|---|---|
| ISI_D_0801 | North Point Baptist Church | Private | X | 53 | X | X | X | X | Swale/bioretention retrofit; remove unused pad |

ISI_D_0801 is a private, faith-based institution located on a 6.8-acre parcel in the Oakleigh/Schoolhouse Coves subwatershed. Several observations and recommendations were made during the assessment of the site to improve water quality. Firstly, the site was recommended for education on proper nutrient management on the lawns due to the presence of high-maintenance turf on the property. Although the Fertilizer Act of 2011 will limit the amount of nutrients in fertilizers in Maryland, proper education on application rates and pesticide management can benefit water quality. Another educational and potential community activity identified at this institution was proper buffer management as a stream intersecting the site contained invasive species and showed evidence of mowing activities in the buffer.

Along with the educational opportunities at ISI_D_0801, other recommendations include storm drain marking, tree planting, and implementation of stormwater retrofits. Several planting areas were noted at the site, most importantly along the stream buffer. Stormwater retrofits at the site could serve both the northern parking lot through installation of bioretention areas in the islands, as well as the southern parking area through a bioswale. The southern parking area currently sheet flows to a turf area where flow then moves in a concentrated manner to the stream on the site. A bioswale could be installed in

this turf area to collect flow and improve water quality prior to discharging to existing surface waters (see Figure 4-51).

**Figure 4-51: Potential Stormwater Retrofit Site in Southern Parking Lot at ISI_D_0801**

#### *4.3.8.4 Pervious Areas*

No pervious areas were assessed in Oakleigh/Schoolhouse Coves.

#### *4.3.8.5 Marinas*

No marinas were assessed in Oakleigh/Schoolhouse Coves.

#### *4.3.8.6 Large Landowners*

None of the large landowners are present in Oakleigh/Schoolhouse Coves.

#### *4.3.8.7 Illicit Discharges*

Oakleigh/Schoolhouse Coves contains one (1) Priority 0 outfall. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

#### *4.3.8.8 Stormwater Conversions*

One (1) detention pond was assessed in Oakleigh/Schoolhouse Coves and is summarized in Table 4-62.

**Table 4-62: Detention Pond Conversion - Oakleigh/Schoolhouse Coves**

| Site ID | Riser | Embank-ment | Vege-tation | Fence Condition | Gate Condition | Water Quality Potential | Access | Flow Path | Horizontal Expansion Potential | Vertical Expansion Potential |
|---|---|---|---|---|---|---|---|---|---|---|
| 326 | Good | Trees | Turf | Good | Locked | Y | Easy | Long | N | N |

SWM_D_326 is a privately-owned facility, located in the Oakleigh/Schoolhouse Coves subwatershed off of North Point Road. This pond is designed to handle runoff from the 2, 10, and 100-year events from a 1.44-acre industrial facility. The size of the pond appeared to be much larger than what should be

needed to treat its relatively small drainage area as boats and vehicles were seen being stored in the ponding area. The major recommendation here is to investigate whether a BMP with a smaller footprint such as a sand filter or bioretention facility could replace the existing dry detention facility.

**Figure 4-52: Vehicular Storage at Detention Pond SWM_D_326**

### *4.3.8.9 Shoreline Restoration*

Oakleigh/Schoolhouse Coves has 2.44 miles of shoreline of which 43% (12.1 acres) of the 100-foot shoreline buffer is classified as open, pervious area. One 420 linear foot shoreline reach at Battle Grove Park was completed in 1995 and was listed as stable in EPS's Shoreline Enhancement Feasibility Study (EPS 1998). Planting of the open pervious shoreline buffer in Oakleigh/Schoolhouse Coves is recommended as much of the shoreline consists of residential or park land.

#### *4.3.8.10 Subwatershed Management Strategy*

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-59 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-59.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees.
4. Educate citizens about the benefits and importance of bayscaping.
5. Educate residents of NSA_D_70 about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments.
6. Include NSA_D_71 in the County's routine street sweeping program.
7. Conduct street tree plantings at the neighborhoods identified in Table 4-59.
8. Conduct tree plantings and storm drain marking at ISI_D_0801.
9. Educate the ISIs indicated in Table 4-61 on proper nutrient management, trash management, and the importance of stream and shoreline buffers.

Municipal Actions

1. Work with the HSI indicated in Table 4-60 and similar businesses to implement appropriate practices for vehicle operations, storage of outdoor materials, waste management, physical plant management, turf/landscape management and stormwater.
2. Investigate the potential for impervious cover removal and stormwater retrofits at ISI_D_0801.
3. Determine the feasibility of converting SWM_D_326 to a sand filter or bioretention area, which would be better suited to its small drainage area.
4. Identify open pervious shoreline areas in Oakleigh/Schoolhouse Coves with the potential for reforestation and preservation.

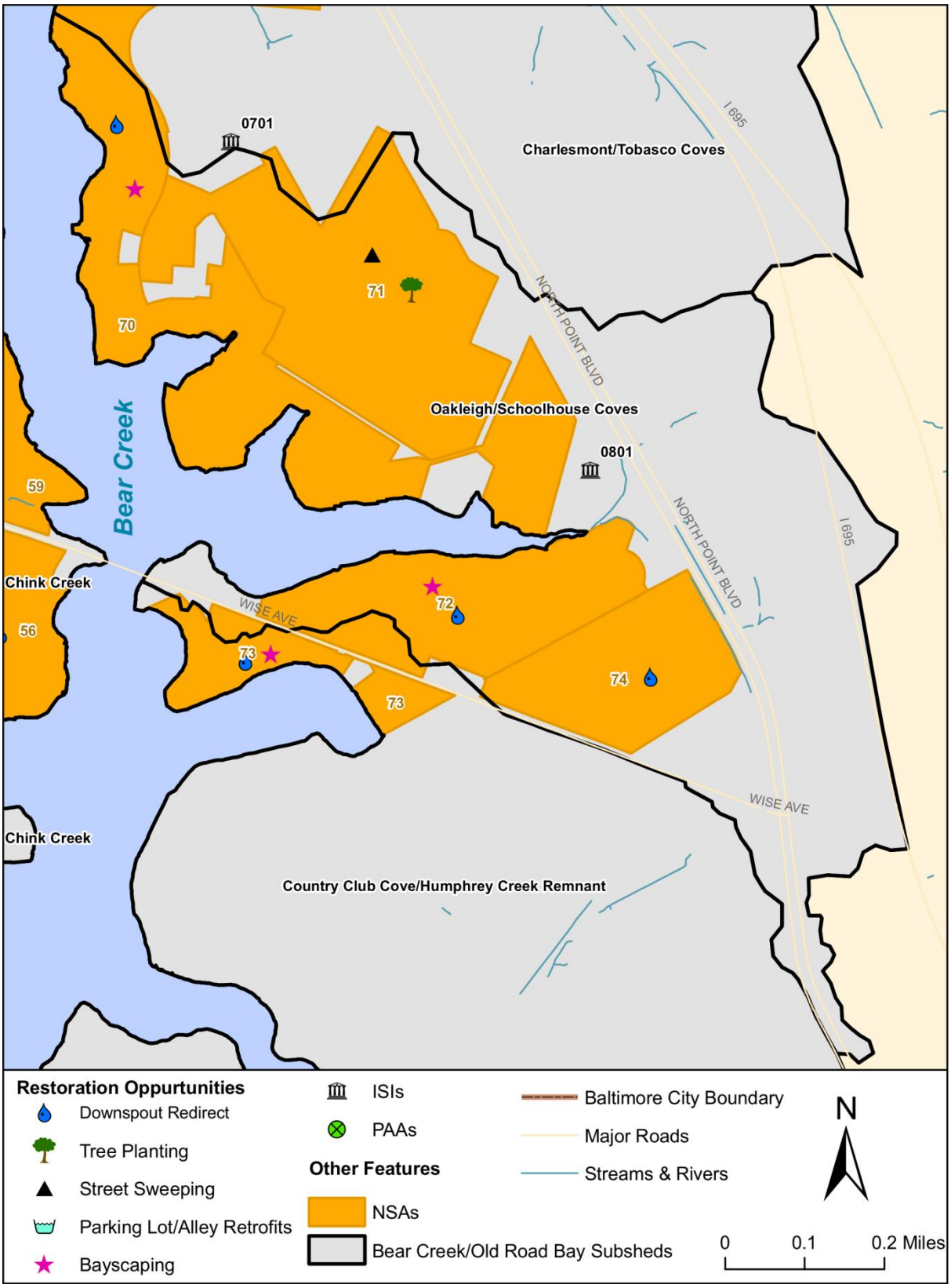


Figure 4-53: Restoration Opportunities in Oakleigh/Schoolhouse Coves

### 4.3.9 Country Club Cove/Humphrey Creek Remnant

Country Club Cove/Humphrey Creek Remnant is the fourth largest subwatershed in the Bear Creek/Old Road Bay study area and is composed of mostly open urban and industrial land uses. Other urban land uses in Country Club Cove/Humphrey Creek Remnant include residential, commercial, and institutional, totaling an urban land cover of 81%. The remainder of Country Club Cove/Humphrey Creek Remnant is comprised of forests, wetlands, and water. Table 4-63 summarizes key subwatershed characteristics of Country Club Cove/Humphrey Creek Remnant.

**Table 4-63: Key Subwatershed Characteristics – Country Club Cove/Humphrey Creek Remnant**

| | | |
|---|---|---|
| **Drainage Area** | 797.9 acres (1.25 sq. mi.) | |
| **Stream Length** | 1.2 miles | |
| **Coastline Length** | 3.5 miles | |
| **Population** | 1,082 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 0.0% |
| | Medium Density Residential: | 12.3% |
| | High Density Residential: | 2.3% |
| | Commercial: | 0.9% |
| | Industrial: | 28.7% |
| | Institutional: | 0.2% |
| | Open Urban: | 35.4% |
| | Forest: | 15.7% |
| | Agriculture: | 0.0% |
| | Water/Wetlands: | 3.0% |
| | Transportation | 1.3% |
| **Impervious Cover** | 24.5% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.0% |
| | B Soils: | 13.2% |
| | C Soils: | 73.2% |
| | D Soils (high runoff potential): | 10.7% |
| | Water | 2.9% |

#### *4.3.9.1 Neighborhoods*

A total of three (3) distinct neighborhoods were identified and assessed within Country Club Cove/Humphrey Creek Remnant during the uplands assessment of Bear Creek/Old Road Bay. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, tree planting, and public education (i.e., bayscaping and increasing lot tree canopy). A summary of neighborhood recommended actions is presented in Table 4-64.

**Table 4-64: NSA Recommendations – Country Club Cove/Humphrey Creek Remnant**

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marking | Bayscape | Increase Lot Canopy | Alley Retrofit | # of Shade Trees | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| NSA_D_73 | 1/4 | X | X | X | | X | X | | | |
| NSA_D_75 | <1/4 | X | X | X | X | | X | X | | Blue alleys |
| NSA_D_76 | 1/4 | X | X | X | X | X | X | X | 6 | Blue alleys; shade tree planting opportunity at circle area on Wells Ave. |

The three (3) NSAs assessed in Country Club Cove/Humphrey Creek Remnant were all recommended for downspout disconnection and education on the benefits of an increased lot canopy. In addition, two of the three neighborhoods were recommended for storm drain marking and bayscaping. The center of the traffic circle on Wells Avenue in NSA_D_76 was identified as an area for potential shade tree plantings.

### *4.3.9.2 Hotspots*

One (1) hotspot investigation was performed within Country Club Cove/Humphrey Creek Remnant on an industrial equipment facility. Table 4-65 summarizes the potential pollution sources found at this site.

**Table 4-65: HSI Results Summary – Country Club Cove/Humphrey Creek Remnant**

| HSI_ID | HSI Status* | Description | Vehicle Operations | Outdoor Materials | Waste Management | Physical Plant | Storm Water | Notes |
|---|---|---|---|---|---|---|---|---|
| HSI_D_0901 | Confirmed | Industrial – Equipment | X | X | X | X | X | Potential retrofit to existing stream (offsite pond) |

Activities observed at HSI_D_0901 include the storage of industrial equipment including vehicles, trailers, and other materials. Materials at this facility were being stored outside and runoff was draining directly to a ditch/stream running alongside the northern border of the property. This ditch/stream has the potential to be converted into a bioswale to provide treatment to runoff from the site. In addition, the site is recommended for education on the proper storage of outdoor materials. Figure 4-54 illustrates how materials are being stored on the site and provides an aerial view of the configuration of the hotspot site and the ditch running through it.

Figure 4-54: Material Stockpiles (left) and Aerial View (right) of HSI_D_0901

### 4.3.9.3 Institutions

One (1) private institutional site was assessed for retrofit opportunities in Country Club Cove/Humphrey Creek Remnant during the uplands assessment of Bear Creek/Old Road Bay. Table 4-66 summarizes recommendations for the institutional site assessed in Country Club Cove/Humphrey Creek Remnant.

Table 4-66: ISI Recommendations – Country Club Cove/Humphrey Creek Remnant

| Site ID | Name | Public/ Private | # Trees for Planting | Trash Management | Storm Drain Marking | Notes |
|---|---|---|---|---|---|---|
| ISI_D_0901 | Shiloh Baptist Church | Private | 27 | X | X | Pond handles 65% of impervious/ street trees on Sparrows Point Road |

ISI_D_0901 is a private, faith-based institution located on a 4.7-acre parcel off of Sparrows Point Road in the Country Club Cove/Humphrey Creek Remnant subwatershed. Opportunities for tree plantings were identified at the institution include the potential for street trees on the portion of property fronting Sparrows Point Road as well as shade tree plantings at the rear of the church building and around the existing stormwater management pond. Approximately 65% of the impervious area on the site is treated by the stormwater management pond, and no stormwater retrofits were identified here. Evidence of dumping was seen in the woods on the eastern portion of the property. Therefore the site is recommended for education on waste management and has the potential for community cleanup and storm drain marking activities.

### 4.3.9.4 Pervious Areas

No pervious areas were assessed in Country Club Cove/Humphrey Creek Remnant.

### 4.3.9.5 Marinas

No marinas were assessed in Country Club Cove/Humphrey Creek Remnant

#### 4.3.9.6 Large Landowners

None of the large landowners are present in Country Club Cove/Humphrey Creek Remnant

#### 4.3.9.7 Illicit Discharges

Country Club Cove/Humphrey Creek Remnant contains one (1) Priority 0 outfall. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

#### 4.3.9.8 Stormwater Conversions

Two (2) detention ponds were assessed in Country Club Cove/Humphrey Creek Remnant and are summarized in Table 4-67.

**Table 4-67: Detention Pond Conversion - Country Club Cove/Humphrey Creek Remnant**

| Site ID | Riser | Embank-ment | Vege-tation | Fence Condition | Gate Condition | Water Quality Potential | Access | Flow Path | Horizontal Expansion Potential | Vertical Expansion Potential |
|---|---|---|---|---|---|---|---|---|---|---|
| 234 | None | No Problem | Wetland Veg. | None | None | Y | Easy | Long | Y | N |
| 290 | None Found | Invasive Veg. | Invasive Veg. | None | None | Y | Moderate | Unobserved | N | N |

SWM_D_234 is a privately-owned facility, located in the Country Club Cove and Humphrey Creek subwatershed at an industrial facility off of Grays Road. This pond is designed to handle runoff from the 2, 10, and 100-year events from a 7.14-acre industrial facility. There is potential for horizontal expansion to the existing turf area between the existing building and the north side of the facility. This facility showed signs of the presence of invasive species in the bottom and along the embankment. The major recommendation at this pond is to investigate whether the private owner altered the pond from the approved design by removing the downstream berm. Currently, stormwater runoff that enters the pond flows directly through the facility without any significant detention time.

**Figure 4-55: Lack of Downstream Berm at SWM_D_234**

SWM_D_290 is a privately-owned facility, located in the Country Club Cove and Humphrey Creek subwatershed at the end of Grays Road. This pond is designed to handle runoff from the 2, 10, and 100-year events from an 8.9-acre industrial facility. A complete assessment was unable to be performed at this pond due to the presence of phragmites which completely engulfed all areas of the facility. It is recommended that vegetative and invasive species maintenance be performed on this pond to facilitate a complete assessment of its conversion feasibility.

**Figure 4-56: Phragmites Engulfing SWM_D_290**

### *4.3.9.9 Shoreline Restoration*

Country Club Cove/Humphrey Creek Remnant has 3.5 miles of shoreline of which 34% (13.8 acres) of the 100-foot shoreline buffer is classified as open, pervious area. No shoreline enhancement projects were identified in EPS's Shoreline Enhancement Feasibility Study (EPS 1998). Planting of the open pervious shoreline buffer in Country Club Cove/Humphrey Creek Remnant is recommended as much of the shoreline consists of residential land or is occupied by a golf course.

#### *4.3.9.10 Subwatershed Management Strategy*

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-64 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-64.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees.
4. Educate citizens about the benefits and importance of bayscaping.
5. Conduct shade tree plantings at the neighborhoods identified in Table 4-64.
6. Conduct tree plantings and storm drain marking at ISI_D_0901.
7. Educate the ISIs indicated in Table 4-66 on proper trash management.

Municipal Actions

1. Work with the HSI indicated in Table 4-65 and similar businesses to implement appropriate practices for vehicle operations, storage of outdoor materials, waste management, physical plant management, and stormwater.
2. Investigate SWM_D_234 to determine is the pond has been altered from its approved design in its permit and enforce improvements if necessary.
3. Conduct invasive species management at SWM_D_290 and perform a complete assessment of the conversion potential of the detention pond.
4. Identify open pervious shoreline areas in Country Club Cove/Humphrey Creek Remnant with the potential for reforestation and preservation.

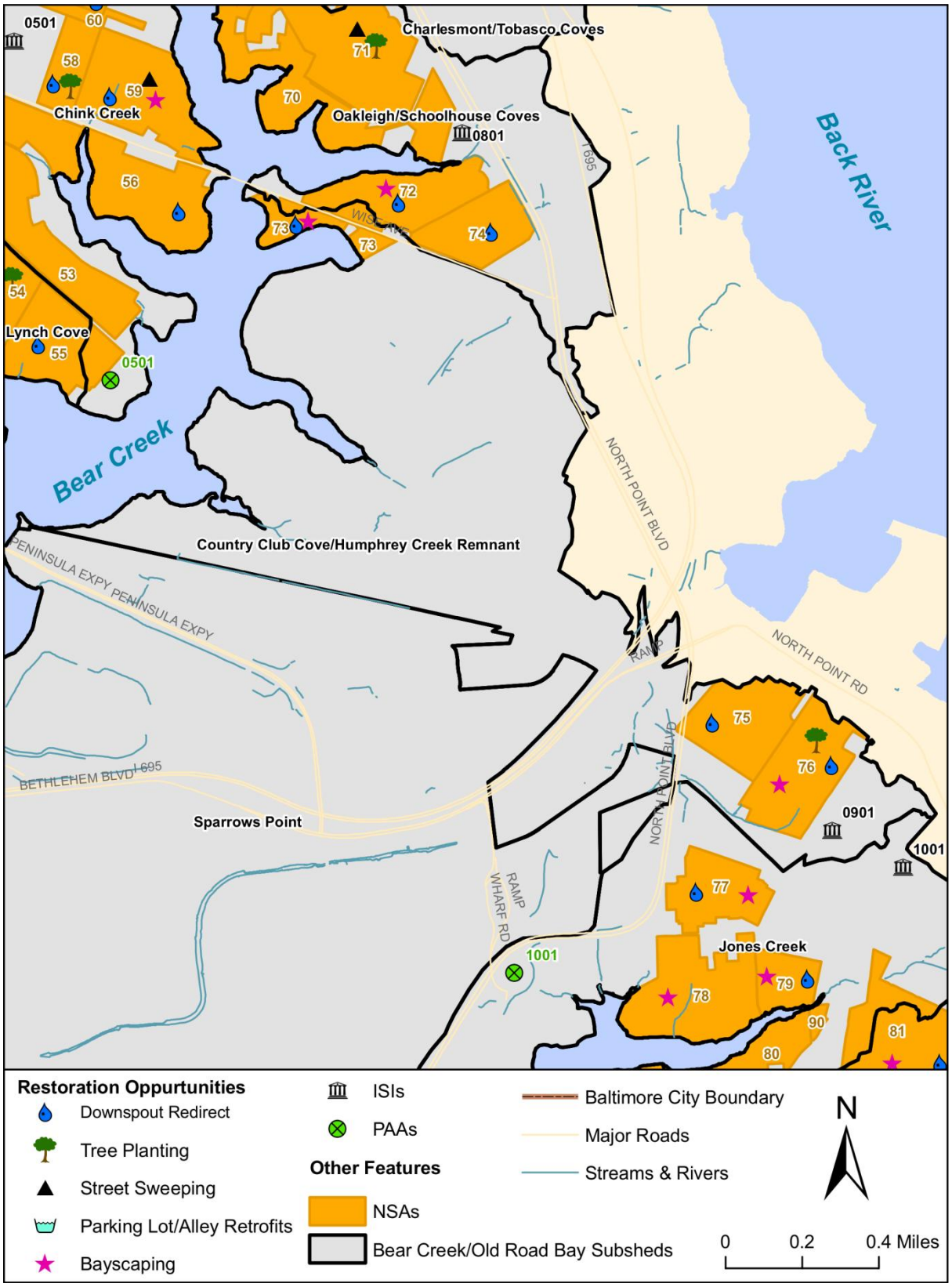


Figure 4-57: Restoration Opportunities in Country Club Cove/Humphrey Creek Remnant

### 4.3.10 Jones Creek

Jones Creek is the third largest subwatershed in the Bear Creek/Old Road Bay study area and is composed of mostly residential and industrial land uses. Other urban land uses in Jones Creek include open urban, commercial, and institutional, totaling an urban land cover of 81%. The remainder of Jones Creek is comprised of forests and water. Table 4-68 summarizes key subwatershed characteristics of Jones Creek.

