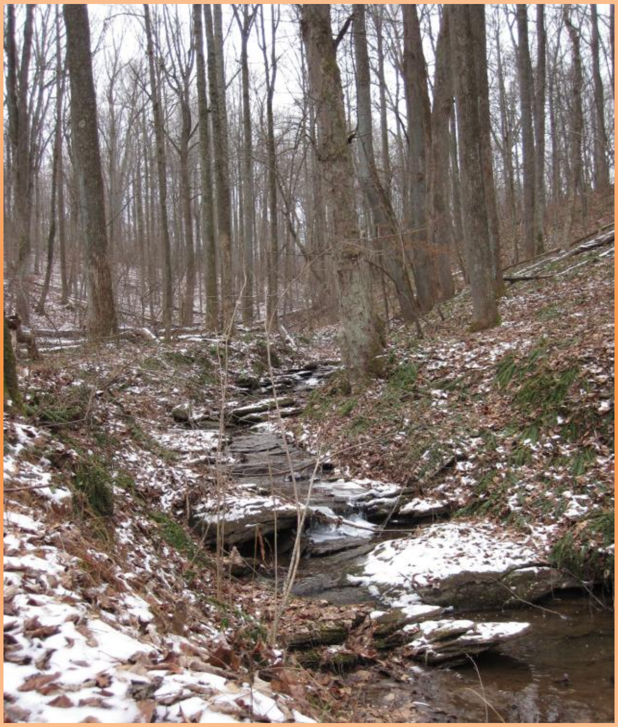
BEAVERDAM RUN, BAISMAN RUN, AND OREGON BRANCH

SMALL WATERSHED ACTION PLAN

FINAL REPORT



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Center for Watershed Protection
KCI Technologies
Coastal Resources Inc.

Baltimore County Executive Kevin Kamenetz and the Baltimore County Council

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ACKNOWLEDGEMENTS

Area I Steering Committee

The Area I SWAP was developed with cooperation and input from citizen organizations, local and state agencies that represent the interests of the Area I watershed.

Organization	*Representative*
Baltimore City Reservoir Natural Resources Section	Clark Howells
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Baltimore County Department of Environmental Protection and Sustainability (EPS) – Watershed Monitoring and Management	Nancy Pentz, Steven Stewart, Erin Wisnieski
Baltimore County Office of Planning	Jessie Bialek
Baltimore County Soil Conservation District	Charlie Conklin, Jim Ensor
Baltimore Ecosystem Study	Ken Belt
Catholic Community of St. Francis Xavier	John O'Hara
Center for Watershed Protection	Julie Schneider
Falls Road Community Association	Harold H. Burns, Jr.
Gunpowder Valley Conservancy	Kirsten Coffen, Peggy Perry
Hayfields Golf Course	Louis Mangione
Baltimore County Recreation and Parks (Oregon Ridge Nature Center)	Courtney Peed
The Valleys Planning Council	Teresa Moore
Upper Western Shore Tributary Team	John Hobner
Watershed Resident	Dori Grasso

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EXECUTIVE SUMMARY

The Area I watershed lies in the Piedmont region of Maryland and is located in central Baltimore County. It encompasses 8,350 acres (13 square miles) and drains to the Loch Raven Reservoir watershed. The watershed is divided into three smaller drainage areas known as subwatersheds: Baisman Run, Beaverdam Run and Oregon Branch. Baisman Run is completely contained within Area I. Portions of Beaverdam Run and Oregon Branch extends to the east of I-83 into areas with more urban land use and will be included in the SWAP for Planning Area O. The Area I watershed is located outside the Urban Rural Demarcation Line (URDL), which ensures limited development in the watershed. The land use in the watershed is dominated by low density residential (46.5%), forested (22.5%), and agricultural (14.7%).

The Area I watershed contributes 6% of the drainage area to the Loch Raven Reservoir watershed. As such, a summary of water quality impairments is provided for the Loch Raven Reservoir watershed. The Loch Raven Reservoir watershed is listed as impaired in the Maryland 303(d) list of impaired waters for several pollutants of concern including: fecal coliform (2008 listing), methylmercury (2002 listing), sedimentation and siltation (1996 listing), total phosphorus (1996 listing) and impacts to benthic/fish communities (2002 listing) (MDE, 2008). In the Area I subwatersheds, the cause of the impairment that is most relevant is for benthic/fish communities in first through fourth order streams. According to the Maryland Department of Environment (MDE) the stream biological community impairment listing has a low priority and a Total Maximum Daily Load (TMDL) will be developed at some point in the future. While the impairments documented in Area I subwatersheds are a lower priority, they may also be contributing to the downstream impairments in the river mainstem and the reservoir impoundment.

Four TMDLs have been completed for the Loch Raven Reservoir watershed. TMDLs developed for total phosphorus and sedimentation/siltation were approved by the US Environmental Protection Agency (EPA) in 2007 and identified a target reduction of 50% for total phosphorus and 25% for sediment. A TMDL for fecal coliform bacteria was approved by EPA in 2009 and the bacteria monitoring station downstream of Area I requires a 80.2% reduction in bacteria (MDE, 2009). A TMDL for methylmercury in fish tissue was also approved by EPA in 2004 and identified atmospheric deposition as the primary source of mercury with limited options to address mercury through stormwater discharges or practices. The Area I watershed is designated as Use III-P, defined as Nontidal Cold Water and Public Water Supply and are found to support populations of native brook trout, indicating high water quality.

The Area I Small Watershed Action Plan (SWAP) includes a watershed restoration plan and implementation strategy that will serve as a work plan for restoring and protecting water quality and aquatic terrestrial habitats and for addressing the need for environmental outreach and education in the watershed. The SWAP defines nine goals and 40 associated objectives for clean water, stream protection, forest and habitat, agricultural practices and stewardship. These goals and objectives have been translated into 53 actions that when implemented over the next nine years (2020 endpoint that aligns with the timeframe for the Maryland pollutant reduction targets for the Chesapeake Bay TMDL) will result in achieving the goals stated in the SWAP.

Implementation of the Area I SWAP will require the cooperative effort of Baltimore County, Gunpowder Valley Conservancy, Baltimore County Soil Conservation District, and local citizen based environmental organizations. To facilitate this cooperative effort an Implementation Committee has been formed to coordinate efforts and jointly seek additional funding to increase the rate of implementation. The Implementation Committee will use an adaptive management approach to ensure maximum effectiveness in implementing actions, and when necessary adjusting the work plant to meet the goals.