**Table 4-68: Key Subwatershed Characteristics – Jones Creek**

| | | |
|---|---|---|
| **Drainage Area** | 922.9 acres (1.44 sq. mi.) | |
| **Stream Length** | 1.7 miles | |
| **Coastline Length** | 5.4 miles | |
| **Population** | 2,591 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 1.3% |
| | Medium Density Residential: | 33.7% |
| | High Density Residential: | 1.2% |
| | Commercial: | 4.3% |
| | Industrial: | 28.5% |
| | Institutional: | 0.8% |
| | Open Urban: | 11.2% |
| | Forest: | 17.9% |
| | Agriculture: | 0.0% |
| | Water/Wetlands: | 1.3% |
| | Transportation | 0.0% |
| **Impervious Cover** | 26.6% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.0% |
| | B Soils: | 0.0% |
| | C Soils: | 52.7% |
| | D Soils (high runoff potential): | 47.2% |
| | Water | 0.1% |

#### *4.3.10.1 Neighborhoods*

A total of five (5) distinct neighborhoods were identified and assessed within Jones Creek during the uplands assessment of Bear Creek/Old Road Bay. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, stormwater retrofits, and public education (i.e., bayscaping, trash management, and pet waste management). A summary of neighborhood recommended actions is presented in Table 4-69.

**Table 4-69: NSA Recommendations – Jones Creek**

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marking | Bayscape | Increase Lot Canopy | Pet Waste | Trash Management | Buffer Improvement | Parking Lot Retrofit | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSA_D_77 | 1/4 | X | X | X | X | X | X | | | | | |
| NSA_D_78 | 1/4 | | X | X | | X | X | | | | | |
| NSA_D_79 | 1/4 | X | X | X | | X | X | | | | | |
| NSA_D_80 | 1/4 | X | X | X | X | X | X | | | X | | Decals on storm drains |
| NSA_D_90 | <1/8 | | | | | | | X | X | X | X | |

Most of the neighborhoods in Jones Creek are recommended for downspout disconnection and public education related to bayscaping and increasing lot tree canopy. Two (2) neighborhoods were recommended for storm drain marking and education on buffer improvement.

NSA_D_90 is a mobile home community located off of Lincoln Avenue at Cooper Avenue. The neighborhood consists of multiple, mobile homes along with a driveway and parking area. Currently, drainage travels through a concrete channel which outlets directly into Jones Creek. This concrete channel could potentially be retrofit into a bioswale to provide water quality treatment to runoff. Figure 4-58 provides a photograph of this potential retrofit site. In addition, NSA_D_90 was recommended for education on pet waste management and trash management.

**Figure 4-58: Potential Stormwater Retrofit at NSA_D_90**

### *4.3.10.2 Hotspots*

Two (2) hotspot investigations were performed within Jones Creek on an industrial manufacturing facility and a commercial storage facility. Table 4-70 summarizes the potential pollution sources found at each of the sites.

**Table 4-70: HSI Results Summary – Jones Creek**

| HSI_ID | HSI Status* | Description | Vehicle Operations | Outdoor Materials | Waste Management | Physical Plant | Storm Water | Notes |
|---|---|---|---|---|---|---|---|---|
| HSI_D_1001 | Potential | Industrial-Manufacturing | X | X | X | | X | Outdoor materials stored with no cover to drain |
| HSI_D_1002 | Confirmed | Commercial-Storage | | X | X | X | X | Observed spilt paint/uncovered metals |

HSI_D_1001 is an industrial manufacturing facility located on North Point Boulevard. This industrial area appeared to be relatively well-maintained with no stains on the parking lot and low-maintenance landscaping. The site is recommended for proper education on waste management and outdoor materials storage as open dumpsters were observed during the assessment and outdoor materials can be seen on aerial photographs (Figure 4-59).

**Figure 4-59: Aerial View (left) and Parking Lot (right) at HSI_D_1001**

HSI_D_1002 is a commercial area that was being used to store materials such as recyclable metals and drums of paint. These materials were being stored outside, and evidence of leaking paint was observed on site (Figure 4-60). Leaking paint was leaving the site and entering the storm drain as evidenced by blue paint at the downstream storm drain inlet. This site was referred to Baltimore County for immediate enforcement.

Figure 4-60: Leaking Contaminants at HSI_D_1002

### *4.3.10.3 Institutions*

One (1) private institutional site was assessed for retrofit opportunities in Jones Creek during the uplands assessment of Bear Creek/Old Road Bay. Table 4-71 summarizes recommendations for the institutional site assessed in Jones Creek.

Table 4-71: ISI Recommendations – Jones Creek

| Site ID | Name | Public/ Private | Nutrient Management | Stormwater Retrofit | Trash Management | Storm Drain Marking | Notes |
|---|---|---|---|---|---|---|---|
| ISI_D_1001 | St Luke's Assisted Living Center | Private | X | X | X | X | Retrofit swale at roof drain outlets |

ISI_D_1001 is a private, senior center located on a 5.7-acre parcel off of Lodge Farm Road in the Jones Creek subwatershed. The facility is comprised of a large building in addition to a parking area which is served by a stormwater pond. Approximately 40% of the parcel is forested while the other pervious area is comprised of high-maintenance turf grass. Because of this high-maintenance landscaping, the institution was recommended for education on proper nutrient management along with trash management. Unlabeled storm drains are recommended for marking as well. As shown in Figure 4-61, roof drains at the southern end of the building outlet through a pipe to a small rip rap basin prior to discharging to the adjacent forested area. The rip rap basin could be converted to a bioretention area or bioswale to provide additional water quality treatment to the runoff from the roof. Because runoff currently flows through a large forested area prior to reaching any surface waters, any retrofit installed might only provide limited water quality treatment.

Figure 4-61: Potential Stormwater Retrofit of Pipe Outfall at ISI_D_1001

### *4.3.10.4 Pervious Areas*

The two (2) pervious areas assessed for restoration potential in Jones Creek are summarized in Table 4-72.

Table 4-72: PAA Descriptions – Jones Creek

| Site_ID | Location | Name | Acres | Ownership |
|---|---|---|---|---|
| PAA_D_1001 | Wharf Rd. & Sparrows Point Rd. Interchange | UNKNOWN | 17.1 | Public |
| PAA_D_1002 | Bay Front Rd. & Lincoln Ave. | UNKNOWN | 8.8 | Private |

PAA_D_1001 is comprised of the public right of way at the interchange of Wharf Road and Sparrows Point Road. At 17.0 acres in total, this site includes 6.6 acres of road while the remaining 10.4 acres is pervious area. Much of the area is composed of trees and other shrubby vegetation but the remaining pervious area contains lightly maintained turf. Although a portion of the area couldn't be planted due to electric utility lines, most of the open pervious area at the interchange could be planted.

Figure 4-62: Planting Opportunities at the Wharf Road/Sparrows Point Road Interchange at PAA_D_1001

PAA_D_1002 is an 8.8-acre, private parcel located on Bay Front Road in the Jones Creek subwatershed. Currently, the property is comprised of turf grass that has been allowed to grow to a height of approximately 2-3 feet. Additionally, signs were seen on a portion of the site indicating that the site was a Chesapeake Bay Critical Area Easement. About half of the site appeared to have recent tree plantings. The main recommendation here is to determine the feasibility of implementing buffer plantings on the remainder of the site.

**Figure 4-63: Chesapeake Bay Critical Area Easement at PAA_D_1002**

### *4.3.10.5 Marinas*

Two (2) marinas were assessed in Jones Creek and are summarized in Table 4-73.

**Table 4-73: Marina Recommendations – Jones Creek**

| Site ID | Type | Clean Marina | Maintenance/ Repair | Petroleum | Sewage | Waste Management | Marina Management | Stormwater Management | Turf | Total Score | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MAR_D_1001 | Marina | Y | 0 | 0 | 100 | 60 | 67 | 40 | 100 | 61 | Maintenance/bottom-washing done without cover in open |
| MAR_D_1002 | Marina/ Boatyard | N | 60 | 0 | 75 | 60 | 33 | 50 | 100 | 64 | |

MAR_D_1001 is the second Maryland Clean Marina that was assessed as part of the planning study. The facility is a marina with a boatyard used for long-term boat storage. No fueling activities were present and the sewage pump-out system appeared to be well maintained with spill prevention methods in place. The facility is recommended for education on proper maintenance procedures as maintenance and bottom-washing is done without cover and could cause the washing of pollutants into Jones Creek.

MAR_D_1002 is a marina and boatyard facility located on Bay Front Road in the Jones Creek subwatershed. The facility conducts maintenance under a cover and no fueling operations were observed here. The site is recommended for education on proper trash management as open dumpsters and loose litter were observed at the site.

#### *4.3.10.6 Large Landowners*

One (1) large industrial landowner's property bisects a portion of Jones Creek: the RG Steel Sparrows Point facility. Information on recommendations and potential restoration opportunities at this site can be found in Section 4.3.14.6.

#### *4.3.10.7 Illicit Discharges*

Jones Creek contains one (1) Priority 1 outfall which indicates major or reoccurring problems that require either immediate action or close monitoring. This subwatershed also contains one (1) Priority 2 outfall and one (1) Priority 0 outfall. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

#### *4.3.10.8 Stormwater Conversions*

No dry detention pond assessments were conducted in Jones Creek.

#### *4.3.10.9 Shoreline Restoration*

Jones Creek has 5.42 miles of shoreline of which 47% (29.6 acres) of the 100-foot shoreline buffer is classified as open, pervious area. One (1) project was identified in EPS's Shoreline Enhancement Feasibility Study (EPS 1998). This project on the Jones Creek west shoreline consists of 9,000 linear feet of enhancement including beneficial use of dredged material and marsh creation. The project would be on private land which might provide an obstacle to implementation. Planting of the open pervious shoreline buffer in Jones Creek is recommended as much of the shoreline consists of residential or park land.

#### *4.3.10.10 Subwatershed Management Strategy*

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-69 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-69.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees.
4. Educate citizens about the benefits and importance of bayscaping, pet waste management, and trash management.
5. Educate residents of NSA_D_80 and NSA_D_90 about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments.
6. Conduct storm drain marking at ISI_D_1001.
7. Educate the ISIs indicated in Table 4-71 on proper nutrient management and trash management.

Municipal Actions

1. Investigate the potential for stormwater retrofits at NSA_D_90 to treat runoff from the impervious driveway and parking areas.
2. Work with the HSI indicated in Table 4-70 and similar businesses to implement appropriate practices for vehicle operations, storage of outdoor materials, waste management, physical plant management, and stormwater.
3. Investigate the potential for implementation of stormwater retrofits at ISI_D_1001.
4. Provide education to marinas on proper maintenance and trash management practices along with the benefits of being certified as a MD Clean Marina.
5. Investigate the feasibility of implementing a shoreline enhancement project on 9,000 linear feet of the Jones Creek western shoreline.
6. Identify open pervious shoreline areas in Jones Creek with the potential for reforestation and preservation.

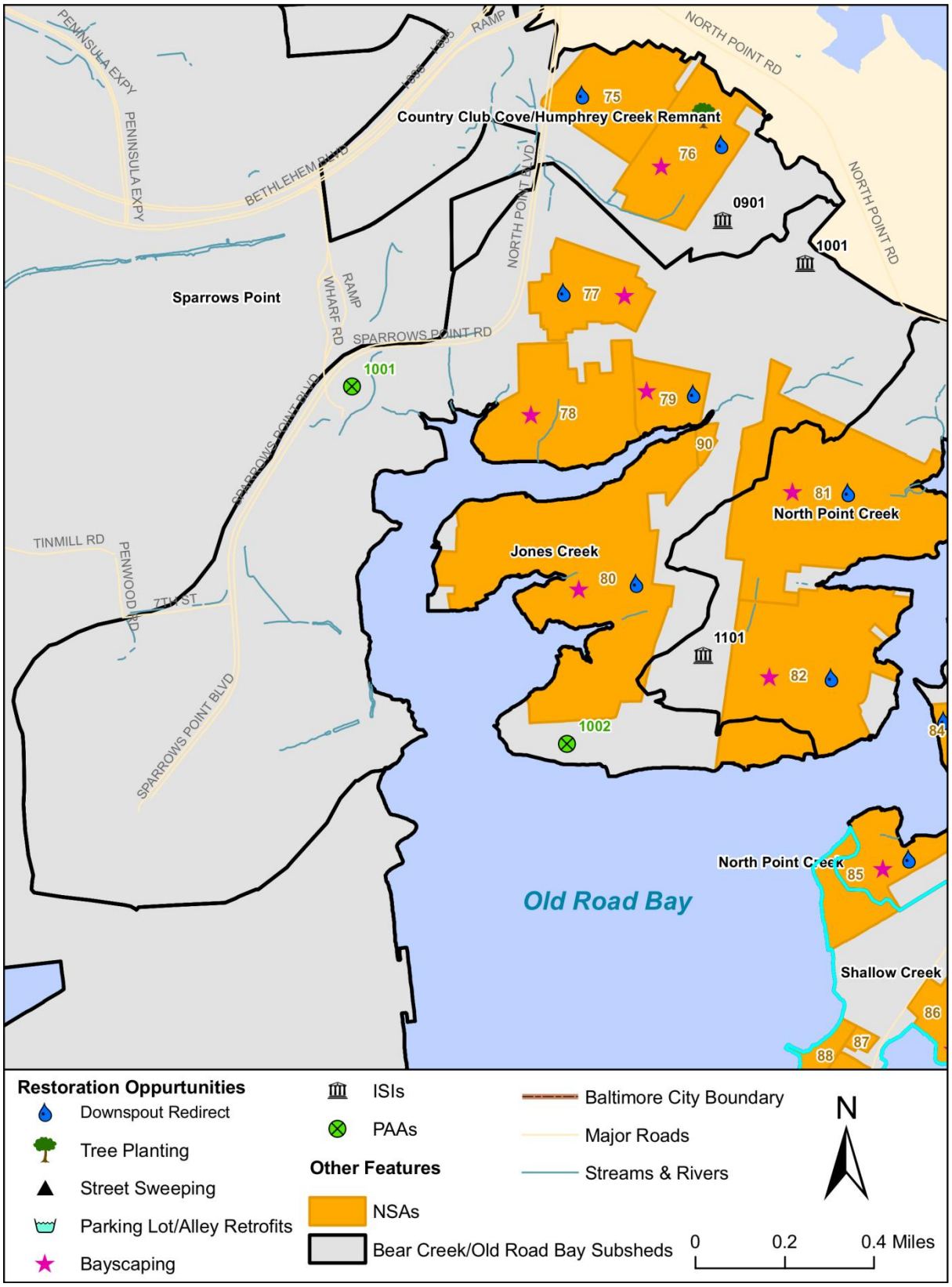


Figure 4-64: Restoration Opportunities in Jones Creek

### 4.3.11 North Point Creek

North Point Creek is the sixth smallest subwatershed in the Bear Creek/Old Road Bay study area. The subwatershed is comprised of 53% urban land including residential, commercial, and industrial uses. In addition, 20% of the land use in North Point Creek is classified as agriculture while the remainder is forest and water. Table 4-74 summarizes key subwatershed characteristics of North Point Creek.

**Table 4-74: Key Subwatershed Characteristics – North Point Creek**

| | | |
|---|---|---|
| **Drainage Area** | 576.2 acres (0.90 sq. mi.) | |
| **Stream Length** | 0.6 miles | |
| **Coastline Length** | 4.1 miles | |
| **Population** | 1,937 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 0.9% |
| | Medium Density Residential: | 46.4% |
| | High Density Residential: | 2.9% |
| | Commercial: | 0.3% |
| | Industrial: | 0.0% |
| | Institutional: | 2.6% |
| | Open Urban: | 0.0% |
| | Forest: | 25.1% |
| | Agriculture: | 20.3% |
| | Water/Wetlands: | 1.6% |
| | Transportation | 0.0% |
| **Impervious Cover** | 16.1% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.0% |
| | B Soils: | 22.2% |
| | C Soils: | 67.1% |
| | D Soils (high runoff potential): | 10.7% |
| | Water | 0.0% |

#### *4.3.11.1 Neighborhoods*

A total of five (5) distinct neighborhoods were identified and assessed within North Point Creek during the uplands assessment of Bear Creek/Old Road Bay. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, stormwater retrofits, and public education (i.e., bayscaping, trash management, and pet waste management). A summary of neighborhood recommended actions is presented in Table 4-75.

**Table 4-75: NSA Recommendations – North Point Creek**

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marking | Bayscape | Increase Lot Canopy | Buffer Improvement | Notes |
|---|---|---|---|---|---|---|---|---|---|
| NSA_D_81 | 1/4 | X | X | X | X | X | X | X | |
| NSA_D_82 | 1/4 | X | X | X | X | X | X | | |
| NSA_D_83 | 1/4 | X | X | X | | X | X | | |
| NSA_D_84 | <1/8 | X | X | | X | | X | | |
| NSA_D_85 | 1/4 | X | X | X | X | X | X | | |

Of the five (5) NSAs that were assessed in North Point Creek, all were noted as having opportunity for downspout disconnections. All five of the neighborhoods in the subwatershed consist of single-family detached dwellings with turf lawns, therefore increasing lot canopies in North Point Creek should be a priority. In addition, all but one neighborhood, a mobile home community, were recommended for education on converting portions of turf lawn to a more native bayscape. NSA_D_81 borders the surface waters of North Point Creek and was recommended for education on the improvement of buffer conditions for properties that reside on the shoreline.

#### *4.3.11.2 Hotspots*

No hotspots were assessed in North Point Creek. One (1) NPDES-permitted facility, a marina, resides in North Point Creek.

#### *4.3.11.3 Institutions*

One (1) public institutional site was assessed for retrofit opportunities in North Point Creek during the uplands assessment of Bear Creek/Old Road Bay. Table 4-76 summarizes recommendations for the institutional site assessed in North Point Creek.

**Table 4-76: ISI Recommendations – North Point Creek**

| Site ID | Name | Public/ Private | # Trees for Planting | Trash Management | Storm Drain Marking | Notes |
|---|---|---|---|---|---|---|
| ISI_D_1101 | Chesapeake Terrace Elementary School | Public | 34 | X | X | Street trees on Lodge Farm & Headland |

ISI_D_1101 is a public, elementary school located on a 13.9-acre parcel at the intersection of Lodge Farm Road and Ellen Avenue. Street tree plantings were recommended at this institution along Lodge Farm Road and Ellen Avenue. In addition, ISI_D_1101 was recommended for education on proper trash management as well as storm drain marking.

#### 4.3.11.4 Pervious Areas

No pervious areas were assessed in North Point Creek.

#### 4.3.11.5 Marinas

No marinas were assessed in North Point Creek.

#### 4.3.11.6 Large Landowners

None of the large landowners are present in North Point Creek.

#### 4.3.11.7 Illicit Discharges

North Point Creek contains three (3) Priority 3 outfalls. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

#### 4.3.11.8 Stormwater Conversions

No dry detention pond assessments were conducted in North Point Creek.

#### 4.3.11.9 Shoreline Restoration

North Point Creek has 4.11 miles of shoreline of which 40% (18.9 acres) of the 100-foot shoreline buffer is classified as open, pervious area. Two (2) projects were identified in EPS's Shoreline Enhancement Feasibility Study (EPS 1998) along North Point State Park but were eliminated due to low enhancement potential. Planting of the open pervious shoreline buffer in North Point Creek is recommended as much of the shoreline consists of residential or park land.

#### *4.3.11.10 Subwatershed Management Strategy*

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-75 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-75.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees.
4. Educate citizens about the benefits and importance of bayscaping.
5. Educate residents of NSA_D_81 about the importance of shoreline buffers and encourage more environmentally friendly shoreline treatments.
6. Conduct storm drain marking and tree planting at ISI_D_1101.
7. Educate the ISIs indicated in Table 4-71 on proper trash management.

Municipal Actions

1. Identify open pervious shoreline areas in North Point Creek with the potential for reforestation and preservation.

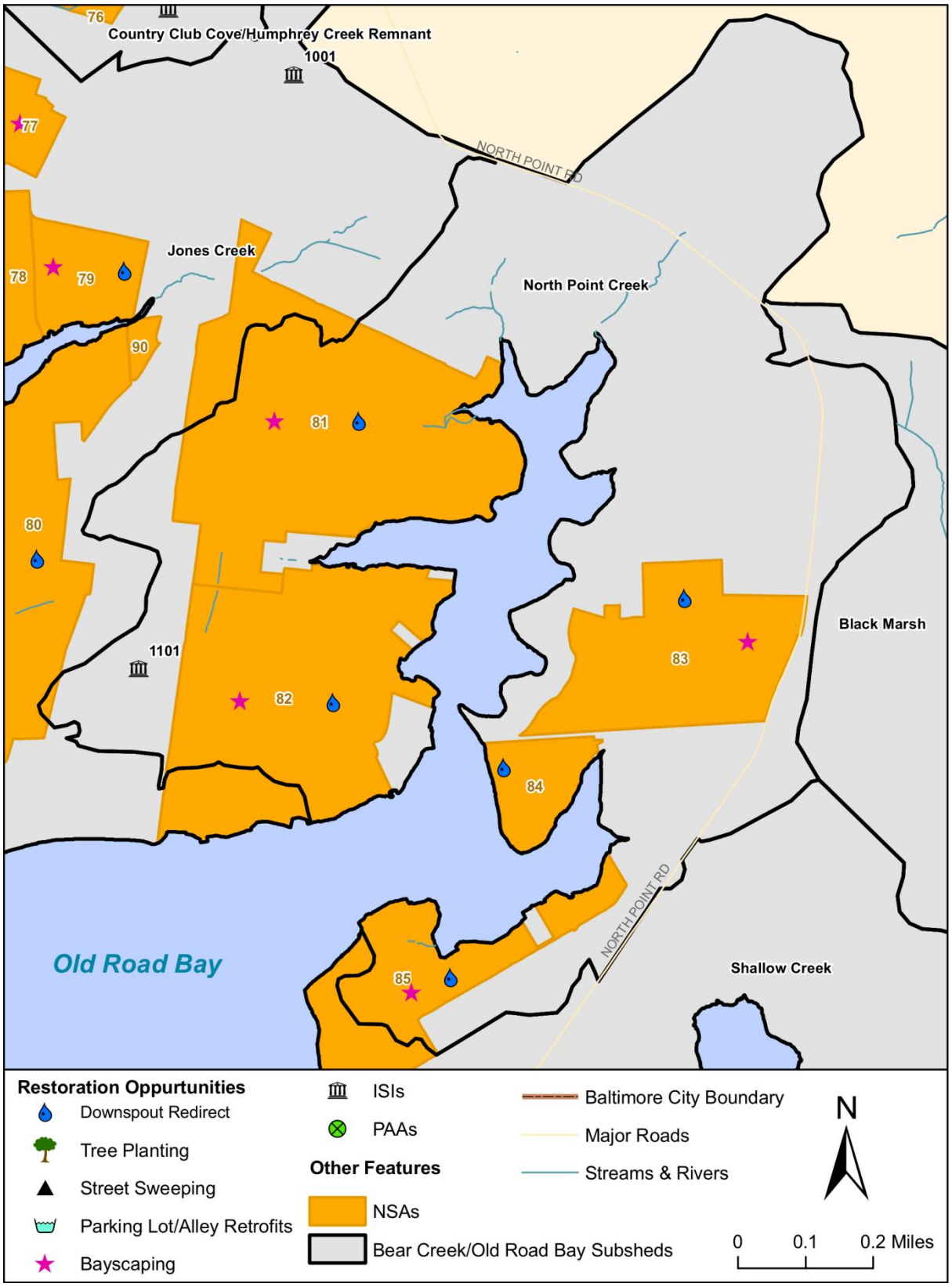


Figure 4-65: Restoration Opportunities in North Point Creek

### 4.3.12 Shallow Creek

Shallow Creek is the fifth largest subwatershed in the Bear Creek/Old Road Bay study area. With only 26% of the land use in the subwatershed classified as urban (residential and institutional), the majority of Shallow Creek falls under forest (39%) and agricultural (26%) land uses. The remainder of the subwatershed is comprised of water and wetlands land uses. Table 4-77 summarizes key subwatershed characteristics of Shallow Creek.

**Table 4-77: Key Subwatershed Characteristics – Shallow Creek**

| | | |
|---|---|---|
| **Drainage Area** | 706.2 acres (1.10 sq. mi.) | |
| **Stream Length** | 0.1 miles | |
| **Coastline Length** | 9.6 miles | |
| **Population** | 605 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 0.0% |
| | Medium Density Residential: | 13.0% |
| | High Density Residential: | 0.0% |
| | Commercial: | 0.0% |
| | Industrial: | 0.0% |
| | Institutional: | 13.1% |
| | Open Urban: | 0.0% |
| | Forest: | 38.7% |
| | Agriculture: | 26.2% |
| | Water/Wetlands: | 9.0% |
| | Transportation | 0.0% |
| **Impervious Cover** | 8.2% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.0% |
| | B Soils: | 2.1% |
| | C Soils: | 51.2% |
| | D Soils (high runoff potential): | 46.7% |
| | Water | 0.0% |

#### *4.3.12.1 Neighborhoods*

A total of three (3) distinct neighborhoods were identified and assessed within Shallow Creek during the uplands assessment of Bear Creek/Old Road Bay. Recommendations for addressing stormwater volume and pollutants at all NSAs within this subwatershed include downspout disconnection and public education (i.e., bayscaping and increasing lot canopy). A summary of neighborhood recommended actions is presented in Table 4-78.

**Table 4-78: NSA Recommendations – Shallow Creek**

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Bayscape | Increase Lot Canopy | Notes |
|---|---|---|---|---|---|---|---|
| NSA_D_86 | 1/4 | X | X | X | X | X | |
| NSA_D_87 | 1/4 | X | X | X | X | X | Blank Ave. could use some trash clean-up |
| NSA_D_88 | 1/4 | X | X | X | X | X | |

In addition to the recommendations mentioned in Table 4-78, Blank Avenue in NSA_D_87 showed evidence of trash and litter and could be a location for a community clean-up event.

#### *4.3.12.2 Hotspots*

No hotspots were assessed and no NPDES-permitted facilities are present within Shallow Creek.

#### *4.3.12.3 Institutions*

Only one ISI was assessed in Shallow Creek and is discussed under "Large Landowners."

#### *4.3.12.4 Pervious Areas*

The one (1) pervious area assessed for restoration potential in Shallow Creek is summarized in Table 4-79.

**Table 4-79: PAA Descriptions – Shallow Creek**

| Site_ID | Location | Name | Acres | Ownership |
|---|---|---|---|---|
| PAA_D_1201 | Bay Shore Rd. | North Point Park | 35.8 | Public |

PAA_D_1201 is a 35.8-acre collection of open pervious areas within the larger North Point Park which is operated and maintained by Maryland DNR. As seen in Figure 4-66, these areas are completely comprised of turf grass that receive full sun exposure and would require minimal site preparation. This area is recommended for reforestation which would provide connectivity to the rest of the forested area in North Point State Park. Possible constraints to reforesting here include potential agricultural use as DNR leases other parts of the park for agricultural use.

**Figure 4-66: Aerial View of PAA_D_1201 in North Point State Park**

### *4.3.12.5 Marinas*

No marinas were assessed in Shallow Creek.

### *4.3.12.6 Large Landowners*

One (1) large landowner property was assessed in the Shallow Creek subwatershed, the Veteran's Administration (VA) Hospital, as detailed in Table 4-80.

**Table 4-80: Large Landowners – Shallow Creek**

| Site ID | Name | Acres |
|---|---|---|
| LLO_D_1201 | Veterans Administration Hospital | 90 |

The Fort Howard VA Hospital is located on 90 acres of land at the southern end of North Point Road in the Shallow Creek subwatershed. Currently, the vast majority of the site is no longer in use and sits in a state of disrepair. One, outpatient facility still operates on the site utilizing one parking lot.

The site is currently being redeveloped so no specific recommendations are being made in regards to elimination of impervious coverage or tree planting at the site. Instead, this site will be considered a redevelopment area, with appropriate pollution reduction credits taken based on redevelopment in accordance with the most recent stormwater requirements in Maryland. Because the site is located directly adjacent to surface waters, it is recommended that development at the site strongly consider enhancement of buffer areas adjacent to Shallow Creek.

#### *4.3.12.7 Illicit Discharges*

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

#### *4.3.12.8 Stormwater Conversions*

No dry detention pond assessments were conducted in Shallow Creek.

#### *4.3.12.9 Shoreline Restoration*

Shallow Creek has 9.58 miles of shoreline of which 43% (44.0 acres) of the 100-foot shoreline buffer is classified as open, pervious area. Four (4) potential projects were identified in EPS's Shoreline Enhancement Feasibility Study (EPS 1998). These include three (3) reaches in Fort Howard State Park and one (1) reach in North Point State Park. The 8,200 linear foot Shallow Creek Segment reach at Fort Howard State Park was deemed stable. The reach in North Point State Park was thought to have limited erosion and little potential for habitat enhancement other than phragmites control. The remaining two (2) reaches at Fort Howard State Park were the 2,200 linear foot Fastland Park Segment and 1,600 linear foot Bay Marsh Segment. Enhancement projects at these locations could include shoreline protection retrofits, ecological enhancement, and beneficial use of dredged materials. Planting of the open pervious shoreline buffer in Shallow Creek is recommended as much of the shoreline consists of residential or park land.

#### *4.3.12.10 Subwatershed Management Strategy*

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

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-78 and educate citizens on the benefits of rain barrels and rain gardens.
2. Increase tree canopies on private lots by educating citizens on the benefits of trees.
3. Educate citizens about the benefits and importance of bayscaping.
4. Conduct a neighborhood trash clean-up on Blank Avenue in NSA_D_87.

<u>Municipal Actions</u>

1. Conduct tree plantings at the PAAs identified in Table 4-79.
2. Coordinate with redevelopment activities planned for the Veteran's Administration Hospital to ensure that all environmental requirements are met.
3. Investigate the feasibility of implementing shoreline protection retrofits, ecological enhancement, and beneficial use of dredged material projects at the 2,200 linear foot Fastland Park Segment and the 1,600 linear foot Bay Marsh Segment at Fort Howard State Park.
4. Identify open pervious shoreline areas in Shallow Creek with the potential for reforestation and preservation.

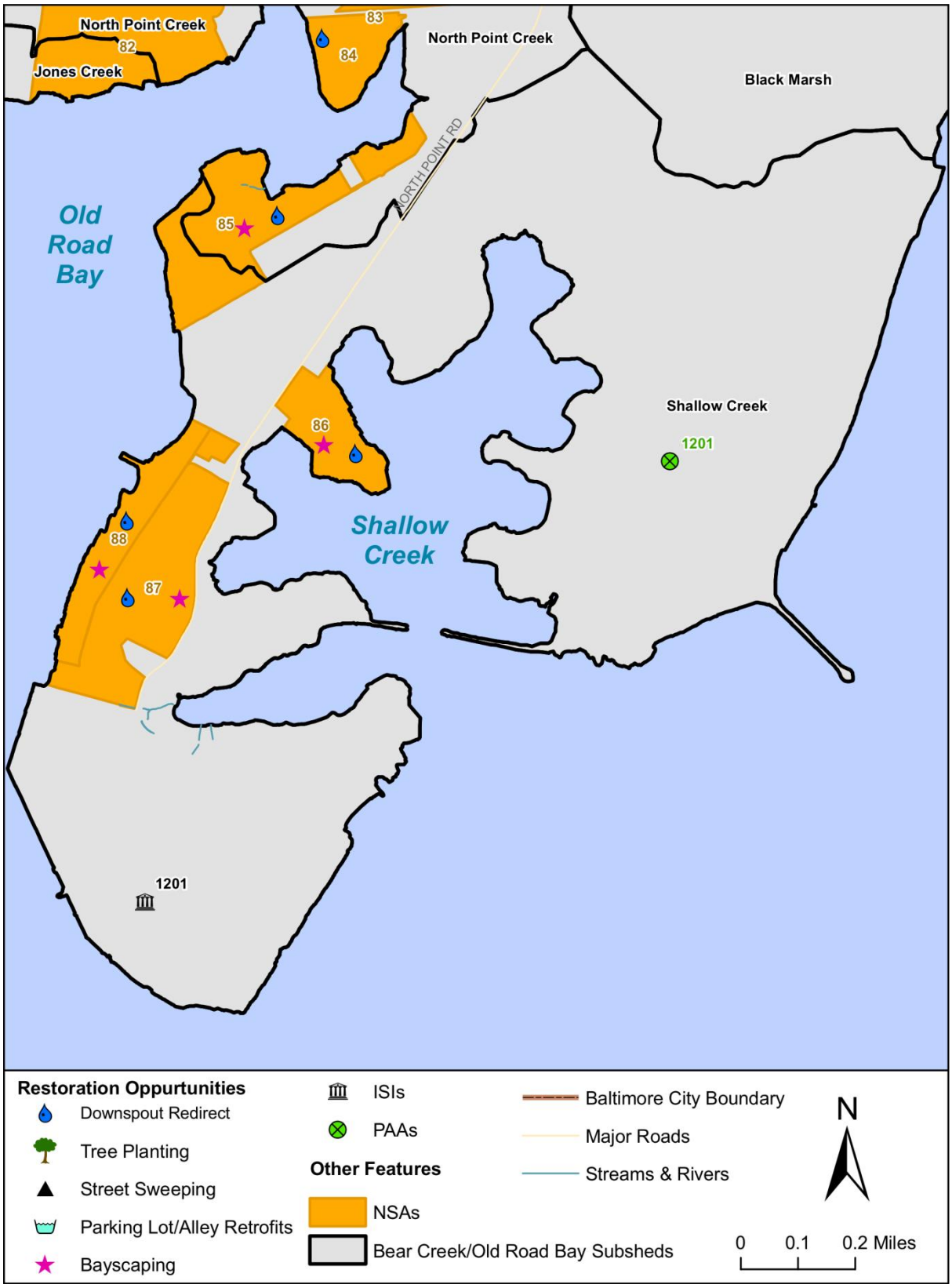


Figure 4-67: Restoration Opportunities in Shallow Creek

### 4.3.13 Black Marsh

Black Marsh is the fifth smallest subwatershed in the Bear Creek/Old Road Bay study area. Only 9% of the subwatershed is classified under urban land uses: residential and commercial. The remainder of Black Marsh is classified as forest (51%) and wetlands/water (33%) with 7% classified as agricultural. Table 4-81 summarizes key subwatershed characteristics of Black Marsh.

**Table 4-81: Key Subwatershed Characteristics – Black Marsh**

| | | |
|---|---|---|
| **Drainage Area** | 569.2 acres (0.89 sq. mi.) | |
| **Stream Length** | 1.8 miles | |
| **Coastline Length** | 3.3 miles | |
| **Population** | 285 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 0.0% |
| | Medium Density Residential: | 8.9% |
| | High Density Residential: | 0.0% |
| | Commercial: | 0.5% |
| | Industrial: | 0.0% |
| | Institutional: | 0.0% |
| | Open Urban: | 0.0% |
| | Forest: | 50.5% |
| | Agriculture: | 7.4% |
| | Water/Wetlands: | 32.6% |
| | Transportation | 0.0% |
| **Impervious Cover** | 4.4% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.0% |
| | B Soils: | 4.1% |
| | C Soils: | 50.7% |
| | D Soils (high runoff potential): | 45.1% |
| | Water | 0.0% |

#### *4.3.13.1 Neighborhoods*

A total of two (2) distinct neighborhoods were identified and assessed within Black Marsh during the uplands assessment of Bear Creek/Old Road Bay. Recommendations for addressing stormwater volume and pollutants at all NSAs within this subwatershed include downspout disconnection, storm drain marking and public education (i.e., bayscaping and increasing lot canopy). A summary of neighborhood recommended actions is presented in Table 4-82.

**Table 4-82: NSA Recommendations – Black Marsh**

| NSA_ID | Lot Size (acres) | % Opportunity for Downspout Disconnection | Rain Barrels | Rain Gardens | Storm Drain Marking | Bayscape | Increase Lot Canopy |
|---|---|---|---|---|---|---|---|
| NSA_D_89 | 1/4 | X | X | X | X | X | X |
| NSA_D_91 | 1/3 | X | X | X | | X | X |

The neighborhoods in Black Marsh are mostly single-family, detached dwellings located on the shoreline and draining to the Chesapeake Bay's main stem. All of the NSAs were recommended for downspout disconnection, bayscaping, and increased lot canopies, while NSA_D_89 was also recommended for storm drain marking.

### *4.3.13.2 Hotspots*

One (1) hotspot investigation was performed within Black Marsh on a commercial restaurant. Table 4-83 summarizes the potential pollution sources found at this site.

**Table 4-83: HSI Results Summary – Black Marsh**

| HSI_ID | HSI Status* | Description | Waste Management | Physical Plant | Storm Water | Notes |
|---|---|---|---|---|---|---|
| HSI_D_1301 | Potential | Commercial-Restaurant | X | X | X | Gravel lot adjacent to wetlands |

HSI_D_1301 is a commercial restaurant located in the Black Marsh subwatereshed. At this site, potential pollution causing activites observed include the presence of open dumpsters and a gravel parking lot located adjacent to wetlands. This site is recommended for education on proper waste management as well as the benefits of wetland buffers for stormwater treatment and water quality.

### *4.3.13.3 Institutions*

No institutions were assessed in Black Marsh.

### *4.3.13.4 Pervious Areas*

No pervious areas were assessed in Black Marsh.

### *4.3.13.5 Marinas*

One (1) marina was assessed in Black Marsh and is summarized in Table 4-84.

**Table 4-84: Marina Recommendations – Black Marsh**

| Site ID | Type | Clean Marina | Maintenance/ Repair | Petroleum | Sewage | Waste Management | Marina Management | Stormwater Management | Turf | Total Score | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MAR_D_1301 | Marina | N | 0 | 0 | 100 | 0 | 100 | 20 | 100 | 59 | Open only part of year/ roll-off pump out/ no fueling |

MAR_D_1301 is a seasonal marina located in the Black Marsh subwatershed. No maintenance or fueling operations were present here and sewage pump-out operations are conducted using a portable sewage pump.

#### *4.3.13.6 Large Landowners*

None of the large landowners are present in Black Marsh.

#### *4.3.13.7 Illicit Discharges*

Black Marsh does not contain any rated outfalls. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

#### *4.3.13.8 Stormwater Conversions*

No dry detention pond assessments were conducted in Black Marsh.