CHAPTER 1.0

Introduction

1.1 Purpose

This Small Watershed Action Plan (SWAP) is a strategy for the restoration and protection of Baisman Run, Beaverdam Run and Oregon Branch known for this report as Area I. The report presents the plan for watershed restoration, describes management strategies for each of the three subwatersheds comprising Area I and identifies priority projects for implementation. A schedule for implementation over a nine year time frame (2020 endpoint that aligns with the timeframe for the Maryland pollutant reduction targets for the Chesapeake Bay TMDL) 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 Baltimore County Department of Environmental Protection and Sustainability (EPS), the Gunpowder Valley Conservancy (GVC), and other partners to keep moving forward with the restoration and protection of Area I.

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, Area I partners have worked together, conducting field assessments, identifying restoration and protection opportunities, and engaging the community, in order to build a successful plan. A Steering Committee, consisting of watershed partners, was formed to develop the Area I SWAP. This includes Baltimore County personnel, members of the Gunpowder Valley Conservancy, a representative from Baltimore City reservoir program, and leaders from the local community. The Steering Committee met regularly throughout the SWAP development to provide input and guidance on the development of the document. Area I Steering Committee members are listed in Table 1-1.

Table 1-1: Area I Steering Committee Members

Name	Organization
Clark Howells	Baltimore City Reservoir Natural Resources Section
Rob Ryan	Baltimore County Department of Environmental Protection and Sustainability (EPS) – Capital Project Operations
Nancy Pentz Steven Stewart Erin Wisnieski	Baltimore County Department of Environmental Protection and Sustainability (EPS) – Watershed Management and Monitoring
Jessie Bialek	Baltimore County Office of Planning
Jim Ensor Charlie Conklin	Baltimore County Soil Conservation District
Ken Belt	Baltimore Ecosystem Study
John O'Hara	Catholic Community of St. Francis Xavier
Julie Schneider	Center for Watershed Protection
Harold H. Burns, Jr.	Falls Road Community Association
Kirsten Coffen Peggy Perry	Gunpowder Valley Conservancy
Louis Mangione	Hayfields Golf Course
Courtney Peed	Baltimore County Recreation and Parks (Oregon Ridge Nature Center)
Teresa Moore	The Valleys Planning Council
John Hobner	Upper Western Shore Tributary Team
Dori Grasso	Watershed Resident

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

- **Stakeholder Meeting #1** (February 16, 2011; 40 attendees): This meeting included an introduction to the SWAP process, the local watershed organization (GVC), and the Area I Steering Committee members. A description of watersheds, county goals, environmental requirements (see Section 1.3), and a SWAP framework was presented. The current conditions of Area I was presented based on desktop analysis and field assessments conducted. The GVC provided an overview of their organization and the programs they provide. The draft vision and goals were presented and attendees were asked to identify the top three most important 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. trash, erosion, etc.) in the watershed.

- **Stakeholder Meeting #2** (May 25, 2011; 16 attendees): Information presented at this meeting included upland and stream assessment field findings, discussion of homeowner restoration options, an overview of the County forest management program and plan for Oregon Ridge Park, and overview of fish and benthic species in the watershed. Stream and upland assessment (i.e. neighborhoods, institutions and hotspots) results were discussed. Potential restoration actions appropriate for the watershed based on data collected were presented (e.g. downspout disconnection, native plantings, fertilizer reduction, etc.). A citizen actions survey was conducted to gauge interest in the potential restoration options and help build a successful SWAP. Baltimore County presented an overview of the Forest Management efforts in the county and specifically the forest management plan developed for the Oregon Ridge Park. Participants were invited to a field trip at Oregon Ridge Park for a presentation and tour of the parks managed forest area. Last, a presentation by Baltimore County provided data on a fish and benthic species survey conducted in the watershed.

- **Stakeholder Meeting #3** (November 2, 2011; 23 attendees): An overview of the SWAP that has been developed for the Area I watershed was presented. This presentation included an overview of the SWAP process, watershed vision and goals, watershed characterization, municipal and citizen strategies, pollutant removal analysis, subwatershed prioritization, and SWAP implementation. A presentation on the care and maintenance of septic systems was provided by Baltimore County. Last, a presentation was presented that discussed actions that citizens can do to help improve the conditions of the watershed. This presentation also provided information on getting involved with the implementation of the Area I SWAP.

In addition to the Stakeholder Meetings an outreach activity was conducted by the steering committee during the SWAP development process as summarized below:

- Forest Management in Baltimore County Parks (June 8, 2011): The County held a tour and presentation of the Oregon Ridge Park managed forest area led by Don Outen of Baltimore County.

1.3 Environmental Requirements

This 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 sections below.

- National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit assessment and planning requirements
- Local Total Maximum Daily Load (TMDL) reductions for total phosphorus, fecal coliform, fish and benthic assessments, methylmercury, and sediment for Area I
- Chesapeake Bay TMDL reductions for nutrients (total nitrogen, total phosphorus) and sediment to meet water quality standards
- Baltimore Reservoir Watershed Management Program requirements

1.3.1 NPDES MS4 Permit

Many requirements of Baltimore County's NPDES permit (99-DP-3317, MD0068314) will be addressed by this plan. One of these requirements is to systematically assess the water quality and develop restoration plans for all watersheds within the county. These assessments must include the following:

- Provide for public participation in the development and implementation of watershed restoration activities
- Determine current water quality conditions
- Identify and rank water quality problems
- Identify all structural and non-structural water quality improvement opportunities
- Report the results of a visual watershed inspection

- Specify an estimated cost and a detailed implementation schedule for identified improvement opportunities

The county's existing NPDES permit also requires the county to address runoff from 20 percent of existing impervious cover. The draft NPDES permit for the next cycle is not finalized, but most likely will include additional restoration of impervious cover and development of TMDL Implementation Plans for both „local' TMDLs (i.e. for watersheds located within Baltimore County) and the Chesapeake Bay TMDL.

1.3.2 Local TMDLs

Area I contains 6% of the Loch Raven Reservoir watershed drainage area. As such, a summary of water quality impairments is provided for the Loch Raven Reservoir watershed. The Loch Raven Reservoir watershed is listed as impaired in the Maryland 303(d) list of impaired waters for several pollutants of concern including: fecal coliform (2008 listing), methylmercury (2002 listing), sedimentation and siltation (1996 listing), total phosphorous (1996 listing) and impacts to benthic/fish communities (2002 listing) (MDE, 2008). Table 1-2 provides a summary of the impairment listing and status.