#### *4.3.13.9 Shoreline Restoration*

Black Marsh has 3.32 miles of shoreline of which 36% (13 acres) of the 100-foot shoreline buffer is classified as open, pervious area. No shoreline enhancement projects were identified in EPS's Shoreline Enhancement Feasibility Study (EPS 1998). Planting of the open pervious shoreline buffer in Black Marsh is recommended as much of the shoreline consists of residential or park land.

#### *4.3.13.10 Subwatershed Management Strategy*

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-82 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-82.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees.
4. Educate citizens about the benefits and importance of bayscaping, lawn management, and fertilizer reduction.

Municipal Actions

1. Work with the HSI indicated in Table 4-83 and similar businesses to implement appropriate practices for waste management, physical plant management, and stormwater.
2. Provide education to marinas on the benefits of being certified as a MD Clean Marina.
3. Identify open pervious shoreline areas in Black Marsh with the potential for reforestation and preservation.

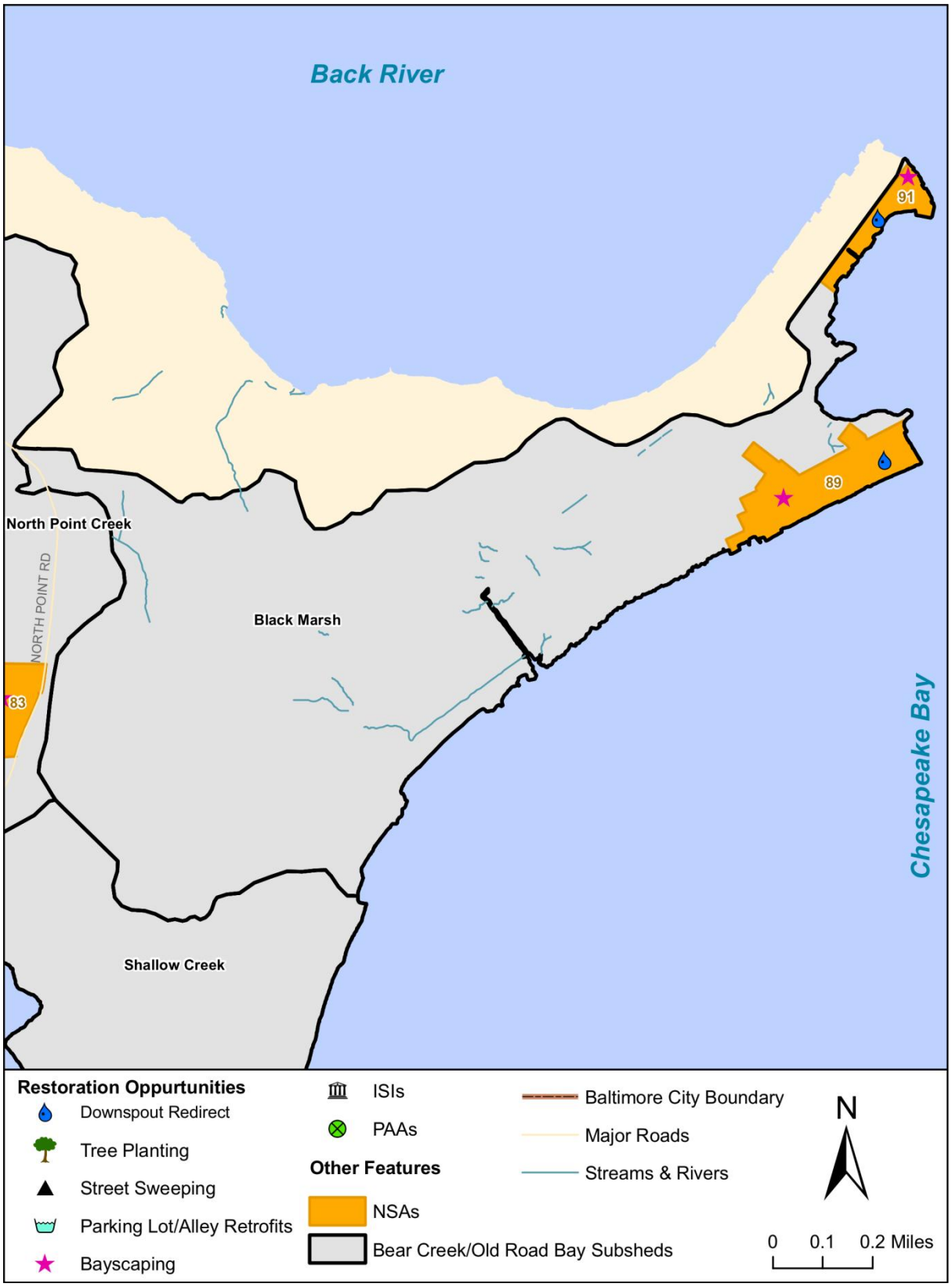


Figure 4-68: Restoration Opportunities in Black Marsh

### 4.3.14 Sparrows Point

Sparrows Point is the largest subwatershed in the Bear Creek/Old Road Bay study area. The majority of the subwatershed is comprised of the urban land use classification of industrial (87%). In addition, 1% of the subwatershed is comprised of the transportation urban land use. The remainder of Sparrows Point consists of forest, water, and wetlands uses. Table 4-85 summarizes key subwatershed characteristics of Sparrows Point.

**Table 4-85: Key Subwatershed Characteristics – Sparrows Point**

| | | |
|---|---|---|
| **Drainage Area** | 2757.9 acres (4.31 sq. mi.) | |
| **Stream Length** | 5.8 miles | |
| **Coastline Length** | 12.6 miles | |
| **Population** | 2 (2010 Census) | |
| **Land Use/Land Cover** | Low Density Residential: | 0.0% |
| | Medium Density Residential: | 0.0% |
| | High Density Residential: | 0.0% |
| | Commercial: | 0.0% |
| | Industrial: | 87.1% |
| | Institutional: | 0.0% |
| | Open Urban: | 0.9% |
| | Forest: | 3.2% |
| | Agriculture: | 0.0% |
| | Water/Wetlands: | 7.3% |
| | Transportation | 1.4% |
| **Impervious Cover** | 27.4% of watershed | |
| **Soils** | A Soils (low runoff potential): | 0.0% |
| | B Soils: | 0.0% |
| | C Soils: | 23.4% |
| | D Soils (high runoff potential): | 75.3% |
| | Water | 1.3% |

#### *4.3.14.1 Neighborhoods*

With the entirety of the subwatershed being encompassed by the RG Steel Sparrows Point facility, no neighborhoods are present in the Sparrows Point subwatershed.

#### *4.3.14.2 Hotspots*

No hotspot assessments were conducted within the Sparrows Point subwatershed. The RG Steel Sparrows Point facility, which qualifies as a hotspot is discussed in this section under Large Landowners." Two (2) NPDES-permitted facilities, an industrial facility and a shipyard, reside in the Sparrows Point subwatershed.

#### 4.3.14.3 Institutions

No institutions were assessed in Sparrows Point.

#### 4.3.14.4 Pervious Areas

No pervious areas were assessed in Sparrows Point.

#### 4.3.14.5 Marinas

No marinas were assessed in Sparrows Point.

#### 4.3.14.6 Large Landowners

The Sparrows Point facility sits on 3,098 acres located almost entirely in the Sparrows Point subwatershed with a small portion extending into the Jones Creek subwatershed. Formerly owned by RG Steel Sparrows Point, LLC, the facility operated as a steel-making operation producing flat-rolled steel for construction, appliance, automotive and other markets (RG Steel, LLC). In August of 2012, a U.S. Bankruptcy Court granted RG Steel approval to sell the property, and the facility was auctioned and purchased by Environmental Liability Transfer Inc., Commericial Development Co., and Hilco Trading Co (Bathon).

Because of the extensive work done by the US EPA and MDE regarding pollution prevention and remediation at Sparrows Point, a specific site visit to the facility was not conducted. Instead, a summary of the key points of the consent decree can be found in the *Bear Creek/Old Road Bay Watershed Characterization Report* in Appendix E.

Changes in ownership at the Sparrows Point facility have been frequent in the recent past. Although the future of steel production activites at the site is in jeopardy, environmental remediation and adherence to the terms of the Consent Decree document will be required of any current and future owners of the property. Baltimore County will continue the dialogue with MDE to track the pollutant removal efficiency of existing and future restoration practices as well as explore partnership options for future offsite improvement measures.

**Table 4-86: Large Landowners – Sparrows Point**

| Site ID | Name | Acres |
|---|---|---|
| LLO_D_1401 | Sparrows Point Facility | 3098 |

#### 4.3.14.7 Illicit Discharges

Sparrows Point does not contain any rated outfalls. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

#### 4.3.14.8 Stormwater Conversions

No dry detention pond assessments were conducted in Sparrows Point.

#### *4.3.14.9 Shoreline Restoration*

Sparrows Point has 12.64 miles of shoreline of which 77% (76.9 acres) of the 100-foot shoreline buffer is classified as open, pervious area. One (1) shoreline enhancement project was identified in EPS's Shoreline Enhancement Feasibility Study (EPS 1998). The 10,000 linear foot reach from Country Club to Lloyd Point was identified as having potential for beneficial use of dredged material. Further shoreline enhancement in this area would be difficult due to the large industrial presence in the subwatershed.

#### *4.3.14.10 Subwatershed Management Strategy*

Municipal Actions

1. Work with EPA and MDE to expedite remediation of contaminated groundwater soils and sediments at the Sparrows Point facility.
2. Coordinate with the Maryland Ports Administration on its proposed Coke Point project at the Sparrows Point facility.

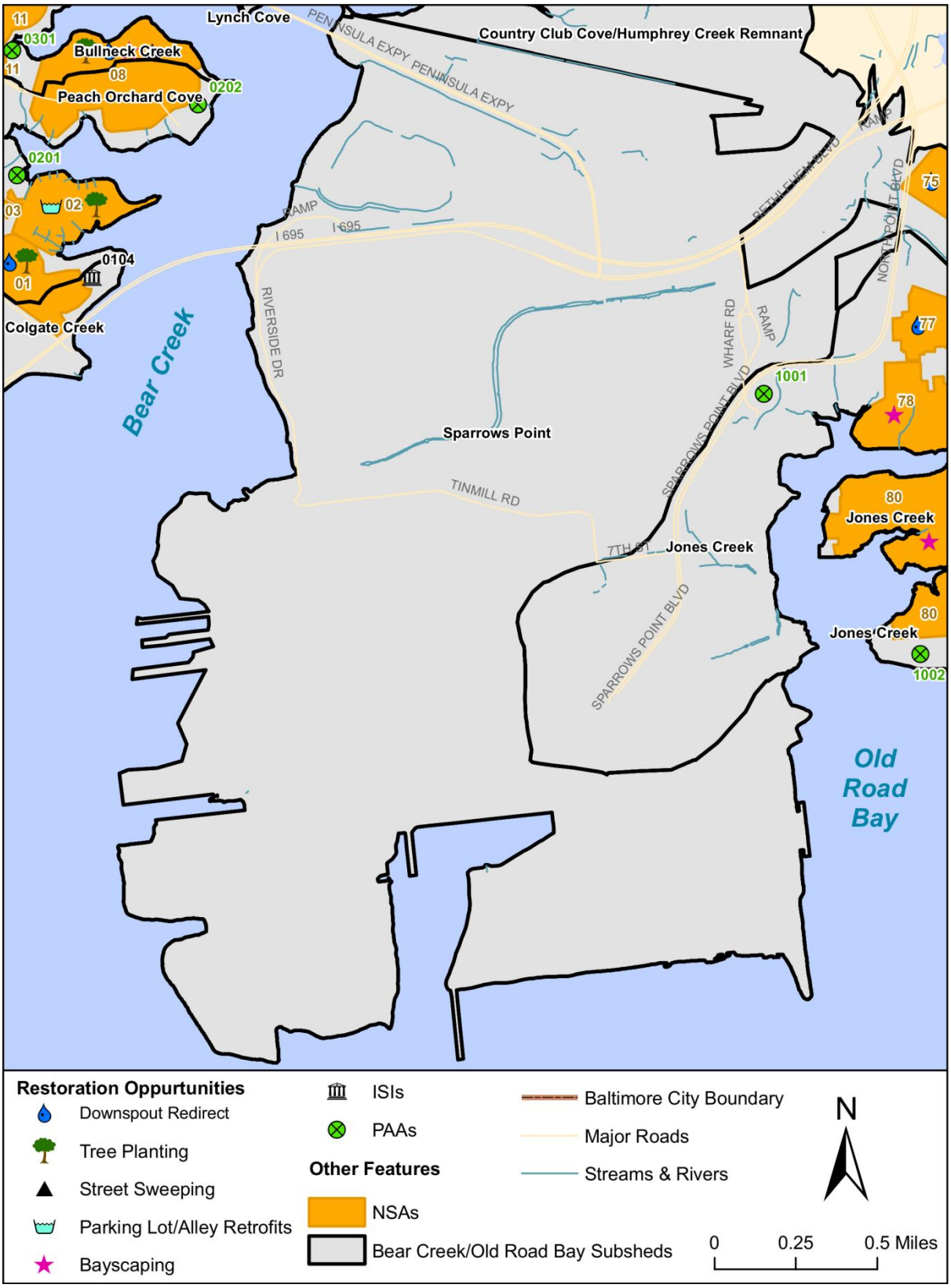


Figure 4-69: Restoration Opportunities in Sparrows Point

## 4.4 Stormwater Retrofit Opportunities

Because multiple stormwater retrofit opportunities were identified through the SWAP study area, Table 4-87 provides a summary of the subwatershed location and assessment category of each.

**Table 4-87: Stormwater Retrofit Subwatersheds and Assessment Category**

| SUBWATERSHED | NSAs | ISIs | PAAs |
|---|---|---|---|
| Colgate Creek | NSA_D_29 | ISI_D_0102<br>ISI_D_0103<br>ISI_D_0104 | |
| Peach Orchard Cove | NSA_D_02 | ISI_D_0201 | PAA_D_0201 |
| Bullneck Creek | NSA_D_14 | | PAA_D_0302 |
| Lynch Cove | | *ISI_D_0403<br>ISI_D_0404 | |
| Chink Creek | | ISI_D_0501 | |
| Bear Creek Headwaters | | *ISI_D_0601 | |
| Charlesmont/Tobasco Coves | | ISI_D_0701 | |
| Oakleigh/Schoolhouse Coves | | ISI_D_0801 | |
| Country Club Cove/ Humphrey Creek Remnant | | | |
| Jones Creek | NSA_D_90 | ISI_D_1001 | |
| North Point Creek | | | |
| Shallow Creek | | | |
| Black Marsh | | | |
| Sparrows Point | | | |

*Sites with Potential for Stream Restoration

## 4.5 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 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 Bear Creek/Old Road Bay to help keep a balance between encouraging recreational boat use and SAV growth.

## 4.6 Watershed-Wide Strategies

Some of the action strategies described in Chapter 3 and Appendix A apply to the entire watershed and were not 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 promotion of advertisements of the Clean Marina Initiative and Clean Boater program. Because all of the subwatersheds in the study have tidal shoreline, most with residential boat docks if not commercial marinas, clean boating practices is a study-wide issue.

***Citizen-based Strategies:*** Actions associated with citizen awareness and participation also relate to the entire watershed in order to promote a positive perception of Bear Creek/Old Road Bay 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 Bear Creek/Old Road Bay SWAP is based on an implementation schedule with an anticipated endpoint of 2025 and an intermediate milestone of 2017. This timeframe is necessary to implement restoration measures and meet the Chesapeake Bay TMDL. The ability to implement this plan within the specified timeframe is dependent upon the availability of staff and sufficient funding. The Bear Creek/Old Road Bay SWAP Implementation Committee (an outgrowth of the Steering Committee) will meet twice per year to assess progress in meeting watershed goals and objectives and to discuss funding options. In addition, completed projects will be recorded in the County's annual NPDES report. An adaptive management approach will be used to meet watershed goals and objectives based on SWAP evaluation data. The Bear Creek/Old Road Bay SWAP Implementation Committee will initiate a revision of the plan within six months if additional TMDLs are developed and approved or when a water quality issue arises.

Progress and success of the Bear Creek/Old Road Bay SWAP will be evaluated during implementation based on the following: interim measurable milestones, pollutant load reduction criteria, implementation tracking, and monitoring. These evaluation components are described in the following sections.

## 5.2 Interim Measurable Milestones

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

## 5.3 Pollutant Load Reduction Criteria

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

## 5.4 Implementation Tracking

Implementation of restoration actions for the Bear Creek/Old Road Bay SWAP will be overseen by the Implementation Committee (an outgrowth of the Steering Committee). The committee will assess progress with individual actions related to the amount complete and the ease of implementation. Overall progress with meeting pollutant reductions will also be assessed. Adaptive management will allow the committee to discuss changes to the action schedule depending on the success of individual

actions and the overall progress with the plan. If additional water quality issues arise, the Bear Creek/Old Road Bay SWAP Implementation Committee will initiate revisions of the plan.

Progress and success of the Bear Creek/Old Road Bay SWAP will be evaluated based on the following: interim measurable milestones, pollutant load reduction criteria, implementation tracking and monitoring. These evaluation components are described in the following sections.

## 5.5 Monitoring

Baltimore County currently conducts water quality monitoring programs within the Middle Bear Creek/Old Road Bay planning area. Additional monitoring is anticipated to assess the effectiveness of restoration projects and progress in meeting nutrient TMDL reductions.

### 5.5.1 Existing Monitoring

Baltimore County conducts chemical, biological, and illicit connection monitoring within the Bear Creek/Old Road Bay watershed. These are described in detail in Chapter 3.4 of the *Watershed Characterization Report* (Appendix E) and listed below:

- Patapsco/Back Rivers Basin Tributary Strategy Data – 1 long-term water monitoring station in the tidal waters of the Patapsco River to measure levels of nutrients, algal abundance, suspended solids, water clarity, dissolved oxygen, turbidity, fluorescence, water temperature, salinity, and pH.

- SAV Monitoring – Baltimore County conducts annual SAV surveys measuring SAV distribution, density, and species to calculate overall SAV coverage in Bear Creek/Old Road Bay.

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

- Tidal Water Random Point Biological Monitoring Program – Baltimore County is initiating a monitoring program that focuses on the tidal water benthic community. The tidal waters in Bear Creek/Old Road Bay will be monitored every other year.

### 5.5.2 SWAP Implementation Monitoring

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

# CHAPTER 6: REFERENCES

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

Baltimore County Department of Environmental Protection and Sustainability (EPS). June 2010. *Master Plan 2020: Water Resources Element.* Prepared by Baltimore County.

Baltimore County. June, 2010. *Water Resources Element (WRE) Technical Memo-B: Pollutant Loading Analysis.* Prepared by Baltimore County, Maryland. Submitted to Maryland Department of Planning.

Baltimore County Department of Environmental Protection and Sustainability (EPS). August 2011. *NPDES – Municipal Stormwater Discharge Permit 2011 Annual Report.* DRAFT

Baltimore County Department of Environmental Protection and Sustainability (EPS). November 2011. *Baltimore County Phase II Watershed Implementation Plan*.

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

Maryland Department of the Environment (MDE). August 2004. *Water Quality Analyses of Chromium in the Inner Harbor/Northwest Branch and Bear Creek Portions of Baltimore Harbor in Baltimore City and Baltimore County, Maryland*.

Maryland Department of the Environment (MDE). September 2004. *Water Quality Analyses for Lead in the Inner Harbor/Northwest Branch and Zinc in the Inner Harbor/Northwest Branch and Bear Creek Portions of Baltimore Harbor in Baltimore City and Baltimore County, Maryland*.

Maryland Department of the Environment (MDE). December 2007. *Total Maximum Daily Loads of Nitrogen and Phosphorus for the Baltimore Harbor in Anne Arundel, Baltimore, Carroll and Howard Counties and Baltimore City, Maryland*.

Maryland Department of the Environment (MDE). May 2009. *Maryland Stormwater Design Manual, Volumes I and II.*

Maryland Department of the Environment (MDE). December 2010. *Total Maximum Daily Load (TMDL) Documentation for Chlordane in Baltimore Harbor*.