Table 1-2: Water Quality Impairment Listing and Status

Impairment (Year Listed)	Water Type	TMDL Status	Applicable Designated Use
Sedimentation/siltation (1996)	Reservoir	TMDL Approved (2007) [1]	Aquatic Life and Wildlife
Total Phosphorus (1996)	Reservoir	TMDL Approved (2007) [1]	Drinking Water Supply
Impacts to Benthic and Fish Communities (based on completed bioassessments (2002))	Streams (1st – 4th order streams)	TMDL Required	Aquatic Life and Wildlife
Methylmercury-fish tissue (2002)	Reservoir	TMDL Approved (2004)	Fishing
Fecal Coliform (2008)	Streams (Mainstem River)	TMDL Approved (2009)	Water Contact Sports

[1] TMDLs for both total phosphorus and sediment were set simultaneously and are dependent on each other.

Impairment listings reflect the inability to meet water quality standards for the designated uses. The Maryland Department of the Environment (MDE) has designated the Gunpowder River above Loch Raven Reservoir as Use III-P, defined as Nontidal Cold Water and Public Water Supply. The designated uses include: water contact sports, leisure activities involving direct contact with surface water, fishing, growth and propagation of trout and other fish, aquatic life and wildlife, agricultural water supply, industrial water supply, and public water supply.

Four TMDLs have been completed for the Loch Raven Reservoir watershed (Table 1-2). These include sedimentation/siltation, total phosphorus, fecal coliform, and methylmercury-fish tissue. In Area I, the benthic/fish community impairment is most relevant. However, according to MDE the stream biological community impairment listing has a low priority and a TMDL will be developed at some point in the future (MDE, 2008). While the impairments documented in Area I subwatersheds are a lower priority, they may also be contributing to the downstream impairments in the river mainstem and the reservoir impoundment.

A single TMDL was developed for total phosphorus and sedimentation/siltation that was approved by MDE in 2007 and is included as Appendix F. Sources of total phosphorus include surface runoff from urban and agricultural land uses in addition to discharge from small industrial sources and the Hampstead Municipal Waste Water Treatment Plant (WWTP). An abundance of total phosphorus creates an environment of excess nutrients that leads to algal blooms. When the algae die, they consume oxygen from the reservoir that decreases the available oxygen to support aquatic life. The algae can also impart a noxious taste and odor to the drinking water that increases water treatment costs. In order to meet the water quality standards, a 50% target reduction of total phosphorus was established.

Sources of sediment in the Loch Raven Reservoir include urban, agricultural, and stream erosion. Sediment accumulation within the reservoir limits the storage capacity and therefore impacts its ability to function as a water supply reservoir. Excessive sedimentation can also negatively impact the fish population and recreational uses. Some of the total phosphorus control measures will also control sediment as phosphorus often enters the reservoir attached to sediment particles. In order to meet the water quality standards, a target reduction of sediment was established as a 25% reduction.

The TMDL for fecal coliform bacteria was approved by MDE in 2009 and is included as Appendix G. Fecal bacteria are microscopic single-celled organisms (primarily fecal coliform and fecal streptococci) found in the wastes of warm-blooded animals. Excessive amounts of fecal bacteria in surface water used for recreation result in an increased risk of pathogen-induced illness to humans. Known sources of bacteria include pet, human, livestock, and wildlife categories. In order to meet water quality standards, bacteria levels measured at the monitoring station downstream of Area I must be reduced by 80.2% (MDE, 2009).

The TMDL for methylmercury in fish tissue was approved by MDE in 2004. Based on early data on mercury in fish tissue from a subset of lakes across the state, MDE announced a statewide fish consumption advisory for lakes. This advisory was established statewide as a precautionary measure because the primary source of mercury is understood to be atmospheric deposition, which is widely dispersed. Based on additional fish tissue data, Maryland has verified that Loch Raven Reservoir is impaired due to mercury in fish tissue. Methylmercury is formed from inorganic mercury by the action of anaerobic organisms that live in aquatic systems including lakes, rivers, wetlands, sediments, soils and the open ocean. This methylation process converts inorganic mercury to methylmercury in the natural environment. Limited options exist to address a methylmercury TMDL through stormwater discharge regulations or practices because the pollution is transported through air deposition. In Maryland, the major sources of mercury air emissions are as follows: 43% power plants, 31% municipal waste combustors, 19% medical waste incinerators, 6% Portland Cement plants, and 1% other (e.g., landfills, oil-fired power plants, other industries) (MDE, 2002).

1.3.3 Chesapeake Bay TMDL

The Chesapeake Bay TMDL was finalized in 2010 by the EPA to restore the Chesapeake Bay and local waterbodies by 2025. This TMDL allocates nutrient and sediment reductions for each bay state and for Maryland that includes a 25 percent reduction in nitrogen, 24 percent reduction in phosphorus and 20 percent reduction in sediment. These reductions were further broken down by county and major river basin. At the state level, Phase 1 Watershed Implementation Plans (WIPs) were developed to determine how each state will help meet pollutant reductions. Phase II WIPs are being developed by each county to outline a strategy to meet pollutant load allocations. This SWAP will be integrated into Baltimore County's Phase II WIP with the other SWAPs already developed. The Phase II WIP will provide the strategy to meet Chesapeake Bay TMDL pollutant load reductions.

1.3.4 Baltimore Reservoir Watershed Management Program

Due to pollution problems in the reservoirs, in 1979, Baltimore City, Baltimore County and Carroll County, Maryland developed a formal agreement to manage the three reservoir watersheds (i.e. Liberty, Prettyboy and Loch Raven) that serve as the major drinking water supply for the region as well as provide recreational opportunities and habitat. In 1984, an updated agreement was signed with an Action Strategy for the reservoir watersheds that recommended actions to reduce sediment and nutrient pollution to reservoirs. In 1990, the 1984 Agreement and Action Strategy were reaffirmed by the new political leadership. In 2005, an entirely new Agreement and Action Strategy was developed to address TMDLs and other emerging contaminants of concern (e.g., salt). The signatories to the 2005 agreement include Baltimore County, Baltimore City, Carroll County, Maryland Department of Environment, Maryland Department of Agriculture, Baltimore County Soil Conservation District, Carroll County Soil Conservation District, Reservoir Watershed Protection Committee, and the Baltimore Metropolitan Council.