Maryland Department of Agriculture (MDA). 2011. *Fact Sheet: The Fertilizer Act of 2011*. Website: http://www.mda.state.md.us/pdf/FertilizerLaw_Facts_final.pdf

Maryland Department of the Environment (MDE). June 2011. *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated: Guidance for National Pollutant Discharge Elimination System Stormwater Permits (DRAFT).*

Maryland Departments of the Environment and of Natural Resources. April 2010. The 2010 Integrated Report of Surface Water Quality in Maryland.

# APPENDIX A:

## Bear Creek/Old Road Bay Action Strategies

# Bear Creek/Old Road Bay Action Strategies

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

***Action***

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

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

***Basis for Performance Measure***

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

***Timeline***

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

***Performance Measure***

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

***Unit Cost***

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

***Responsible Party***

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

1. Baltimore County
2. Dundalk Renaissance Corporation (DRC)
3. Eastfield/Stanbrook Community (ESC)
4. Turners Station Conservation Team (TSCT)
5. Baltimore County Marine Trade Association (BCMTA)
6. Maryland Port Administration (MPA)
7. SWAP Implementation Committee

Table A-2: Bear Creek/Old Road Bay Action Strategies – Action Detail Matrix

| | Action | Basis for Performance Measure | Performance Measure | Total Number Units | Period 1 9/12-6/13 | Period 2 7/13-6/15 | Period 3 7/15-6/17 | Period 4 7/17-6/19 | Period 5 7/19-6/21 | Period 6 7/21-6/23 | Period 7 7/23-6/25 | Unit Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **RESTORATION ACTIONS** | | | | | | | | | | | | |
| | ***Nutrient Reduction*** | | | | | | | | | | | |
| 1 | Replace lawns with bayscapes in the 23 neighborhoods identified. | Conduct 8 bayscaping education events targeting 3 neighborhoods per event (114.7 acres of lawn identified for bayscaping x 2% participation rate = 2.3 acres) | 2% participation x 223.8 acres | 8 events | 1 events | 2 events | 2 events | 2 events | 1 events | | | $500 / event |
| 2 | Continue municipal road maintenance street sweeping activities. Investigate the 5 neighborhoods recommended for street sweeping to implement activities and/or adjust frequency as needed. | 44.7 miles of road within neighborhoods identified for street sweeping | 100% participation x 44.7 miles | 44.7 miles | 44.7 miles | 44.7 miles | 44.7 miles | 44.7 miles | 44.7 miles | 44.7 miles | 44.7 miles | Existing Staff |
| | ***Stormwater Management*** | | | | | | | | | | | |
| 3 | Investigate the potential conversion of 6 existing dry detention ponds to enhanced water quality treatment. | 6 out of 9 existing detention ponds identified as having physical expansion capability x assume 100% projected participation = 6 conversions | 9 conversions x 67% participation | 6 conversions | | 2 conversions | 2 conversions | 2 conversions | | | | $3,200 / acre |
| 4 | Investigate the feasibility of implementing stormwater retrofits to treat runoff from impervious surfaces (parking lots, alleys) in the 3 neighborhoods identified. | 3 potential neighborhood sites identified | 3 neighborhoods investigated | 3 investigations | 2 investigations | 3 investigations | | | | | | Existing Staff |
| 5 | Investigate the feasibility of implementing stormwater retrofits for parking lots and/or inlets at the 11 institutional sites identified (8 public, 3 private). | 11 potential institution sites identified | 11 institutions investigated | 11 investigations | 6 investigations | 12 investigations | | | | | | Existing Staff |
| 6 | Design and implement stormwater retrofits at feasible sites identified in Actions 4 and 5. | 3 neighborhoods + 11 institutions = 14 sites identified x 50% participation rate = 7 stormwater retrofits | 50% participation x 14 retrofit sites | 7 sites | | 2 sites | 2 sites | 2 sites | 1 sites | | | $50,000 / retrofit |
| 7 | Work with institutional partners to reduce impervious cover at the 10 institutional sites identified (10 public, 1 private). | Maximum potential of 1.42 acres of impervious cover removal identified x 75% participation rate; Work with institutions to remove impervious cover and meet 1.1 acres reduction goal | 75% participation x 1.42 acres | 1.1 acres | | 0.54 acres | 0.54 acres | | | | | $25,000 / acre |
| 8 | Develop and implement a downspout disconnection program. Use rainbarrels, rain gardens, and/or redirection for downspout disconnection in the 76 recommended neighborhoods. | 288 acres of impervious rooftop identified x 67% participation rate = 193 acres | 67% participation x 288 acres | 192.8 acres | 14.8 acres | 29.7 acres | 29.7 acres | 29.7 acres | 29.7 acres | 29.7 acres | 29.7 acres | $150 / house |
| | ***Urban Tree Canopy*** | | | | | | | | | | | |
| 9 | Investigate the feasibility of planting riparian stream buffers on open pervious land. | 227 acres of open pervious land identified within the 100-foot stream buffer through GIS analysis. | Feasible buffer planting sites identified | 227 acres | 113 acres investigated | 114 acres investigated | | | | | | Existing Staff |
| 10 | Investigate the feasibility of planting riparian shoreline buffers on open pervious land. | 360 acres of open pervious land identified within the 100-foot shoreline buffer through GIS analysis. | Feasible buffer planting sites identified | 360 acres | 180 acres investigated | 180 acres investigated | | | | | | Existing Staff |
| 11 | Reforest stream buffer at feasbile sites with a minimum width of 35 feet. | 227 acres of open pervious stream buffer identified in the GIS analysis x 20% participation rate =45 acres | 20% participation x 227 acres | 45 acres | 3.5 acres | 7.0 acres | 7.0 acres | 7.0 acres | 7.0 acres | 7.0 acres | 7.0 acres | $15,000 / acre |
| 12 | Reforest shoreline buffer at feasbile sites with a minimum width of 35 feet. | 360 acres of open pervious shoreline buffer identified in the GIS analysis x 10% participation rate = 36 acres | 10% participation x 360 acres | 36 acres | 2.8 acres | 5.5 acres | 5.5 acres | 5.5 acres | 5.5 acres | 5.5 acres | 5.5 acres | $15,000 / acre |
| 13 | 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.) | 20 acres of PAA sites with open pervious cover & minimal site prep required x 90% participation rate = 18.1 acres | 90% participation x 20 acres | 18.1 acres | 1.4 acres | 2.8 acres | 2.8 acres | 2.8 acres | 2.8 acres | 2.8 acres | 2.8 acres | $6,000 / acre |
| 14 | Encourage street and shade tree planting in the 38 recommended neighborhoods. | Maximum potential of 7,299 trees x (1 acre/400 trees) = 18.2 acres x 75% participation rate = 13.6 acres (or 5,474 trees) | 75% participation x 18.2 acres | 5474 trees | 421 trees | 842 trees | 842 trees | 842 trees | 842 trees | 842 trees | 842 trees | $175 / tree |
| 15 | Encourage institutions to plant trees on available open space at the 31 sites identified. | Maximum potential of 4,864 trees x (1 acre/400 trees) = 12.2 acres x 88% participation rate = 10.7 acres (or 4,281 trees) | 88% participation x 4,864 trees | 4281 trees | 329 trees | 659 trees | 659 trees | 659 trees | 659 trees | 659 trees | 659 trees | $175 / tree |
| 16 | Baltimore County shall continue to require riparian buffers and forest conservation for all new and re-development. | On-going, keep track of existing riparian buffer and forest preserved | Acres preserved | On-going | On-going | On-going | On-going | On-going | On-going | On-going | On-going | Existing Staff |
| 17 | Maintain trees planted at reforestation/tree planting sites. | Tree maintenance (watering, mowing, weeding, etc.) is required for the first 5 years to ensure successful growth; projected number of acres to be reforested/planted: 79+126+10+7.3+.5 = 223 acres (max 626 acres) | Maintain 223 acres | Maintain | Maintain | Maintain | Maintain | Maintain | Maintain | Maintain | Maintain | $1,300 / acre |

Responsible Parties:

1. Baltimore County
2. DRC
3. ESC
4. TSCT
5. BCMTA
6. MPA
7. MSA
8. SWAP Implementation Committee

Table A-2: Bear Creek/Old Road Bay Action Strategies – Action Detail Matrix

| | Action | Basis for Performance Measure | Performance Measure | Total Number Units | Period 1 9/12-6/13 | Period 2 7/13-6/15 | Period 3 7/15-6/17 | Period 4 7/17-6/19 | Period 5 7/19-6/21 | Period 6 7/21-6/23 | Period 7 7/23-6/25 | Unit Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | Improve forest health by removing exotic invasive species. | Remove 1 acres of exotic species per year | Remove 8 acres of exotic species | 8.0 acres | 1.0 acres | 2.0 acres | 2.0 acres | 2.0 acres | 2.0 acres | 2.0 acres | 2.0 acres | $1,300 / acre |
| 19 | Continue revitalization and redevelopment of Baltimore County Communities incorporating an increase of parkland. Develop a tracking system and track associated load reductions | 1.191 acres of redevelopment opportunity identified x 67% redevelopment | Redevelop 67% of ,1,191 acres of urban area | 798.0 acres | 61.4 acres | 122.8 acres | 122.8 acres | 122.8 acres | 122.8 acres | 122.8 acres | 122.8 acres | Existing Staff |
| | ***Trash Management*** | | | | | | | | | | | |
| 20 | Post no dumping signs in problem areas identified and enforce no dumping. | Signs posted; Upland sites identified with trash management/dumping issues: 22 neighborhoods + 11 hotspots + 15 institutions = 48 sites | Post 20% of signs per year | 48 signs | 10 signs | 19 signs | 19 signs | | | | | $40 / sign |
| 21 | Identify areas where additional trash cans, covered receptacles, and/or better maintenance measures are needed. | Assess bus stops and community parks in the watershed. | Problem areas identified and addressed | Identification | Identify | Identify | | | | | | Existing Staff |
| 22 | Implement recycling and add separate receptacles for recycling on public properties such as parks. | Implement recycling in County parks | Address community parks | TBD | | Implement | Implement | | | | | Existing Staff |
| 23 | Encourage and support community cleanups in neighborhoods. | 18 neighborhoods identified as having trash management issues | 2-3 community cleanups per year | 18 cleanups | 4-6 cleanups | 4-6 cleanups | 4-6 cleanups | 4-6 cleanups | 4-6 cleanups | 4-6 cleanups | 4-6 cleanups | Existing Staff |
| 24 | Encourage and support waterway cleanups in streams and tidal areas. | Conduct annual stream and tidal area cleanups. | 1 cleanup per year | 8 cleanups | 2 cleanups | 2 cleanups | 2 cleanups | 2 cleanups | 2 cleanups | 2 cleanups | 2 cleanups | |
| 25 | Support and expand Baltimore County's "Clean Green County" initiative | Average residential recycling rate of at least 50% | 50% residential recycling rate | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 26 | Develop and implement signs and educational material for the trash campaign in the watershed. | Develop signs and post throughout watershed; | Develop material, post signs | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | $9,000 / year |
| 27 | Develop a trash treaty for institutions, public properties and neighorhoods. | Develop signs and post throughout watershed | Develop material, post signs | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 28 | Encourage institional partners, community groups, and patrons of public properties to sign and support a trash treaty. | Have sign-up events | 1 sign-up event per year | 8 events | 1 event | 2 events | 2 events | 2 events | 1 event | | | Existing Staff |
| 29 | Develop a County-wide Trash Reduction Strategy and a trash reduction tracking mechanism | Trash Reduction Strategy and tracking mechanism develped by 2013 | Develop Strategy & mechanism | Develop | | | | | | | | Existing Staff |
| | ***Tidal Waters*** | | | | | | | | | | | |
| 30 | Install and maintain navigation channel markers to prevent encroachment from boats into SAV and habitat areas. | Continue to support marked channels | Channel markers maintained | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 31 | Evaluate potential locations for wetland creation and enhancement throughout the watershed. | Identify feasible tidal areas and plant species | Feasible planting sites identified | Identification | Identify | Identify | | | | | | Existing Staff |
| 32 | Implement wetland plantings at feasible sites. | Feasible wetland creation implemented | Planting at feasible sites | TBD | | | | | Implement | | | Existing Staff |
| 33 | Evaluate shoreline enhancement project potential of the 6 sites identified in Bear Creek/Old Road Bay as part of DEPRM's Shoreline Feasibility Study. | 6 potential shoreline enhancement site identified in the Shoreline Feasibility Study | Feasible shoreline sites identified | Assess site | | Assess sites | | | | | | Existing Staff |
| 34 | Implement shoreline enhancement projects at feasible sites. | Maximum potential of 23,700 feet of shoreline restoration x 75% participation; Complete 4 shoreline enhancement projects | 75% participation x 23,700 LF | 17775 LF | 1367 LF | 2735 LF | 2735 LF | 2735 LF | 2735 LF | 2735 LF | 2735 LF | $1,000,000 / project |
| 35 | Investigate solutions to erosion problems at Stansbury Pond and implement countermeasures | Implement countermeasures at Stansbury Pond | 400 LF shoreline restoration | 400 LF | | 400 LF | | | | | | Existing Staff |
| | ***Stream Corridor Restoration*** | | | | | | | | | | | |
| 36 | Identify eroded stream banks and channel alterations with feasible restoration potential. | Investigate potential stream restoration sites | Feasible restoration sites identified | Identification | | Identify | | | | | | Existing Staff |
| 37 | Complete stream restoration projects at feasible sites. | Complete stream restoration projects at feasible sites. | Feasible sites restored | TBD | | | | | Implement | | | Existing Staff |
| | ***Land Preservation*** | | | | | | | | | | | |
| 38 | Identify lands available for permanent conservation and preservation. | Develop a catalog of lands within the 100-foot stream and shoreline buffers available to permanent conservation and preservation. | Available land identified | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39 | Work with private property owners to undertake perpetual land conservation easements on currently undeveloped properties. | Identify and assist privately-owned properties within the 100-foot stream and shorline buffers move to permanent conservation and preservation | 10% of available land parcels conserved | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 40 | Acquire undeveloped parcels for permanent conservation and preservation | Identify forested parcels within the 100-foot stream and shorline buffers and facilitate perservation and conservation through agencies. | 10% of available land parcels conserved | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| | ***Coordination*** | | | | | | | | | | | |
| 41 | Work with the Maryland Ports Administration to identify partnership opportunities on potential retrofit projects | Identify potential partnership projects | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 42 | Work with the Maryland Ports Administration to improve environmental conditions at deep water port facilities | Coordinate with MPA | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 43 | Coordinate with the Maryland Ports Administration on its proposed Coke Point project at the Sparrows Point facility. | Coordinate with MPA | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 44 | Work with State agencies to expedite remediation of contaminated groundwater soils and sediments at the Sparrows Point facility | Coordinate with appropriate state agencies | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 45 | Work with industrial partners to implement stormwater BMPs and reduce impervious cover at the industrial sites identified. | Conduct annual meetings with industrial site owners to discuss feasibility of impervious cover removal | 1 industrial facility meeting per year | 13 meetings | 1 meetings | 2 meetings | 2 meetings | 2 meetings | 2 meetings | 2 meetings | 2 meetings | Existing Staff |
| **OUTREACH & AWARENESS** | | | | | | | | | | | | |
| 46 | Distribute pollution prevention information to facilities falling within hotspot categories and marinas identified in the watershed and provide guidance/workshops. Include working with business partners to cut off stream access in areas with dumping issues and encourage them to keep parking lots free of trash and debris. | 22 hotspot sites assessed; Categories identified: shopping centers, auto-related facilities, industrial facilities, construction facilities, and marinas; Conduct 2 workshops and distribute outreach material | 1 workshop every 3 years | 4 workshops | 1 workshop | | 1 workshop | | 1 workshop | 1 workshop | | $500 / workshop |
| 47 | Distribute information to the public and to facilities near waterways on the benefits of living shorelines and SAVs. | Conduct watershed tour and distribute educational information. | Conduct tour | 1 tour | 1 tour | | | | | | | Existing Staff |
| 48 | Locally recognize the 2 marinas that are certified Maryland Clean Marinas and encourage the remaining marinas to participate in the Clean Marina Initiative. | Advertise Clean Marina Initiative and participating marinas in local newspapers | 1 advertisement per year | 8 advertisement | 1 ad | 2 ads | 2 ads | 2 ads | 1 ad | | | $40/ad |
| 49 | Increase citizen awareness of Clean Boater Pledge Program | Advertise Clean Boater Program in local newspapers | 1 advertisement per year | 8 advertisement | 1 ad | 2 ads | 2 ads | 2 ads | 1 ad | | | $40/ad |
| 50 | Form partnerships with community groups and discuss the BMP recommendations from the neighborhood assessments and implementation options. | 91 neighborhoods assessed - target at least 3 neighborhoods per informational meeting | 2 neighborhood meetings per year | 26 meetings | 2 meetings | 4 meetings | 4 meetings | 4 meetings | 4 meetings | 4 meetings | 4 meetings | $500 / meeting |
| 51 | Form partnerships with institutions and discuss the BMP recommendations from the institutional assessments and implementation options. Include implementing/enhancing recycling programs on their properties. | 19 institutions assessed | 3-4 institution meetings per year | 24-32 meetings | 6-8 meetings | 9-12 meetings | 9-12 meetings | 9-12 meetings | 6-8 meetings | | | Existing Staff |
| 52 | Work with community groups to install storm drain markers in the 68 recommended neighborhoods. | Install markers in 68 neighborhoods identified | 5-6 neighborhoods per year | 68 sites | 5 sites | 11 sites | 11 sites | 11 sites | 10 sites | 10 sites | 10 sites | $11 / event (site) |
| 53 | Work with institutional sites to install storm drain markers at the 17 recommended sites. | Install markers at 17 institutions identified | 1-2 institutions per year | 17 sites | 1 sites | 3 sites | 3 sites | 3 sites | 3 sites | 2 sites | 2 sites | $11 / event (site) |
| 54 | 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) | 1 tour per 5 years | 2 tours | | 1 tour | | 1 tour | | | | Existing Staff |
| 55 | Develop and distribute public awareness materials that promote the use of public access to Bear Creek, Old Road Bay, and Shallow Creek. | Develop and distribute material; work with marinas to produce materials and include marina locations. | 2 signs per year | 26 signs | 2 signs | 4 signs | 4 signs | 4 signs | 4 signs | 4 signs | 4 signs | Existing Staff |
| 56 | Support the completion of the Star Spangled Banner National Historic Trail to create access for pedestrians, cyclists, and water-related recreation. | Provide support to connections to the waterfront along the Star Spangled Banner National HistoricTrail | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 57 | Develop water trails that connect with Bay Gateways in the area. | Develop map, brochures, and signs for water trail | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 58 | Address bootleg marinas | Identify sites and require proper zoning, removal of slips, and fines | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 59 | Increase agency collaboration through in-house meetings | Conduct 4 meetings with County Economic Development agency | 2 meetings per year | | 2 meetings | 2 meetings | | | | | | Existing Staff |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 60 | Conduct water trail tours for community groups including description of public access points, navigation channel markings, shoreline/wetland enhancement project(s), etc. | Conduct annual educational tours | 1 tour per year | | 1 tour | 2 tours | 2 tours | 2 tours | 2 tours | | | Existing Staff |
| 61 | Support the MD Green School Program and the Green Ribbon Schools Program | Increase the number of Environmental Education Certifications and Green Ribbons Schools Awards at schools in the study area | 1 certification per year | 13 certifications | 1 certification | 2 certifications | 2 certifications | 2 certifications | 2 certifications | 2 certifications | 2 certifications | Existing Staff |
| 62 | Increase the number of meaningful watershed experiences for youth in the planning area. | Provide annual watershed experiences through school activities. | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| **MONITORING** | | | | | | | | | | | | |
| 63 | Continue to monitor and remove illicit connections through the Illicit Connections Program | Inspect all 10 of the non-prioritized outfalls within 2 years and the 19 priority 1 or 2 outfalls according to their designated inspection schedule | 5 routine inspections per year | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 64 | Continue monitoring hotspots through upland surveys in the watershed | Complete inspections on X hotspots and provide recommendations on pollution prevention measures | X hotspot inspections per year | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 65 | 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 | 13 miles of stream adopted | 13 miles of stream | 1 mile adopted | 2 miles adopted | 2 miles adopted | 2 miles adopted | 2 miles adopted | 2 miles adopted | 2 miles adopted | Existing Staff |
| 66 | Continue stormwater facility maintenance and inspection program | Assure continued function of Stormwater Facilities as required as part of the NPDES MS4 permit. | Continue routine inspections | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 67 | Continue to work with teachers to develop water quality monitoring activities for students at Baltimore County public schools. | Identify schools with potential opportunities for program implementation | Monitoring activities implemented | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 68 | Monitor nitrogen and phosphorus levels within the planning area | Complete annual monitoring of nutrient levels in the planning area | Annual monitoring | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 69 | Monitor SAV coverage in the watershed annually. | SAV coverage is monitored yearly and reports are produced quantifying % coverage in tidal waters | Yearly reports | 13 reports | 1 report | 2 reports | 2 reports | 2 reports | 2 reports | 2 reports | 2 reports | Existing Staff |
| 70 | Work with DNR to monitor deer population in the watershed | White-tailed deer populations monitored yearly and biannual reports are produced by Maryland Department of Natural Resources | Biannual reports | 7 reports | 1 report | 1 report | 1 report | 1 report | 1 report | 1 report | 1 report | Existing Staff |
| **FUNDING** | | | | | | | | | | | | |
| 71 | Coordinate grant funding requests to secure funding and implement restoration projects to meet TMDL nutrient reductions requirements. | Seek a minimum of 1 grant per year to meet nutrient reduction goals within 13 years | 1 grant proposal per year | 13 proposals | 1 proposal | 2 proposals | 2 proposals | 2 proposals | 2 proposals | 2 proposals | 2 proposals | Existing Staff |
| 72 | Support an increase in funding for the Baltimore County - Green Building Tax Credit Program as a model. | Work with Baltimore County Department of Economic Development to lobby for increase in funding | Lobby | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 73 | Support an increase in funding requests for environmental education in the watershed | Seek a minimum of 1 grant per year to improve environmental education within 13 years | 1 grant proposal per year | 13 proposals | 1 proposal | 2 proposals | 2 proposals | 2 proposals | 2 proposals | 2 proposals | 2 proposals | |
| 74 | Develop a stormwater management utility fee for Baltimore County applicable to the planning area. | Develop stormwater management utility fee by July, 2013 | Fee developed by 7/13 | 1 Utility Fee | Develop | | | | | | | Existing Staff |
| 75 | Coordinate with industrial sites in the watershed to obtain funding on potential restoration partnership projects. | Funding for partnership projects obtained | Funding | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing | Existing Staff |
| 76 | Support an increase in applications for the Maryland Department of Natural Resources Land Conservation Programs including Program Open Space, Rural Legacy, and Maryland Environmental Trust | Submit a minimum of 1 application per year | 1 application per year | 13 applications | 1 application | 2 applications | 2 applications | 2 applications | 2 applications | 2 applications | 2 applications | Existing Staff |
| **REPORTING** | | | | | | | | | | | | |
| 77 | Bear Creek/Old Road Bay SWAP Implementation Committee will meet to discuss implementation progress and assess any changes needed to meet the goals. | Conduct meetings in a semi-annual basis | 2 meetings per year | 26 meetings | 2 meetings | 4 meetings | 4 meetings | 4 meetings | 4 meetings | 4 meetings | 4 meetings | Existing Staff |
| 78 | Develop a unified restoration tracking system to track progress toward meeting TMDL reduction requirements. | Tracking system currently being developed for similar SWAPs (e.g., Back River, Jones Falls) | Tracking system developed | On-going | On-going | On-going | On-going | On-going | On-going | Ongoing | Ongoing | Existing Staff |
| 79 | Update the status of citizen-based restoration projects and BMPs on an annual basis | Provide progress update in annual NPDES Report. | NPDES annual report | Annual Reports | 1 Annual Report | 2 Annual Reports | 2 Annual Reports | 2 Annual Reports | 2 Annual Reports | 2 Annual Reports | 2 Annual Reports | Existing Staff |
| 80 | Continue to update status of County capital budget restoration projects and BMPs | Provide progress update in annual NPDES Report. | NPDES annual report | Annual Reports | 1 Annual Report | 2 Annual Reports | 2 Annual Reports | 2 Annual Reports | 2 Annual Reports | 2 Annual Reports | 2 Annual Reports | Existing Staff |