1.4 USEPA Watershed Planning A-I Criteria

The Clean Water Act (CWA) was amended in 1987 and established the Section 319 Nonpoint Source Management Program, after recognizing the need for federal assistance with 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 human activities, wildlife and atmospheric deposition, and is deposited on the ground to eventually be carried to receiving waters by stormwater runoff. Common NPS pollutants and sources include:

- Excess fertilizers, herbicides, and insecticides from agricultural and residential lands
- Oil, grease, and toxic chemicals from urban runoff
- Sediment from improperly managed construction sites, agricultural and forest lands, and eroding stream banks
- Bacteria and nutrients from livestock, wildlife, pet waste, and failing septic systems

CWA Section 319 grant funds can be requested to support nonpoint source related 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 plans to restore impaired water bodies and address nonpoint source pollution using Section 319 funds must meet USEPA's nine minimum elements, known as the "A through I criteria" for watershed planning. The "A through I criteria" are summarized below:

A. Identification of the causes and sources that will need to be controlled to achieve the load reductions estimated in the watershed plan
B. Estimates of pollutant load reductions expected through implementation of proposed nonpoint source (NPS) management measures

C. A description of the NPS management measures that will need to be implemented
D. An estimate of the amount of technical and financial assistance needed to implement the plan
E. An information/education component that will be used to enhance public understanding and encourage participation
F. A schedule for implementing the NPS management measures
G. A description of interim, measurable milestones
H. A set of criteria to determine load reductions and track substantial progress towards attaining water quality standards
I. A monitoring component to determine whether the watershed plan is being implemented

This Area I SWAP meets the A through I criteria. Table 1-3 shows where these criteria are addressed throughout this document.

Table 1-3: U.S. EPA Watershed Planning "A-I" Criteria

Chapter of the Report	USEPA A-I Criteria								
	A	B	C	D	E	F	G	H	I
Chapter 1. Introduction					X				
Chapter 2. Vision, Goals and Objectives			X						
Chapter 3. Restoration Strategies	X	X	X		X			X	
Chapter 4. Subwatershed Management Strategies	X		X		X				
Chapter 5. Plan Evaluation						X	X	X	X
Appendix A. Area I Action Strategies			X	X	X	X	X		X
Appendix B. Cost Analysis and Potential Funding Sources				X					
Appendix C. Chesapeake Bay Program Pollutant Load Reduction Efficiencies		X						X	
Appendix D. U.S. Environmental Protection Agency A Through I Criteria for Watershed Planning									
Appendix E. Area I Watershed Characterization Report	X	X	X		X				

Chapter of the Report	USEPA A-I Criteria								
	A	B	C	D	E	F	G	H	I
Appendix F. TMDL for phosphorus and sediment for the Loch Raven Reservoir	X								
Appendix G. TMDL for Fecal Bacteria for the Loch Raven Reservoir	X								
Appendix H. TMDL for Mercury in Loch Raven Reservoir	X								
Appendix I. Baltimore County Synoptic Survey Results	X								
Appendix J. Biological Assessment of Beaverdam Run Watershed	X								
Appendix K. Stream Corridor Assessment Survey Data	X								
Appendix L. Uplands Survey Data	X								

1.5 Partner Capabilities

In order to achieve effective watershed restoration, the capabilities of many organizations must be brought together and coordinated. Within Area I partner organizations include Baltimore County EPS, Baltimore City Reservoirs, Gunpowder Valley Conservancy, Oregon Ridge Park, Falls Road Community Association, The Valleys Planning Council, and Baltimore Ecosystem Study.

1.5.1 Baltimore County Environmental Protection and Sustainability (EPS)

Baltimore County EPS has a waterway restoration program to implement restoration projects, including stream restoration, stormwater conversions and retrofits, and reforestation projects. Baltimore County has an extensive monitoring program that assesses the current ambient water quality, efficiency of various restoration projects in relation to pollutant removal and biological community improvement, and tracks trends over time. The county also has an illicit connection program that monitors storm drain outfalls, tracks pollutant sources, and coordinates remediation.

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

1.5.2 Baltimore City Reservoir Natural Resources Section

The City of Baltimore, Reservoir Natural Resources Section, is responsible for the management of the three City-owned drinking water reservoirs (Liberty, Prettyboy and Loch Raven) and the surrounding forest buffers. Overall the City manages approximately 24,580 acres of property within Baltimore and Carroll Counties. Management activities include water quality monitoring, forest health assessments, roadway and access road maintenance, snow removal, and the development and enforcement of watershed regulations designed to protect the forest buffers and drinking water resources. The Reservoir Natural Resources Section is committed to the protection of the reservoirs and contiguous watershed lands from outside influences that would adversely impact the drinking water resource and interfere with providing the highest quality public water supply to consumers within the Baltimore Metropolitan area.

1.5.3 Gunpowder Valley Conservancy

The Gunpowder Valley Conservancy (GVC), a non-profit organization, serves as a bridge connecting citizens with programs and information that can help them become better stewards of the natural and historical resources in the watershed. The GVC mobilizes people and resources to care for the land, water and character of the Gunpowder watershed. The main focus of the organization is on land preservation, restoration, stream adoption and education. In addition, the GVC works with homeowners to reduce stormwater runoff from their yard through installation of rain barrels and rain gardens.

1.5.4 Oregon Ridge Park

Oregon Ridge Park is Baltimore County's largest park. The 1,043 acre park in Cockeysville, Maryland is operated by the Baltimore County Recreation and Parks Department. The park has numerous recreation opportunities that include walking and hiking trails, a swimming beach, nature center, picnic areas, a lodge, and cross-country skiing and sledding. The park is located in the Oregon Branch and Baisman Run subwatersheds. The Oregon Ridge Nature Center organizes environmental education opportunities that include canoeing, nature walks, and other programs.

1.5.5 Falls Road Community Association

The Falls Road Community Association, Inc. (FRCA) was formed in 1947 by community leaders who anticipated growth on Chestnut Ridge in Baltimore County and desired to bring the views of the residents into the planning process. Throughout the rapid growth of the county in recent years, FRCA has been the voice of the residents in legislative and land use issues, and in discussions about what should or should not happen whenever these matters impact the community. Today the FRCA represents households in a large crescent from I-695 north to Shawan Road and from Greenspring east to I-83. The FRCA currently works to balance impacts from development in the community.

1.5.6 The Valleys Planning Council

Started in the early 1960's, The Valleys Planning Council (VPC), works to conserve open space that protects Baltimore County's agricultural, natural, historic and scenic resources. The VPC also works to promote a balanced and rational use of the land for the benefit of present and future generations. The VPC works in a 130 square mile area in the northwest quadrant of Baltimore County that stretches east and west from Rt. 30 to I-83, and stretches north to south from I-695 to the Prettyboy Reservoir.

The Valleys Planning Council represents over 500 member families within a 130-square-mile area of northwestern Baltimore County. While the geographic scope of the council's work is limited to this area, studies and legal precedents often have a county-wide (or wider) impact. The Valleys Planning Council has been at the forefront of land use planning and preservation for more than four decades.

1.5.7 Baltimore Ecosystem Study

The Baltimore Ecosystem Study (BES) is a National Science Foundation Long Term Ecological Research site where research data on an ecological system has been collected at a set of sampling stations in the Gwynns Falls watershed, and in a forested reference site, Pond Branch, that is located in the Beaverdam Run subwatershed. Baisman Run is also part of the long-term monitoring effort with low density residential as it major land use. As a part of the National Science Foundation's Long-Term Ecological Research Network, BES seeks to understand how Baltimore's ecosystems change over time. The ecological knowledge derived from BES supports educational and community-based activities, and interactions with the Baltimore community.

1.6 Area I Overview

The Area I watershed consists of three subwatersheds that drain to the Loch Raven Reservoir watershed: Baisman Run, Beaverdam Run, and Oregon Branch located west of I-83. Portions of Beaverdam Run and Oregon Branch extend to the east of I-83 into areas with more urban land use and will be included in a separate SWAP. Area I is approximately 8,350 acres (13.05 mi^2) or six percent of the Loch Raven Reservoir watershed.

The Area I watershed is located outside the Urban Rural Demarcation Line (URDL) that ensures limited development in the watershed. The land use in the watershed is dominated by low density residential (46.5%), forested (22.5%), and agricultural (14.7%). The watershed has a low impervious cover of 6.5%. The soils in the watershed consist of mostly hydrologic soil groups B (61%) and C (32.8%) with moderate to low infiltration rates. The total population for the watershed is 5,549 people based on the 2000 census which translates into a low average population density of 0.7 people/acre. The watershed consists of 66.2 miles of streams that were assessed during the development of the SWAP and generally found to be well forested, stable systems.

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

Table 1-4: Area I Key Watershed Characteristics

Key Watershed Characteristics	Subwatershed			Total
	Baisman Run	Beaverdam Run	Oregon Branch	
Drainage Area (acres)	1,056.0 (1.65 mi^2)	4,984.6 (7.79 mi^2)	2,309.4 (3.61 mi^2)	**8,350.0 (13.05 mi^2)**
Stream Miles	11.4	33.6	21.2	**66.2**
Jurisdiction	Baltimore County			
Total Population (2000 Census)	432	4,405	712	**5,549**
Land Use/Land Cover (%)				
Very Low Density Residential (Agricultural)	0.9%	1.9%	3.0%	**2.0**%
Very Low Density Residential (Forested)	6.7%	10.1%	6.7%	**8.7**%
Low Density Residential	36.0%	63.7%	13.9%	**46.5**%

Key Watershed Characteristics	Subwatershed			Total
	Baisman Run	**Beaverdam Run**	**Oregon Branch**	
Commercial	0.0%	1.2%	0.5%	**0.9**%
Industrial	0.0%	0.1%	0.0%	**0.1**%
Institutional	0.5%	0.0%	0.2%	**0.1**%
Open Urban Land	0.0%	1.3%	11.5%	**4.0**%
Agriculture	0.4%	6.8%	38.0%	**14.7**%
Forest	55.6%	14.4%	24.8%	**22.5**%
Transportation	0.0%	0.3%	1.4%	**0.5**%
Impervious Cover (%)	4.1%	7.7%	4.9%	**6.5**%
Hydrologic Soil Group (%)				
A (low runoff potential)	0.0%	0.0%	0.0%	**0.0%**
B	76.0%	63.9%	48.0%	**61.0%**
C	21.8%	28.2%	47.9%	**32.8%**
D (high runoff potential)	2.2%	7.7%	0.4%	**5.0%**