Responsible Parties:

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6. MPA
7. MSA
8. SWAP Implementation Committee

Table A-2: Bear Creek/Old Road Bay Action Strategies – Goal Objective Matrix

| | Action | Respons. Party* | Goal 1 | | | | | Goal 2 | | | | | | | | | | Goal 3 | | | | | Goal 4 | | | | Goal 5 | | | | | Goal 6 | | | | | Goal 7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 |
| | **RESTORATION ACTIONS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ***Nutrient Reduction*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Replace lawns with bayscapes in the 23 neighborhoods identified. | 1, 2, 3, 4 | X | X | | | | | | | | | | | | | | | | | | | | | | | X | | | | X | | | | | | X | X | |
| 2 | Continue municipal road maintenance street sweeping activities. Investigate the 5 neighborhoods recommended for street sweeping to implement activities and/or adjust frequency as needed. | 1 | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ***Stormwater Management*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Investigate the potential conversion of 6 existing dry detention ponds to enhanced water quality treatment. | 1 | X | X | X | X | X | | | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Investigate the feasibility of implementing stormwater retrofits to treat runoff from impervious surfaces (parking lots, alleys) in the 3 neighborhoods identified. | 1 | X | X | X | X | X | | | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Investigate the feasibility of implementing stormwater retrofits for parking lots and/or inlets at the 11 institutional sites identified (8 public, 3 private). | 1 | X | X | X | X | X | | | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | X | X | |
| 6 | Design and implement stormwater retrofits at feasible sites identified in Actions 4 and 5. | 1 | X | X | X | X | X | | | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | Work with institutional partners to reduce impervious cover at the 10 institutional sites identified (10 public, 1 private). | 1, 2, 3, 4, 7 | X | X | X | X | X | | | | | | | X | X | | | | | | | | | | | | | X | | X | X | | | | | | | | X |
| 8 | Develop and implement a downspout disconnection program. Use rainbarrels, rain gardens, and/or redirection for downspout disconnection in the 76 recommended neighborhoods. | 1, 2, 3, 4, 7 | X | X | | | X | | | | | | | | | | | | | | | | | | | | X | | | | X | | | | | | X | X | |
| | ***Urban Tree Canopy*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Investigate the feasibility of planting riparian stream buffers on open pervious land. | 1 | X | X | | | | X | X | X | | | | | | | | | | | | | X | | | | | | | | | | | | | | X | X | |
| 10 | Investigate the feasibility of planting riparian shoreline buffers on open pervious land. | 1 | X | X | | | | | X | X | X | | | | | | | | | | | | X | | | | | | | | | | | | | | X | X | |
| 11 | Reforest stream buffer at feasbile sites with a minimum width of 35 feet. | 1, 2, 3, 4, 7 | X | X | | | | X | X | X | | | | | | | | | | | | | X | | | | | | | | | | | | | | X | X | |
| 12 | Reforest shoreline buffer at feasbile sites with a minimum width of 35 feet. | 1, 2, 3, 4, 7 | X | X | | | | | X | X | X | | | | | | | | | | | | X | | | | | | | | | | | | | | X | X | |
| 13 | 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.) | 1, 2 | X | X | | | | X | X | X | X | | | | | | | | | | | | | | | | | | | | X | | | | | | X | X | |
| 14 | Encourage street and shade tree planting in the 38 recommended neighborhoods. | 2, 3, 4 | X | X | | | | X | X | X | X | | | | | | | | | | | | | | | | | | | | X | | | | | | X | X | |
| 15 | Encourage institutions to plant trees on available open space at the 31 sites identified. | 2, 3, 4 | X | X | | | | X | X | X | X | | | | | | | | | | | | | | | | | X | | X | X | | | | | | X | X | X |
| 16 | Baltimore County shall continue to require riparian buffers and forest conservation for all new and re-development. | 1 | X | X | | | | X | X | X | X | | | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| 17 | Maintain trees planted at reforestation/tree planting sites. | 1, 2, 3, 4, 7 | X | X | | | | X | X | X | X | | | | | | | | | | | | X | | | | | | | | | | | | | | X | X | |

Responsible Parties:

1. Baltimore County
2. DRC
3. ESC
4. TSCT
5. BCMTA
6. MPA
7. MSA
8. SWAP Implementation Committee

Table A-2: Bear Creek/Old Road Bay Action Strategies – Goal Objective Matrix

| | Action | Respons. Party* | Goal 1 | | | | | Goal 2 | | | | | | | | | | Goal 3 | | | | | Goal 4 | | | | Goal 5 | | | | | Goal 6 | | | | | Goal 7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 |
| 18 | Improve forest health by removing exotic invasive species. | 2, 3, 4 | X | X | | | | X | X | X | X | | | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| 19 | Continue revitalization and redevelopment of Baltimore County Communities incorporating an increase of parkland. Develop a tracking system and track associated load reductions | 1 | X | X | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ***Trash Management*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | Post no dumping signs in problem areas identified and enforce no dumping. | 1 | | | X | | | | | | | | | | | | | X | X | | | | | | | | | | | | | | | | | | X | X | |
| 21 | Identify areas where additional trash cans, covered receptacles, and/or better maintenance measures are needed. | 1 | | | X | | | | | | | | | | | | | X | X | | X | | | | | | | | | | | | | | | | X | X | |
| 22 | Implement recycling and add separate receptacles for recycling on public properties such as parks. | 1 | | | X | | | | | | | | | | | | | X | X | | X | | | | | | | | | | | | | | | | X | X | |
| 23 | Encourage and support community cleanups in neighborhoods. | 1, 2, 3, 4, 7 | | | X | X | | | | | | | | X | X | | | X | X | X | | X | X | | | | | | | | X | | | | | | X | X | |
| 24 | Encourage and support waterway cleanups in streams and tidal areas. | 1, 2, 3, 4, 7 | | | X | | | X | X | | X | | | | | | | | X | X | | X | X | | | | | | | | X | | | | | | X | X | |
| 25 | Support and expand Baltimore County's "Clean Green County" initiative | 1, 2, 3, 4, 7 | | | X | X | | | | | | | | X | X | | | X | X | | X | | | | | | | | | | X | | | | | | X | X | |
| 26 | Develop and implement signs and educational material for the trash campaign in the watershed. | 1 | | | X | X | | | | | | | | X | X | | | X | X | | X | | | | | | | | | | | | | | | | X | X | |
| 27 | Develop a trash treaty for institutions, public properties and neighorhoods. | 1, 2, 3, 4, 5, 6, 7 | | | X | X | | | | | | | | X | X | | | X | X | | X | | | | | | | X | | X | X | | | | | | X | X | X |
| 28 | Encourage institional partners, community groups, and patrons of public properties to sign and support a trash treaty. | 1, 2, 3, 4, 7 | | | X | X | | | | | | | | X | X | | | X | X | | X | | | | | | | X | | X | X | | | | | | X | X | X |
| 29 | Develop a County-wide Trash Reduction Strategy and a trash reduction tracking mechanism | 1 | | | X | X | | | | | | | | X | X | | | X | X | | X | | | | | | | | | | X | | | | | | X | X | |
| | ***Tidal Waters*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 30 | Install and maintain navigation channel markers to prevent encroachment from boats into SAV and habitat areas. | 1 | | | | | | | | | | | X | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| 31 | Evaluate potential locations for wetland creation and enhancement throughout the watershed. | 1 | X | X | | | | | | | | X | | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| 32 | Implement wetland plantings at feasible sites. | 1 | X | X | | | | | | | | X | | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| 33 | Evaluate shoreline enhancement project potential of the 6 sites identified in Bear Creek/Old Road Bay as part of DEPRM's Shoreline Feasibility Study. | 1 | X | X | | | | | X | X | X | | | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| 34 | Implement shoreline enhancement projects at feasible sites. | 1 | X | X | | | | | X | X | X | | | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| 35 | Investigate solutions to erosion problems at Stansbury Pond and implement countermeasures | 1 | | | | | | | | | X | | | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| | ***Stream Corridor Restoration*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 36 | Identify eroded stream banks and channel alterations with feasible restoration potential. | 1 | X | X | | | | X | X | X | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| 37 | Complete stream restoration projects at feasible sites. | 1 | X | X | | | | X | X | X | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| | ***Land Preservation*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 38 | Identify lands available for permanent conservation and preservation. | 1 | | | | | | | | X | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | |

Responsible Parties:

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Table A-2: Bear Creek/Old Road Bay Action Strategies – Goal Objective Matrix

| | Action | Respons. Party* | Goal 1 | | | | | Goal 2 | | | | | | | | | | Goal 3 | | | | | Goal 4 | | | | Goal 5 | | | | | Goal 6 | | | | | Goal 7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 |
| 39 | Work with private property owners to undertake perpetual land conservation easements on currently undeveloped properties. | 1, 2 | | | | | | | | X | | | | | | | | | | | | | X | | | | | | | | X | | | | | | | | |
| 40 | Acquire undeveloped parcels for permanent conservation and preservation | 1, 2 | X | X | | | | | | X | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| | ***Coordination*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 41 | Work with the Maryland Ports Administration to identify partnership opportunities on potential retrofit projects | 1, 6 | | | X | X | X | | | | | | | X | X | | | | | | | | | | | | | | | | | | X | | | | | | |
| 42 | Work with the Maryland Ports Administration to improve environmental conditions at deep water port facilities | 1, 6 | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| 43 | Coordinate with the Maryland Ports Administration on its proposed Coke Point project at the Sparrows Point facility. | 1, 6 | | | X | | X | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| 44 | Work with State agencies to expedite remediation of contaminated groundwater soils and sediments at the Sparrows Point facility | 1, 6 | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | | | | |
| 45 | Work with industrial partners to implement stormwater BMPs and reduce impervious cover at the industrial sites identified. | 1, 6 | | | X | X | X | | | X | | | | X | X | | | | | | | | | | | | | | | | | | X | X | X | | | | |
| | **OUTREACH & AWARENESS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 46 | Distribute pollution prevention information to facilities falling within hotspot categories and marinas identified in the watershed and provide guidance/workshops. Include working with business partners to cut off stream access in areas with dumping issues and encourage them to keep parking lots free of trash and debris. | 1, 2, 3, 4, 5, 7 | X | X | | X | | | | | | | | X | X | | | X | X | | | X | | | | | | | | | | | | | X | X | X | X | |
| 47 | Distribute information to the public and to facilities near waterways on the benefits of living shorelines and SAVs. | 1, 5 | X | X | X | | | | X | | | | X | | | | X | | | | | | X | | | | | | | | X | | | | | | | | |
| 48 | Locally recognize the 2 marinas that are certified Maryland Clean Marinas and encourage the remaining marinas to participate in the Clean Marina Initiative. | 1, 5 | | | | X | | | | | | | | X | X | X | X | | | | | | | | | X | | | | | X | X | | | | | X | X | |
| 49 | Increase citizen awareness of Clean Boater Pledge Program | 1, 5 | | | | X | | | | | | | | X | X | X | X | | X | | | X | | | | X | | | | | X | X | | | | | X | X | |
| 50 | Form partnerships with community groups and discuss the BMP recommendations from the neighborhood assessments and implementation options. | 1, 2, 3, 4, 7 | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | |
| 51 | Form partnerships with institutions and discuss the BMP recommendations from the institutional assessments and implementation options. Include implementing/enhancing recycling programs on their properties. | 1, 2, 3, 4, 7 | | | | | X | | | | | | | | | | | | | | X | | | | | | | X | | X | X | | | | | | | | X |
| 52 | Work with community groups to install storm drain markers in the 68 recommended neighborhoods. | 1, 2, 3, 4, 7 | X | X | | X | | | | | | | | X | X | | | | | | | | | | | | | | | | X | | | | | | X | X | |
| 53 | Work with institutional sites to install storm drain markers at the 17 recommended sites. | 1, 2, 3, 4, 7 | X | X | | X | | | | | | | | X | X | | | | | | | | | | | | | X | | X | X | | | | | | X | X | X |
| 54 | Conduct a tour of a completed water quality project/BMP on public property. | 1 | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 55 | Develop and distribute public awareness materials that promote the use of public access to Bear Creek, Old Road Bay, and Shallow Creek. | 1 | | | | | | | | | | | | | | X | X | | | | | | | X | X | | | | | | X | | | | | | | | |
| 56 | Support the completion of the Star Spangled Banner National Historic Trail to create access for pedestrians, cyclists, and water-related recreation. | 1 | | | | | | | | | | | | | | | | | | | | | | X | X | | | | X | | | | | | | | | | |
| 57 | Develop water trails that connect with Bay Gateways in the area. | 1, 2, 3, 4, 5, 7 | | | | | | | | | | | | | | | | | | | | | | X | | | | | X | | | | | | | | | | |
| 58 | Address bootleg marinas | 1, 5 | | | | X | | | | | | | | X | X | X | | | | | | | | | | | | | | | | | | | | | | | |
| 59 | Increase agency collaboration through in-house meetings | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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Table A-2: Bear Creek/Old Road Bay Action Strategies – Goal Objective Matrix

| | Action | Respons. Party* | Goal 1 | | | | | Goal 2 | | | | | | | | | | Goal 3 | | | | | Goal 4 | | | | Goal 5 | | | | | Goal 6 | | | | | Goal 7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 |
| 60 | Conduct water trail tours for community groups including description of public access points, navigation channel markings, shoreline/wetland enhancement project(s), etc. | 1 | | | | | | | X | | X | | X | | | X | X | | | | | | X | X | | | | | X | | | | | | | | | | |
| 61 | Support the MD Green School Program and the Green Ribbon Schools Program | 1, 2, 3, 4 | | | | | | | | | | | | | | | | | | | X | | | | | | | X | | X | X | | | | | | | | X |
| 62 | Increase the number of meaningful watershed experiences for youth in the planning area. | 1, 2, 3, 4, 7 | | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X | | | | | | | | X |
| **MONITORING** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 63 | Continue to monitor and remove illicit connections through the Illicit Connections Program | 1 | X | X | X | X | X | | | | | | | X | X | | | | | | | | | | | | | | | | | | | | | X | | | |
| 64 | Continue monitoring hotspots through upland surveys in the watershed | 1 | | | | X | | | | | | | | X | X | | | X | | | | | | | | | | | | | | | | | | X | | | |
| 65 | Implement a Stream Watch program, a citizen-based program to increase the ability to monitor/identify sources of water quality and habitat degradation. | 1, 2, 3, 4, 7 | X | X | | | | X | X | | | | | | | | | | | X | | | X | | | | | | | | X | | | | | X | | | |
| 66 | Continue stormwater facility maintenance and inspection program | 1 | X | X | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | |
| 67 | Continue to work with teachers to develop water quality monitoring activities for students at Baltimore County public schools. | 1, 2, 3, 4, 7 | X | X | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X | | | | | X | | | X |
| 68 | Monitor nitrogen and phosphorus levels within the planning area | 1 | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | |
| 69 | Monitor SAV coverage in the watershed annually. | 1 | | | | | | | | | X | | X | | | | | | | | | | X | | | | | | | | | | | | | X | | | |
| 70 | Work with DNR to monitor deer population in the watershed | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | |
| **FUNDING** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 71 | Coordinate grant funding requests to secure funding and implement restoration projects to meet TMDL nutrient reductions requirements. | 1, 2, 3, 4, 7 | X | X | X | X | X | | | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | |
| 72 | Support an increase in funding for the Baltimore County - Green Building Tax Credit Program as a model. | 1, 2, 3, 4, 7 | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 73 | Support an increase in funding requests for environmental education in the watershed | 1, 2, 3, 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 74 | Develop a stormwater management utility fee for Baltimore County applicable to the planning area. | 1 | X | X | X | X | X | | | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | |
| 75 | Coordinate with industrial sites in the watershed to obtain funding on potential restoration partnership projects. | 1 | X | X | X | X | X | | | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | |
| 76 | Support an increase in applications for the Maryland Department of Natural Resources Land Conservation Programs including Program Open Space, Rural Legacy, and Maryland Environmental Trust | 1, 2, 3, 4, 7 | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| **REPORTING** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 77 | Bear Creek/Old Road Bay SWAP Implementation Committee will meet to discuss implementation progress and assess any changes needed to meet the goals. | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 78 | Develop a unified restoration tracking system to track progress toward meeting TMDL reduction requirements. | 1, 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 79 | Update the status of citizen-based restoration projects and BMPs on an annual basis | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 80 | Continue to update status of County capital budget restoration projects and BMPs | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Responsible Parties:

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# 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 Bear Creek/Old Road Bay SWAP. Each is described below.