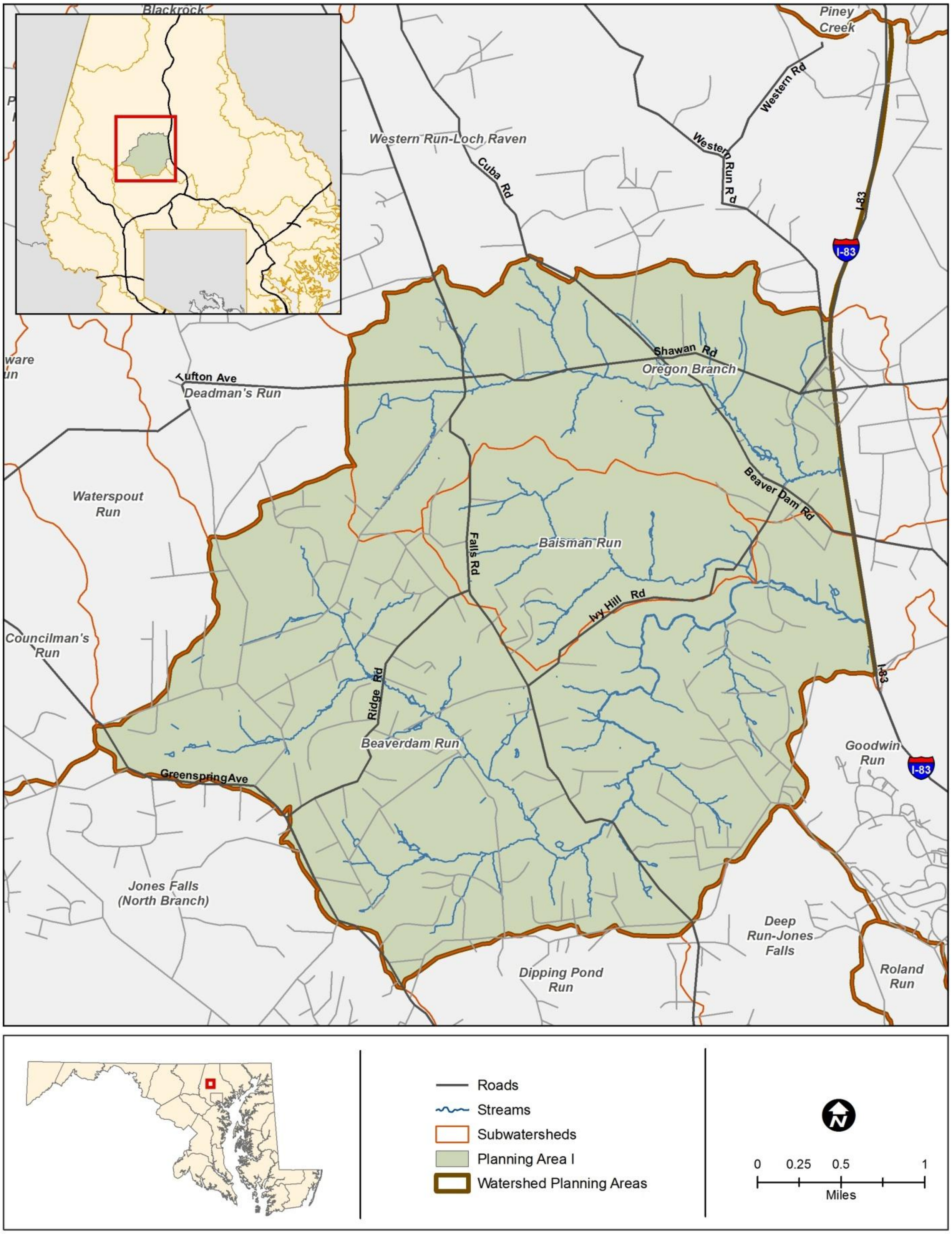

Figure 1-1: Area I SWAP Subwatersheds

1.7 Report Organization

This report is organized into the following five major chapters:

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

Chapter 2 presents the watershed vision, goals and objectives for restoring the Area I watershed.

Chapter 3 describes the types of watershed restoration practices planned for Area I and estimated pollutant load reductions.

Chapter 4 discusses prioritization of restoration of the three subwatersheds in the Area I watershed and summarizes subwatershed specific restoration and protection strategies.

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

This volume (Volume 1) also includes the following appendices with additional, detailed information used to develop and support this SWAP:

- Appendix A: Area I Action Strategies
- Appendix B: Cost Analysis and Potential Funding Sources
- Appendix C: Chesapeake Bay Program Pollutant Load Reduction Efficiencies
- Appendix D: U.S. Environmental Protection Agency A Through I Criteria for Watershed Planning

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

- Appendix E: Area I Watershed Characterization Report
- Appendix F: Total Maximum Daily Loads of Phosphorus and Sediments For

Loch Raven Reservoir and Total Maximum Daily Loads of Phosphorus for Prettyboy Reservoir, Baltimore, Carroll and Harford Counties, MD and York County, PA (MDE, 2006)

- Appendix G: Total Maximum Daily Loads of Fecal Bacteria for the Loch Raven Reservoir Basin in Baltimore, Carroll and Harford Counties, Maryland (MDE, 2009)
- Appendix H: Total Maximum Daily Loads of Mercury for Loch Raven Reservoir in Baltimore County, Maryland (MDE, 2002)
- Appendix I: Baltimore County Synoptic Survey Results
- Appendix J: Biological Assessment of Beaverdam Run Watershed
- Appendix K: Stream Corridor Assessment Survey Data
- Appendix L: Uplands Survey Data

CHAPTER 2.0

Vision, Goals and Objectives

2.1 Vision Statement

The Area I Steering Committee adopted the following vision statement that acted as a guide in the development of the SWAP:

Our vision is a watershed that supports healthy, diverse, and balanced ecosystems.

2.2 Area I SWAP Goals and Objectives

The Steering Committee created a vision statement for Area I and identified nine goals to define the desired improvements. The goals were refined based on feedback from watershed residents at stakeholder meetings. Stakeholders were given the opportunity to rank the importance of goals and raise any additional issues of importance to the community. Stakeholder participation is important to ensure the implementation and success of the plan. To achieve watershed goals, stakeholders then identified the type of restoration activities that are of interest. The watershed goals, organized by category, are provided below:

GOALS:

<u>Clean Water</u>

- Goal 1: Improve and maintain stream conditions
- Goal 2: Reduce pollution from stormwater runoff
- Goal 3: Decrease bacterial contamination in streams

<u>Stream Protection</u>

- Goal 4: Protect high quality streams
- Goal 5: Promote environmentally sensitive development

<u>Forest and Habitat</u>

- Goal 6: Promote tree planting, reforestation and forest sustainability
- Goal 7: Restore and maintain aquatic and terrestrial biodiversity

<u>Agricultural Practices</u>

- Goal 8: Promote implementation of conservation practices on agricultural lands

Stewardship

- Goal 9: Support environmental stewardship

The following sections present a discussion of each of the nine goals for restoring and protecting the Area I watershed that are organized by category. For each goal, a series of objectives was developed to ensure that the plan will meet each goal. Measurable action items for each objective are presented in Appendix A.

Clean Water

2.2.1 Goal 1: Improve and Maintain Stream Conditions

Area I drains into the Loch Raven Reservoir watershed that is designated as Use III-P, defined as Nontidal Cold Water and Public Water Supply. Through community awareness, capital projects, and citizen actions, stream quality can be improved or maintained.

Objectives:

1. Effectively communicate the mission of the SWAP and the importance of a healthy watershed to community groups and leaders.
2. Implement stream and habitat restoration projects to stabilize streams, reduce erosion, and reconnect streams to floodplains.
3. Promote and increase use of Bayscaping, Bay-Wise landscape management, and rain gardens on existing and proposed properties.

2.2.2 Goal 2: Reduce Pollution from Stormwater Runoff

Throughout the watershed, stormwater runoff carries sources of pollution to streams. Actions are needed in Area I to help achieve the phosphorus and sediment Total Maximum Daily Loads (TMDL) for the Loch Raven Reservoir watershed. Reducing sources of non-point source pollution and implementing more effective stormwater management will reduce pollution in the stream system.

Objectives:

1. Meet TMDL goal to reduce phosphorus by 50%.
2. Meet TMDL goal to reduce sediment by 25%.
3. Convert old stormwater management (SWM) facilities to more efficient best management practices (BMPs) and implement stormwater control practices throughout the watershed to the maximum extent practicable.

4. Create riparian buffer where it is lacking and enhance existing riparian buffers to filter runoff and provide habitat.
5. Reduce fertilizer/pesticide/herbicide use on lawns throughout the watershed.

2.2.3 Goal 3: Decrease Bacterial Contamination in Streams

Fecal bacteria are microscopic single-celled organisms (primarily fecal coliform and fecal streptococci) found in the wastes of warm-blooded animals. Excessive amounts of fecal bacteria in surface water used for recreation are known to indicate an increased risk of pathogen-induced illness to humans. A TMDL for fecal coliform was developed for the tributaries that drain to the Loch Raven Reservoir. The primary sources of fecal coliform identified in the TMDL are wildlife (mammals and waterfowl), humans (septic systems), pets, and livestock (agricultural livestock). The bacteria monitoring station downstream of Area I must realize a 80.2% reduction in bacteria to meet the TMDL requirement. Reductions in bacterial contamination in streams can be achieved through TMDL implementation in both the urban and rural sections of Area I.

Objectives:

1. Meet TMDL goal to reduce bacteria by 80%.
2. Promote proper disposal of pet waste to reduce bacteria from the watershed.
3. Promote proper maintenance of septic systems.
4. Promote the use of agricultural Best Management Practices to reduce bacteria.

Stream Protection

2.2.4 Goal 4: Protect High Quality Streams

The streams in Area I currently are in good condition and some support native brook trout. In addition, Area I currently has a low impervious cover of 6.5 percent that is an indicator of good stream health (Schueler et al. 2009). The fish and benthic index of biological integrity (IBI) data indicate good to fair conditions in the majority of the watershed with well-forested, lightly developed stream reaches. Activities should be conducted to ensure the protection of these high quality streams.

Objectives:

1. Monitor aquatic populations and, if needed, implement habitat restoration projects including fish blockage removal and riparian buffer enhancement to remove biological impairments.

2. Monitor for sources of water pollution and trends over time.
3. Promote preservation of riparian and upland forest cover to reduce pollutant loads in runoff.
4. Perform stream restoration and stabilization projects to connect high quality stream reaches.

2.2.5 Goal 5: Promote Environmentally Sensitive Development

The strategy for this goal is to ensure that what development does occur is built in an environmentally sensitive fashion. Environmentally sensitive development reduces the impact on the land by preserving natural areas, providing on-site stormwater treatment, and minimizing the creation of impervious surfaces. This type of development limits the amount of disturbance to conservation areas including forest and open land. A reduction in runoff and pollutant loads is achieved through the use of stormwater management facilities that include filtration/infiltration techniques in addition to the reduction of impervious cover put on the ground.

Objectives:

1. Continue to apply Baltimore County's forest buffer regulations to enhance and protect streams.
2. Continue to enforce sediment and erosion control practices and, when required by MD law, apply new sediment and erosion control regulations to projects.
3. Continue to apply forest conservation regulations to enhance and protect natural resources.
4. Continue implementing stormwater management regulations that increase the use of non-structural techniques using Environmental Site Design (ESD) guidelines to the maximum extent possible.

<u>Forest and Habitat</u>

2.2.6 Goal 6: Promote Tree Planting, Reforestation and Forest Sustainability

Trees and forests provide a host of benefits that include cleaning the air we breathe, reducing stormwater runoff and pollutants, providing habitat for wildlife, reducing the cost of heating and cooling, and providing recreation and aesthetic benefits. Trees and forests reduce stormwater runoff by increasing evapotranspiration into the air and infiltration of rainwater into the soil. The presence of trees also helps to slow down and temporarily store runoff, which further promotes infiltration, and decreases flooding and erosion downstream. In addition, trees and forests reduce pollutants by transforming them into less harmful substances. In Area I, several opportunities for tree planting were identified along stream banks, in neighborhoods, commercial and institutional areas. Also, the Forest Health Assessment and Management Plan for Oregon Ridge Park should continue to be implemented.

Objectives:

1. Work with rural residential landowners and the multiple owners of contiguous forest patches to increase the tree canopy and forest health through implementation of Forest Management Plans.
2. Plant native trees on institutional properties identified in the upland assessment.
3. Reforest open pervious areas to increase riparian buffers where possible, and promote natural habitats.
4. Increase riparian forest buffer on agricultural land.
5. Control exotic invasive plants in forest areas and encourage residents, institutions and businesses to remove invasive species from their properties and replace with native species.
6. Maintain and restore the health of watershed forests and promote sustainable forest management.
7. Encourage native tree and vegetation planting on residential properties.
8. Implement the Forest Health Assessment and Management Plan for Oregon Ridge Park.

2.2.7 Goal 7: Restore and Maintain Aquatic and Terrestrial Biodiversity

An abundance of aquatic and terrestrial biodiversity is a good indicator of a healthy watershed. Enhancing and maintaining the aquatic and terrestrial biodiversity in Area I will preserve habitats and ecosystems in the Loch Raven Reservoir and Chesapeake Bay. Addressing the Maryland 303 (d) listed impairment for impacts to the benthic/fish community will help maintain aquatic biodiversity. In addition, on-going efforts to manage the deer population should be continued.

Objectives:

1. Restore and protect portions of the stream network, such that conditions can support diverse aquatic and riparian communities.
2. Protect and enhance native brook trout habitat.

3. Monitor for sources of water pollution and aquatic habitat degradation and trends over time.
4. Create riparian buffers and enhance existing riparian buffers to provide quality understory and forest canopy to provide habitat and improve water quality.
5. Investigate and promote deer population management strategies.

Agricultural Practices

2.2.8 Goal 8: Promote the Implementation of Conservation Practices on Agricultural Lands

Agricultural practices (cropland, orchards, and pasture including horse farms) make up the third largest land use (14.7 percent) in Area I. This goal attempts to integrate the use of established, as well as new or innovative, conservation practices on all agricultural lands. There are a large number of proven agricultural practices that can be used by farmers to reduce pollutant runoff by reducing soil loss, trapping nutrients, and minimizing the amounts of nutrients and pesticides used on the land. The use of these practices will also help meet other watershed goals to maintain and restore stream conditions and aquatic biodiversity, and reduce pollution from stormwater runoff including bacteria.