## Cost Analysis

The cost analysis is based on the actions detailed in Appendix A. Cost estimates are summarized in Tables B-1, B-2, and B-3. Table B-1 presents cost estimates based on the maximum implementation scenario described in Chapter 3. Table B-2 presents costs estimates based on the projected participation rates needed to achieve the 2017 reduction goals in nutrient loads from urban runoff, also described in Chapter 3. Table B-3 presents costs estimates based on the projected participation rates needed to achieve the 2025 reduction goals in nutrient loads from urban runoff. For each scenario, estimates are provided in 2012 dollars and represent total cost estimates for the anticipated implementation timeframe. Unit costs are based on a combination of local information and previous SWAPs completed for other local watersheds. BMP costs are not annualized over the implementation timeframe and do not include costs of existing staff. Costs are also presented in dollars per pound of nitrogen, phosphorus, and sediment removal for those BMPs where pollutant removal calculations were possible (refer to Chapter 3). This provides an additional tool for the assessment and selection of BMPs. The total cost of implementation exclusive of staffing costs is approximately $25,005,109 for maximum implementation and $9,686,616 based on projected participation rates meeting the 2025 pollution reduction goals.

**Table B-1: Maximum Estimated Costs for Bear Creek/Old Road Bay SWAP Implementation**

| Action | Unit Cost | Max Quantity | Max Total Cost | Max TN Load Reduction (lbs / yr) | Max TP Load Reduction (lbs / yr) | Max TSS Load Reduction (lbs / yr) | Max Cost / lb of TN Removal per year | Max Cost / lb of TP Removal | Max Cost / lb of TSS Removal |
|---|---|---|---|---|---|---|---|---|---|
| Bayscaping Education | $ 500 / event | 8 events | $ 4,000 | 125 | 7 | 0 | $ 32 | $ 569 | $ - |
| SWM Conversions | $ 3,200 / acre | 80 acres | $ 254,880 | 90 | 6 | 11,982 | $ 2,823 | $ 45,191 | $ 21 |
| SW Retrofits | $ 50,000 / retrofit | 11 retrofits | $ 550,000 | 51 | 9 | 6,442 | $ 10,778 | $ 58,474 | $ 85 |
| Impervious Cover Removal | $ 25,000 / acre | 1.4 acre | $ 36,181 | 5 | 2 | 845 | $ 7,724 | $ 20,808 | $ 43 |
| Downspout Disconnection Program | $ 300 / house | 6,543 houses | $ 1,962,900 | 1,386 | 256 | 175,023 | $ 1,416 | $ 7,682 | $ 11 |
| Reforest Stream Buffer | $ 15,000 / acre | 227 acres | $ 3,408,341 | 1,109 | 55 | 14,043 | $ 3,074 | $ 61,532 | $ 243 |
| Reforest Shoreline Buffer | $ 15,000 / acre | 360 acres | $ 5,404,800 | 1,755 | 87 | 22,055 | $ 3,079 | $ 61,880 | $ 245 |
| Pervious Area Reforestation | $ 6,000 / acre | 20 acres | $ 120,838 | 98 | 5 | 1,233 | $ 1,232 | $ 24,752 | $ 98 |
| Neighborhood Tree Planting | $ 175 / tree | 3,817 trees | $ 667,971 | 138 | 7 | 1,731 | $ 4,850 | $ 97,461 | $ 386 |
| Institutional Tree Planting | $ 175 / tree | 3,285 trees | $ 574,875 | 119 | 6 | 1,489 | $ 4,850 | $ 97,461 | $ 386 |
| Tree Maintenance | $ 6,500 / acre | 660 acres | $ 4,291,883 | N/A | N/A | N/A | NA | NA | NA |
| Remove Invasive Species | $ 250 / acre | 13 acres | $ 3,250 | N/A | N/A | N/A | NA | NA | NA |
| Post Signs | $ 40 / sign | 26 signs | $ 1,040 | N/A | N/A | N/A | NA | NA | NA |
| Navigation Channel Markers | $ 5,000 / year | 13 years | $ 65,000 | N/A | N/A | N/A | NA | NA | NA |
| Shoreline Enhancement Projects | $ 1,000,000 / project | 7 projects | $ 7,000,000 | 3,792 | 2,607 | 10,688,700 | $ 1,846 | $ 2,685 | $ 1 |
| Pollution Prevention Workshops | $ 500 / workshop | 4 workshops | $ 2,000 | N/A | N/A | N/A | NA | NA | NA |
| Clean Marina and Boater ads | $ 50 / ad | 13 ads | $ 650 | N/A | N/A | N/A | NA | NA | NA |
| Neighborhood BMP Meetings | $ 500 / meeting | 26 meetings | $ 13,000 | N/A | N/A | N/A | NA | NA | NA |
| ISI Recommendation Meetings | $ 500 / meeting | 19 meetings | $ 9,500 | N/A | N/A | N/A | NA | NA | NA |
| Storm Drain Markers | $ 400 / site | 85 sites | $ 34,000 | N/A | N/A | N/A | NA | NA | NA |
| Trash Campaign Materials | $ 9,000 / year | 13 years | $ 117,000 | N/A | N/A | N/A | NA | NA | NA |
| Waterway Cleanups | $ 1,000 / cleanup | 41 cleanups | $ 41,000 | N/A | N/A | N/A | NA | NA | NA |
| Water Quality Monitoring Report | $ 34,000 / report | 13 reports | $ 442,000 | N/A | N/A | N/A | NA | NA | NA |
| | | ***Total:*** | ***$ 25,005,109*** | ***8,667*** | ***3,047*** | ***10,923,544*** | | | |

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

**Table B-2: 2017 Projected Estimated Costs for Bear Creek/Old Road Bay SWAP Implementation**

| Action | Unit Cost | Proj. 2017 Quantity | Proj. 2017 Total Cost | Proj. 2017 TN Load Reduction (lbs / yr) | Proj. 2017 TP Load Reduction (lbs / yr) | Proj. 2017 TSS Load Reduction (lbs / yr) | Proj. 2017 Cost / lb of TN Removal per year | Proj. 2017 Cost / lb of TP Removal per year | Proj. 2017 Cost / lb of TSS Removal per year |
|---|---|---|---|---|---|---|---|---|---|
| Bayscaping Education | $ 500 / event | 5 events | $ 2,500 | 2 | 0 | 0 | $ 1,602 | $ 28,430 | $ - |
| SWM Conversions | $ 3,200 / acre | 53 acres | $ 169,920 | 30 | 2 | 3,994 | $ 5,646 | $ 90,382 | $ 43 |
| SW Retrofits | $ 50,000 / retrofit | 4 retrofits | $ 200,000 | 15 | 3 | 1,841 | $ 13,717 | $ 74,422 | $ 109 |
| Impervious Cover Removal | $ 25,000 / acre | 1.1 acre | $ 27,136 | 4 | 1 | 633 | $ 7,724 | $ 20,808 | $ 43 |
| Downspout Disconnection Program | $ 300 / house | 1,686 houses | $ 505,824 | 357 | 66 | 45,102 | $ 1,416 | $ 7,682 | $ 11 |
| Reforest Stream Buffer | $ 15,000 / acre | 17 acres | $ 262,180 | 85 | 4 | 1,080 | $ 3,074 | $ 61,532 | $ 243 |
| Reforest Shoreline Buffer | $ 15,000 / acre | 14 acres | $ 207,877 | 68 | 3 | 848 | $ 3,079 | $ 61,880 | $ 245 |
| Pervious Area Reforestation | $ 6,000 / acre | 7 acres | $ 41,829 | 34 | 2 | 427 | $ 1,232 | $ 24,752 | $ 98 |
| Neighborhood Tree Planting | $ 175 / tree | 1,101 trees | $ 192,702 | 40 | 2 | 499 | $ 4,850 | $ 97,470 | $ 386 |
| Institutional Tree Planting | $ 175 / tree | 1,112 trees | $ 194,573 | 40 | 2 | 504 | $ 4,850 | $ 97,461 | $ 386 |
| Tree Maintenance | $ 6,500 / acre | 55 acres | $ 355,558 | N/A | N/A | N/A | NA | NA | NA |
| Remove Invasive Species | $ 250 / acre | 5 acres | $ 1,250 | N/A | N/A | N/A | N/A | N/A | N/A |
| Post Signs | $ 40 / sign | 10 signs | $ 400 | N/A | N/A | N/A | N/A | N/A | N/A |
| Navigation Channel Markers | $ 5,000 / year | 5 years | $ 25,000 | N/A | N/A | N/A | NA | NA | NA |
| Shoreline Enhancement Projects | $ 1,000,000 / project | 1 project | $ 1,000,000 | 711 | 489 | 2,004,131 | $ 1,406 | $ 2,046 | $ 0 |
| Pollution Prevention Workshops | $ 500 / workshop | 2 workshops | $ 1,000 | N/A | N/A | N/A | NA | NA | NA |
| Clean Marina and Boater ads | $ 50 / ad | 5 ads | $ 250 | N/A | N/A | N/A | NA | NA | NA |
| Neighborhood BMP Meetings | $ 500 / meeting | 10 meetings | $ 5,000 | N/A | N/A | N/A | NA | NA | NA |
| ISI Recommendation Meetings | $ 500 / meeting | 7 meetings | $ 3,500 | N/A | N/A | N/A | NA | NA | NA |
| Storm Drain Markers | $ 400 / site | 34 sites | $ 13,600 | N/A | N/A | N/A | NA | NA | NA |
| Trash Campaign Materials | $ 9,000 / year | 5 years | $ 45,000 | N/A | N/A | N/A | NA | NA | NA |
| Waterway Cleanups | $ 1,000 / cleanup | 19 cleanups | $ 19,000 | N/A | N/A | N/A | NA | NA | NA |
| Water Quality Monitoring Report | $ 34,000 / report | 5 reports | $ 170,000 | N/A | N/A | N/A | NA | NA | NA |
| | | ***Total:*** | ***$ 3,444,098*** | ***1,385*** | ***574*** | ***2,059,060*** | | | |

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

**Table B-3: 2025 Projected Estimated Costs for Bear Creek/Old Road Bay SWAP Implementation**

| Action | Unit Cost | Proj. 2025 Quantity | Proj. 2025 Total Cost | Proj. 2025 TN Load Reduction (lbs / yr) | Proj. 2025 TP Load Reduction (lbs / yr) | Proj. 2025 TSS Load Reduction (lbs / yr) | Proj. 2025 Cost / lb of TN Removal per year | Proj. 2025 Cost / lb of TP Removal per year | Proj. 2025 Cost / lb of TSS Removal per year |
|---|---|---|---|---|---|---|---|---|---|
| Bayscaping Education | $ 500 / event | 8 events | $ 4,000 | 2 | 0 | 0 | $ 1,602 | $ 28,430 | $ - |
| SWM Conversions | $ 3,200 / acre | 80 acres | $ 254,880 | 45 | 3 | 5,991 | $ 5,646 | $ 90,382 | $ 43 |
| SW Retrofits | $ 50,000 / retrofit | 7 retrofits | $ 350,000 | 26 | 5 | 3,221 | $ 13,717 | $ 74,422 | $ 109 |
| Impervious Cover Removal | $ 25,000 / acre | 1.1 acre | $ 27,136 | 4 | 1 | 633 | $ 7,724 | $ 20,808 | $ 43 |
| Downspout Disconnection Program | $ 300 / house | 4,384 houses | $ 1,315,143 | 929 | 171 | 117,266 | $ 1,416 | $ 7,682 | $ 11 |
| Reforest Stream Buffer | $ 15,000 / acre | 45 acres | $ 681,668 | 222 | 11 | 2,809 | $ 3,074 | $ 61,532 | $ 243 |
| Reforest Shoreline Buffer | $ 15,000 / acre | 36 acres | $ 540,480 | 176 | 9 | 2,206 | $ 3,079 | $ 61,880 | $ 245 |
| Pervious Area Reforestation | $ 6,000 / acre | 18 acres | $ 108,755 | 88 | 4 | 1,109 | $ 1,232 | $ 24,752 | $ 98 |
| Neighborhood Tree Planting | $ 175 / tree | 2,863 trees | $ 501,025 | 103 | 5 | 1,298 | $ 4,850 | $ 97,470 | $ 386 |
| Institutional Tree Planting | $ 175 / tree | 2,891 trees | $ 505,890 | 104 | 5 | 1,311 | $ 4,850 | $ 97,461 | $ 386 |
| Tree Maintenance | $ 6,500 / acre | 142 acres | $ 924,450 | N/A | N/A | N/A | NA | NA | NA |
| Remove Invasive Species | $ 250 / acre | 13 acres | $ 3,250 | N/A | N/A | N/A | N/A | N/A | N/A |
| Post Signs | $ 40 / sign | 26 signs | $ 1,040 | N/A | N/A | N/A | N/A | N/A | N/A |
| Navigation Channel Markers | $ 5,000 / year | 5 years | $ 25,000 | N/A | N/A | N/A | NA | NA | NA |
| Shoreline Enhancement Projects | $ 1,000,000 / project | 4 projects | $ 4,000,000 | 2,844 | 1,955 | 8,016,525 | $ 1,406 | $ 2,046 | $ 0 |
| Pollution Prevention Workshops | $ 500 / workshop | 4 workshops | $ 2,000 | N/A | N/A | N/A | NA | NA | NA |
| Clean Marina and Boater ads | $ 50 / ad | 8 ads | $ 400 | N/A | N/A | N/A | NA | NA | NA |
| Neighborhood BMP Meetings | $ 500 / meeting | 26 meetings | $ 13,000 | N/A | N/A | N/A | NA | NA | NA |
| ISI Recommendation Meetings | $ 500 / meeting | 19 meetings | $ 9,500 | N/A | N/A | N/A | NA | NA | NA |
| Storm Drain Markers | $ 400 / site | 85 sites | $ 34,000 | N/A | N/A | N/A | NA | NA | NA |
| Trash Campaign Materials | $ 9,000 / year | 8 years | $ 72,000 | N/A | N/A | N/A | NA | NA | NA |
| Waterway Cleanups | $ 1,000 / cleanup | 41 cleanups | $ 41,000 | N/A | N/A | N/A | NA | NA | NA |
| Water Quality Monitoring Report | $ 34,000 / report | 8 reports | $ 272,000 | N/A | N/A | N/A | NA | NA | NA |
| | | ***Total:*** | ***$ 9,686,616*** | ***4,543*** | ***2,170*** | ***8,152,369*** | | | |

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

**Potential Funding Sources**

Funding sources for the implementation of the Bear Creek/Old Road Bay SWAP includes local government funding for Baltimore County, monetary and time contributions to the Dundalk Renaissance Corporation, and various grants as described below.

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

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

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

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

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

**Table B-4: Bear Creek/Old Road Bay 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-4 (con't): Bear Creek/Old Road Bay 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>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>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>YES | 3-5 years |

# APPENDIX C:

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

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

***Values in parentheses are in progress of official approval***

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

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

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

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

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

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

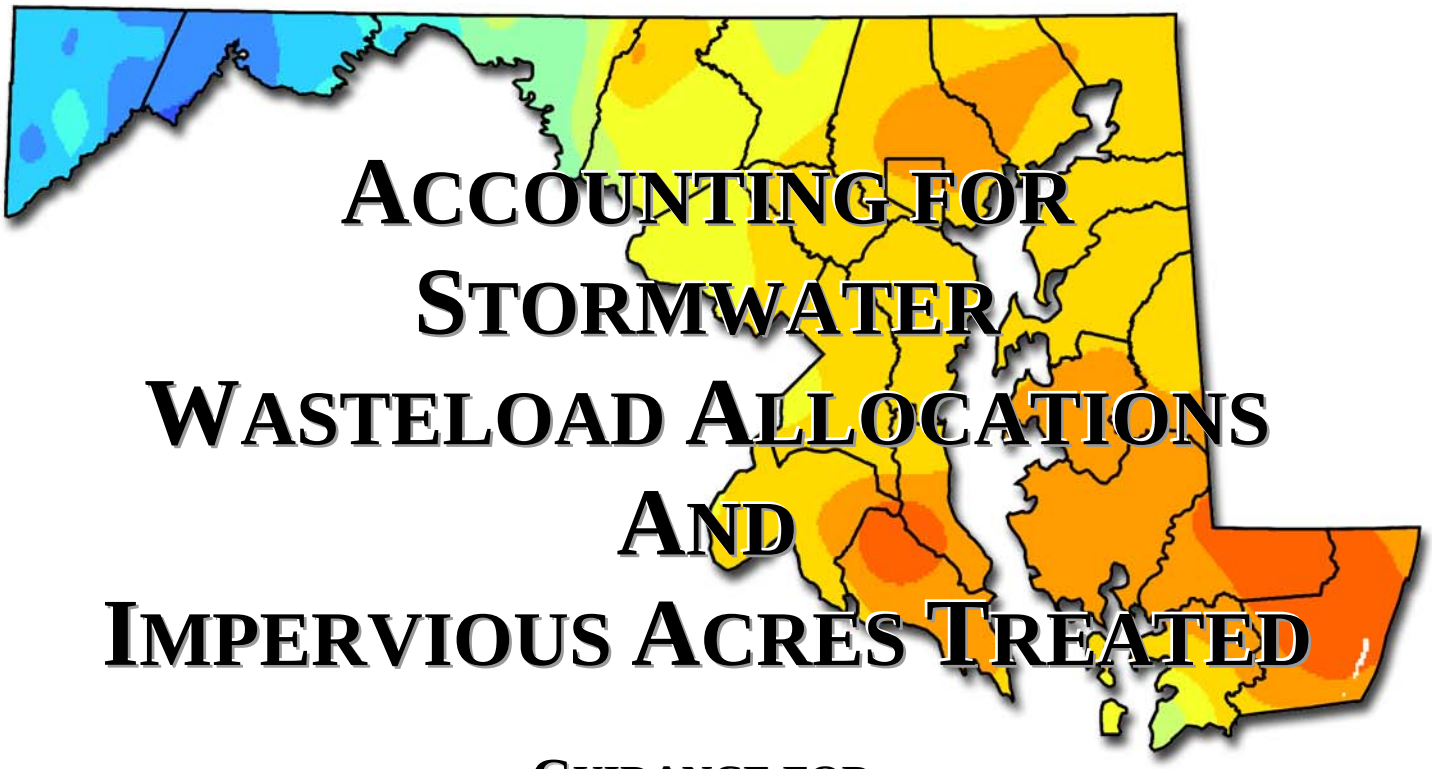
| | | | | |
|---|---|---|---|---|
| efficiency) | | | | |
| Cover Crop Standard Other Wheat (Low-till gets only TN efficiency) | Coastal Plain/Piedmont Crystalline/Karst Settings* | 24% | 7% | 10% |
| | Mesozoic Lowlands/Valley and Ridge Siliciclastic** | 18% | 7% | 10% |
| Cover Crop Late Drilled Wheat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

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

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

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

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



# ACCOUNTING FOR STORMWATER WASTELOAD ALLOCATIONS AND IMPERVIOUS ACRES TREATED

## GUIDANCE FOR NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM STORMWATER PERMITS

## JUNE (DRAFT) 2011

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DEPARTMENT OF THE ENVIRONMENT

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## I. Introduction

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

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

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

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

## II. Modeling Methods

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

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

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

**Table 1.** CBP Annual Urban Runoff Loads Per Acre

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

(Adapted from CBP Model, Version 5.3.0, 2011)

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

**3. BMP Efficiency Matrices**: This guidance provides two BMP efficiency matrices for computer model input values. One contains traditional stormwater retrofits, i.e., wet ponds, bioretention, and filtering practices, and efficiencies provided in the CBP Model. A second matrix contains alternate urban practices, i.e., stream restoration, street sweeping, and septic

system upgrades, that can be used to meet stormwater WLAs. Together these matrices provide local governments with numerous options for meeting NPDES stormwater WLAs and impervious cover restoration requirements.

## III. Establishing Baselines

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

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

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

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

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

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

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

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

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

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

**6. Stormwater Management by Era**: Maryland's Urban BMP Database has records for over 33,000 facilities statewide, yet only 22,000 have complete information on drainage area and year built. The under-counting of BMPs has contributed to a flawed analysis regarding Maryland's

stormwater management programs that have been implemented since the early 1980's. To better reflect actual program implementation, BMPs may be recorded in four stormwater management eras when facility data are incomplete.

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

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

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

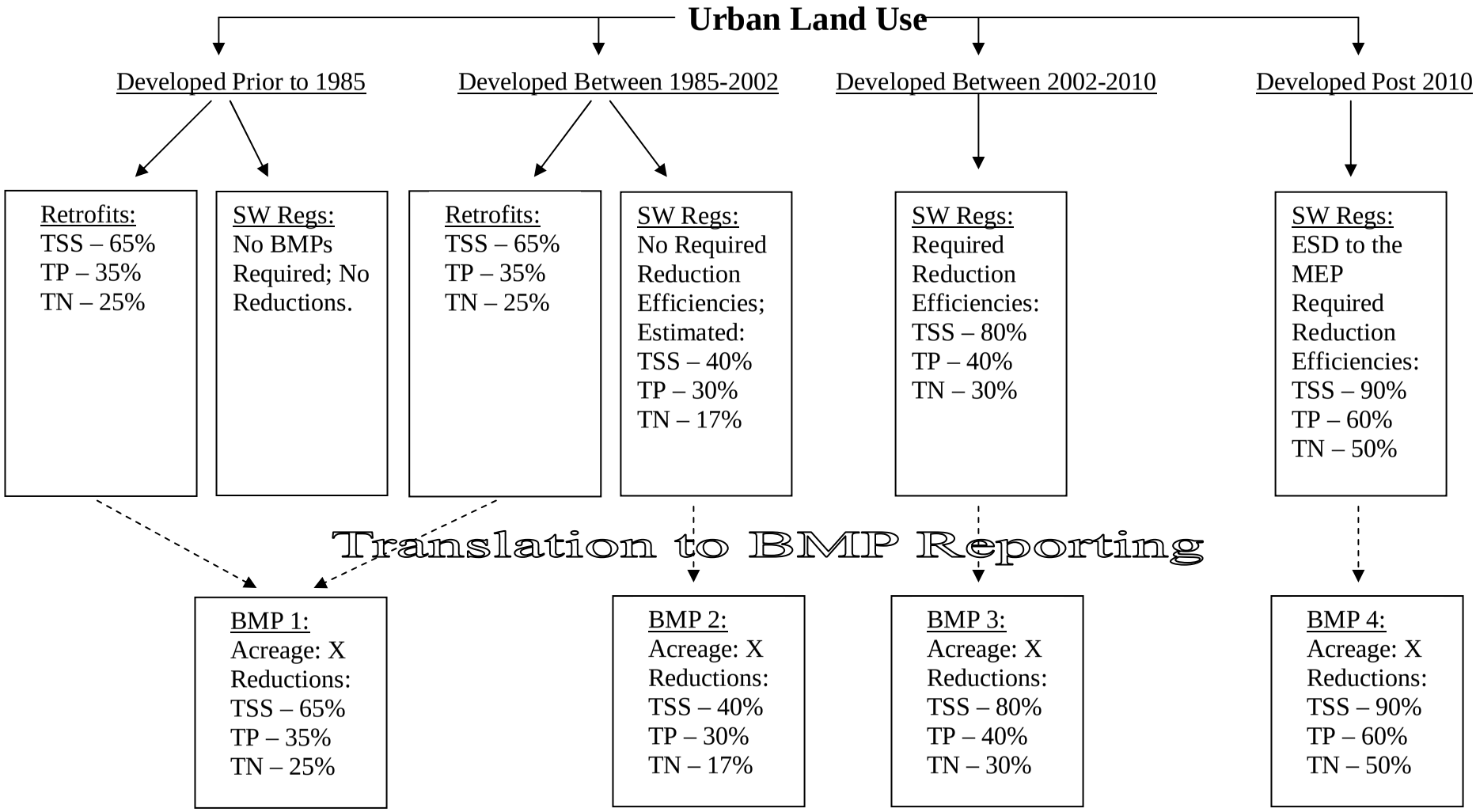
**Table 2.** Stormwater Management by Era Accounting Approach

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

(Adapted from MDE Stormwater Management by Era, 2009)

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

# Figure 1. Stormwater Management by Era



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

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

## IV. Structural Restoration Credits

### 1. ESD and BMP Retrofits

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

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

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

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

**Table 3.** Retrofit of a Dry Pond Constructed Circa 1985

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

(Adapted from the 2000 Maryland Stormwater Design Manual)

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

**2. Redevelopment** can play a significant role in reducing stormwater pollutants. First, redevelopment limits the expansion of Maryland's urban footprint, preserving undeveloped resource lands. Second, redevelopment usually occurs in older urban environments, replacing unmanaged impervious surfaces with the controls mandated in the *Manual*. Stormwater

management requirements for redevelopment are outlined in the Code of Maryland Regulations (COMAR 26.17.02.05D), and discussed in the *Manual* (Supplement 1, pages 5.117 – 5.120). These specify that some combination of impervious area reduction and water quality treatment needs to be provided.

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

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

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

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

**5. Recording Structural BMP Retrofits**: NPDES stormwater permits require that all stormwater retrofit data be recorded on a stormwater restoration database (Appendix C). A comprehensive list of structural BMPs can be found in Table 4. All BMP efficiencies are derived from the CBP unless otherwise noted. BMP definitions and design criteria can be found in Maryland's *Manual*, materials that support the CBP's approved BMP efficiencies, and within the body of this guidance document. Impervious acres treated shall be calculated from the approved plans for each retrofit. BMP drainage areas need to be GIS-mapped as polygon shape files and linked to the restoration database. The GIS mapping of these retrofits shall be used by

localities to demonstrate how the 20% impervious cover restoration requirement is being met and also to prevent the double reporting of structural BMPs. Additionally, local governments shall use the previously calculated baseline pollutant loads, BMP implementation rates, and the efficiencies provided in Table 4 to show progress toward meeting NPDES stormwater WLAs.

**Table 4.** Structural BMP Retrofit Matrix

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

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

## V. Alternative Restoration Credits

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

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

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

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

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

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

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

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

**Table 5.** Street Sweeping Pollutant Removal Efficiencies

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

(CBP Street Sweeping Efficiencies, 2011)

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

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

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

**Table 6.** Pollutant Reduction Efficiencies Associated with Impervious Surface Elimination

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

(Adapted from CBP Model, Version 5.3.0, 2011)

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

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

**Table 7.** Tree Planting and Reforestation Pollutant Load Reduction Efficiencies

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

(Adapted from CBP Model, Version 5.3.0, 2011)

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

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

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

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

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

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

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

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

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

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

**Method I**: Baseline Stream Restoration Credit

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

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

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

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

**Method II**: Stream Restoration using ESD and Structural BMPs

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

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

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

**Table 8.** Stream Restoration Credits

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

In this example, a certain level of management is provided using upland BMPs (13.6 acres of impervious area treatment). This includes 2 acres of disconnection credit where field observations confirm that runoff from impervious surfaces will sheetflow onto vegetated areas and provide water quality treatment. Another 2 acres of disconnection practices are implemented

by working with residential property owners. Because the baseline credit is available, the upland BMPs combined with stream restoration result in a credit for a significant portion of the watershed impervious area. Incorporating these strategies together in small watersheds provides an advantage toward achieving impervious area restoration credit. As a general rule, whether Methods I or II is used, the impervious area credit for stream restoration shall not be greater than the total impervious area within the drainage for that project.

**Method III**: Local Monitoring for Stream Restoration Credits

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

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

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

**Table 9.** Annual Shoreline Stabilization Credit

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

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

extremes. The pollutant load reduction rates provided by MDE for shoreline stabilization may be used for NPDES stormwater permit accounting.

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

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

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

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

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

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

## VI. An Equivalent Impervious Acre

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

**Table 10.** Pollutant Loads for Impervious and Forest Cover

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

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

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

**Table 11.** Estimated Pollutant Load Reductions from Mechanical Street Sweeping

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

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

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

**Table 12.** Equivalent Impervious Acre Analyses for Street Sweeping

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

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

**Table 13.** An Equivalent Impervious Acre

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

## VII. Alternative Urban BMP Matrix

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

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

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

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

**Table 14.** Matrix of Alternative Urban BMPs

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

* Only nutrient values were used to derive impervious acre equivalent

## VIII. Bibliography


Anne Arundel County Department of Public Works. 2010. Stormwater National Pollutant Discharge Elimination System, 2009, Annual Report for Anne Arundel County. Anne Arundel County Department of Public Works. Annapolis, MD.

Anne Arundel County Department of Public Works. 2010. Step Pool Storm Conveyance (SPSC) Design Guidelines (Revisions 1 and 2). Anne Arundel County Department of Public Works. Annapolis, MD. http://www.aacounty.org/DPW/Watershed/StepPoolStormConveyance.cfm.

Baish, A.S. and Caliri, M.J. 2009. Average Nutrient and Sediment Effluent Removal Efficiencies for Stormwater Best Management Practices in Maryland from 1984-2002. Johns Hopkins University, School of Engineering. Baltimore, MD.

Baltimore City Department of Public Works. 2006. NPDES Stormwater Permit Program, 2005 Annual Report. Baltimore City Department of Public Works. Baltimore, MD.

Baltimore County Department of Environmental Protection and Resource Management. 2008. Spring Branch – Small Watershed Action Plan. Volume I and II. Baltimore County Department of Environmental Protection and Resource Management. Towson, MD.

Baltimore County Department of Environmental Protection and Resource Management. 2010. NPDES Municipal Stormwater Permit, 2010 Annual Report. Baltimore County Department of Environmental Protection and Resource Management. Towson, MD.

Baltimore County Department of Environmental Protection and Resource Management. 2010. Stream Restoration Impervious Surface Credits and Pollutant Load Removal. Presentation by Steve Stewart at November 17, 2010 NPDES Stormwater Workgroup Meeting. Baltimore, MD.

Booth, D.B. 2005. Challenges and Prospects for Restoring Urban Streams: A Perspective from the Pacific Northwest of North America. Journal of North American Benthological Society. 24(3): 724-737.

Center for Watershed Protection. 2008. Deriving Reliable Pollutant Removal Rates for Municipal Street Sweeping and Storm Drain Cleanout Programs in the Chesapeake Bay Basin. Center for Watershed Protection. Ellicott City, MD.

Chesapeake Bay Program. 2010. Protocol for Development, Review, and Approval of Loading and Effectiveness Estimates for Nutrient and Sediment Controls in the Chesapeake Bay Model. Chesapeake Bay Program Water Quality Goal Implementation Team.

Chesapeake Bay Program. Urban Stormwater Workgroup – Current Projects and Info. http://www.chesapeakebay.net/committee_urbanworkgroup_projects.aspx?menuitem=16750.

Chesapeake Bay Program. BMP Definitions. http://archive.chesapeakebay.net/pubs/subcommittee/nsc/uswg/BMP_Definitions.PDF (accessed February 1, 2011).

Chesapeake Bay Program. BMP Guidance for the States and the District. http://archive.chesapeakebay.net/pubs/subcommittee/nsc/uswg/BMP_Guidance_for_States_and_the_District.PDF (accessed February 1, 2011).

Chesapeake Bay Program. BMP Pollutant Removal Efficiencies. http://archive.chesapeakebay.net/pubs/subcommittee/nsc/uswg/BMP_Pollutant_Removal_Efficiencies.PDF (accessed February 1, 2011).

Chesapeake Bay Program. BMP Stream Restoration in Urban Areas, Crediting Jurisdictions for Pollutant Load Reductions. http://archive.chesapeakebay.net/pubs/subcommittee/nsc/uswg/BMP_Stream_Restoration_and_Pollutant_Load_Reductions.PDF (accessed February 1, 2011).

Chesapeake Bay Program. Modeling Team. http://www.chesapeakebay.net/committee_msc_info.aspx.

Claytor, R., and Schueler, T.R., 1997. Technical Support Document for the State of Maryland Stormwater Design Manual Project. Water Management Administration. Maryland Department of the Environment, Baltimore, MD.

Code of Federal Regulation (CFR), Title 40 – Protection of Environment, Chapter 1 – U.S. Environmental Protection Agency, Part 122.26 Stormwater Discharges.

Code of Maryland Regulations (COMAR), Title 26 Department of the Environment, Subtitle 17, Water Management Administration, Chapter 02 Stormwater Management.

Hassett, B., Palmer, M.A., Bernherdt, E., Smith, S., Carr, J., Hart, D. 2005. Restoring Watersheds Project by Project, Trends in Chesapeake Bay Tributary Restoration. Frontiers in Ecology and Environment. 3(5): 259-267.

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

Kaushal, S.S., Groffman, P.M., Mayer, P.M., Striz, E., and Gold, A.J. 2008. Effects of Stream Restoration on Denitrification in an Urbanizing Watershed. Ecological Applications. 18(3): 789-804.

Maryland Department of the Environment. 1987. Design Procedures for Stormwater Management Extended Detention Structures. Maryland Department of the Environment. Baltimore, MD.

Maryland Department of the Environment. 2000 and 2008. 2000 Maryland Stormwater Design Manual, Volume I and II (including Supplement 1). Maryland Department of the Environment. Baltimore, MD.

Maryland Department of the Environment. 2008. Shore Erosion Control Guidelines for Waterfront Property Owners, 2nd Edition. Maryland Department of the Environment. Baltimore, MD.

Maryland Department of the Environment. 2008. Maryland Policy for Nutrient Cap Management and Trading in Maryland's Chesapeake Bay Watershed. Maryland Department of the Environment. Baltimore, MD.

Maryland Department of the Environment. 2009. Maryland's Urban Stormwater Best Management Practices by Era Proposal. Maryland Department of the Environment. Baltimore, MD.

Maryland Department of the Environment. 2010. NPDES Stormwater Workgroup Survey. September 16, 2010 NPDES Stormwater Workgroup Meeting Handout. Maryland Department of the Environment. Baltimore, MD.

Maryland Department of Natural Resources. Maryland Shorelines Online. http://www.dnr.state.md.us/ccp/coastalatlas/shorelines.asp.

Maryland Department of Natural Resources. 2009. No Net Loss of Forest Task Force. Maryland Department of Natural Resources. Annapolis, MD.

Maryland State Highway Administration. 2010. Methodology for Pollutant Removal and Impervious Acre Accounting. Presentation by Dana Havlik at November 17, 2010 NPDES Stormwater Workgroup Meeting. Baltimore, MD.

Montgomery County Department of Environmental Protection. 2003. Countywide Stream Protection Strategy. Montgomery County, Rockville, MD.

Palmer, M.A. 2008. Reforming Watershed Restoration: Science in Need of Application and Applications in Need of Science. Estuaries and Coasts. 32(1): 1559-2723.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO.

Walsh, C.J., and Kunapo, J. 2009. The Importance of Upland Flow Paths in Determining Urban Effects on Stream Ecosystems. Journal of North American Benthological Society. 28 (4): 977–990.

Weammert, S.E. 2007. The Mid-Atlantic Water Program (MAWP), BMP Efficiencies Reported by the Chesapeake Bay Watershed Jurisdictions prior to 2003. University of Maryland. College Park, MD.

Yetman, K.T. 2001. Stream Corridor Assessment Survey, SCA Survey Protocols. Maryland Department of Natural Resources. Annapolis, MD.

## Appendix A -- Stormwater Model Weblinks

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

1. Maryland Assessment and Scenario Tool

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

2. Hydrological Simulation Program -- Fortran:

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

3. Stormwater Management Model

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

4. Watershed Treatment Model

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

## Appendix B -- Maryland's Urban BMP Database

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

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

## Appendix C -- Maryland's NPDES Stormwater Restoration Database

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

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

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

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

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

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

## Appendix E -- CBP Stream Restoration Guidance

### Stream Restoration in Urban Areas
### Crediting Jurisdictions for Pollutant Load Reductions

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

**Stream Restoration in Urban Areas**

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

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

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

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

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

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

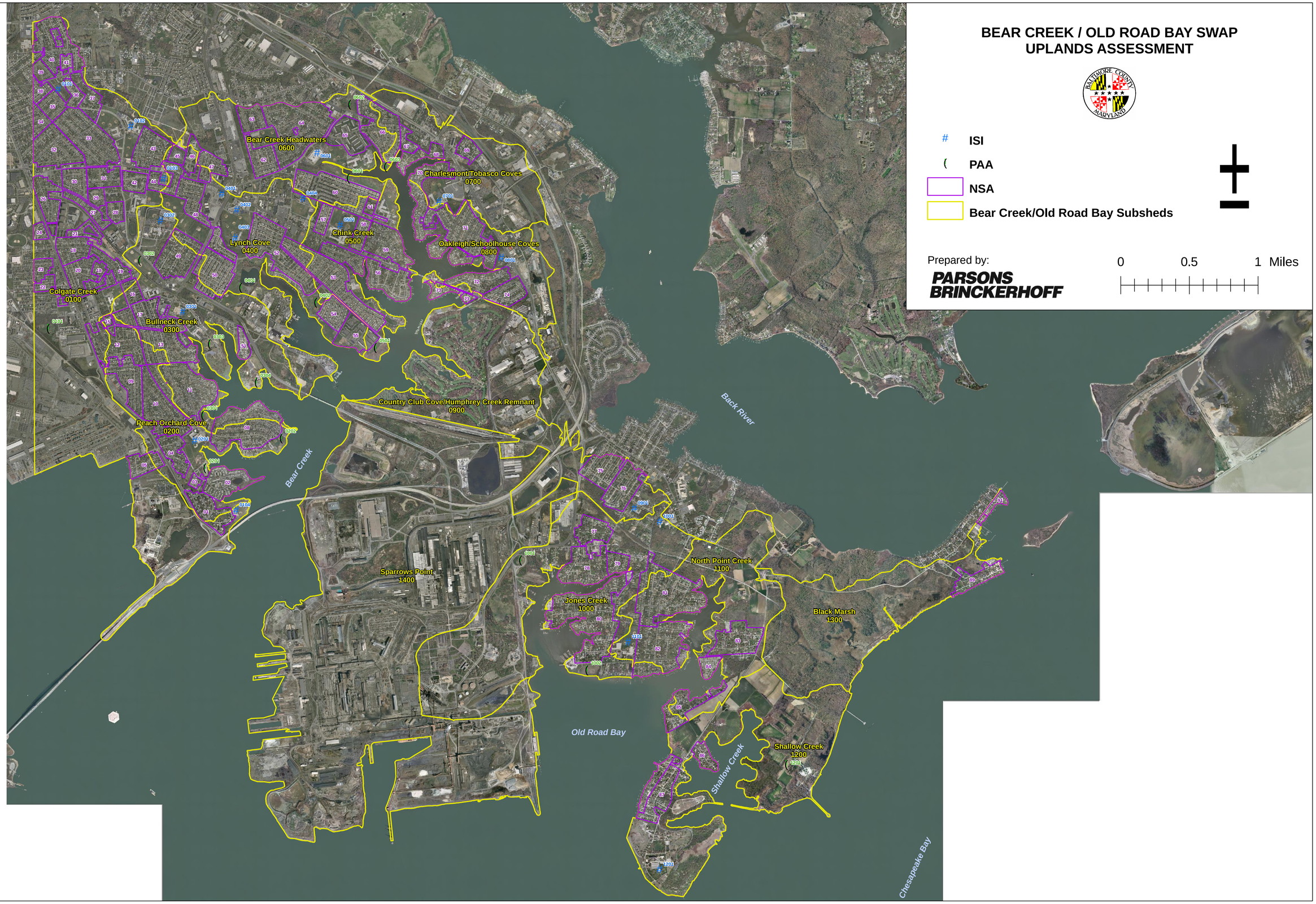
The Chesapeake Bay watershed jurisdictions will annually report the number of urban stream miles restored in each Chesapeake Bay Watershed Model county segment to the Chesapeake Bay Program Office.

**Pollutant Load Reductions Associated with Stream Restoration in Urban Areas**

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

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

# APPENDIX D:

## Bear Creek/Old Road Bay SWAP Uplands Assessment Map

# BEAR CREEK / OLD ROAD BAY SWAP UPLANDS ASSESSMENT