Objectives:

1. Continue to promote agricultural conservation/best management practices designed to improve water quality by way of outreach, education and technical support to the farming community through existing agencies such as University of Maryland Extension Baltimore County, and Soil Conservation District.
2. Provide outreach to small horse farms, and home gardeners.
3. Educate the agricultural community on the need to improve the quality of stream buffers.
4. Encourage preservation and stewardship through conservation easements.

Stewardship

2.2.9 Goal 9: Support Environmental Stewardship

Direct outreach to communities in the watershed is key to the success of the SWAP. Resources need to be available to educate community members regarding measures they can take in their communities and on their individual properties to enhance water quality and monitor stream conditions. Additionally, connecting watershed stakeholders to the high quality resources in the watershed provides opportunities for education and outreach, and encourages a greater sense of watershed stewardship. An abundance of outdoor activities in the watershed, including hiking, swimming, fishing, and equestrian activities present opportunities for stewardship awareness.

Objectives:

1. Promote conservation practices for homeowners.
2. Provide environmental awareness and stewardship opportunities for the public.
3. Maintain trails to prevent erosion and encourage recreation in Oregon Ridge Park.
4. Promote stream stewardship, particularly on catch and release trout streams.

2.3 Area I SWAP Action Strategies

Action strategies describe the method used to achieve the objective and ultimately the water quality goal. An example of an action strategy for phosphorus reduction could be “reducing fertilizer use on five acres in neighborhoods identified as high maintenance lawns” in a given subwatershed. 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., acres of impervious area treated by converted SWM facilities). However, the numerical values assigned to these actions are to serve as a guide rather than as an absolute measure in achieving watershed goals and objectives. Chapter 3, Section 3.5 quantifies the pollutant reduction analysis for achieving water quality goals. It is intended that the actions address multiple watershed goals and objectives. Appendix A provides a table that lists the action strategies proposed for Area I and the related goals and objectives.

The general types of restoration strategies proposed for the Area I watershed are discussed further in Chapters 3 and 4. The SWAP emphasizes an adaptive management approach in the implementation process. This approach includes evaluating the success of SWAP implementation over time (see Chapter 5) and modifying action strategies based on effectiveness, community acceptance, and funding availability.

CHAPTER 3.0

Restoration Strategies

3.1 Introduction

This chapter presents an overview of the key restoration strategies and associated pollutant load reductions proposed for restoring the Area I watershed. A complete list of actions proposed for the watershed including goals and objectives targeted, timelines, performance measures, cost estimates, and responsible parties is included in Appendix A. The key restoration strategies are the focus of this chapter ranging from stream restoration capital projects to public education and outreach. It is important that a combination and variety of restoration practices are implemented to engage citizens and meet watershed-based goals and objectives.

The Area I watershed restoration and preservation will occur as a partnership between the local government, watershed groups and citizens. All partners are critical to the success of the overall watershed restoration strategy. Local governments can implement large capital projects such as stormwater retrofits, stream restoration, changes in municipal operations, and large-scale public awareness. Watershed groups and citizens can implement locally based programs such as tree planting and downspout disconnection that require citizen participation, and increase awareness. Therefore, key restoration strategies are divided into three categories: urban municipal strategies (Section 3.2), urban citizen-based strategies (Section 3.3), and agricultural best management practices (Section 3.4). It is important that all groups are active in restoration activities and that a variety of projects are implemented.

The watershed pollutant loading analysis performed to estimate current nutrient loads generated by the various non-point sources within the Area I watershed is discussed in Section 3.3. Section 3.4 discusses the pollutant removal calculations for proposed best management practice (BMP) strategies discussed in Sections 3.2 and 3.3 to ensure that total maximum daily load (TMDL) requirements are met in the Area I watershed.

3.2 Urban Municipal Strategies

The Baltimore County government 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 Area I are discussed in the following sections.

3.2.1 Stormwater Management

Increased importance of water quality and water resource protection led to the development of the Maryland Stormwater Design Manual which provided BMP design standards and environmental incentives (MDE, 2000). The manual was updated to adopt low impact practices that mimic natural hydrologic processes to restore pre-development conditions. The Maryland Stormwater Act of 2007 requires that environmental site design (ESD) be implemented to the maximum extent practicable via nonstructural BMPs and/or other improved site design techniques. The intent of ESD BMPs is to distribute and reduce flow through multiple small BMPs throughout a development site and reduce stormwater runoff leaving that site. This will also reduce pollutant loads and sediment caused by erosive velocities.

A total of 73 existing SWM facilities are located within the Area I watershed including dry and wet ponds, wetlands, infiltration/filtration practices, extended detention, and proprietary BMPs. Existing SWM facilities treat a total drainage area of approximately 980.7 acres of urban land or 12 percent of the total urban land use in the watershed.

3.2.2 Stormwater Management Conversions

Detention ponds are typically designed to address water quantity only (flood control) and therefore, provide almost no pollutant removal. Therefore, they are good candidates for conversion to a type of facility that provides water quality benefits in addition to quantity control. Five existing dry detention ponds within the Area I watershed were investigated for potential conversion to an extended detention facility or other practice that provides greater water quality benefits. Dry extended detention ponds are designed to capture and retain stormwater runoff from smaller more frequent storms (e.g., 1 year) for a minimum duration (e.g., 24 hours) to allow sediment and pollutants to settle while also being able to provide flood control if additional storage is incorporated into the design. Out of the five dry detention ponds assessed, four were considered to have potential for conversion for water quality.

3.2.3 Stormwater Retrofits

Stormwater retrofits involve implementing BMPs in existing developed areas where SWM practices do not exist to help improve water quality. Stormwater retrofits improve water quality by capturing and treating runoff before it reaches the receiving water body. Potential sites for upland stormwater retrofits within the conveyance system were identified in several locations. Potential retrofits include the conversion of grass ditches to wet or dry swales in three neighborhoods and a gravel area that could be used to treat stormwater runoff.

Impervious surfaces including roads, parking lots, rooftops, and other paved surfaces prevent precipitation from naturally infiltrating into the ground. As a result, impervious surface runoff can result in erosion, flooding, habitat degradation, and increased pollutant loads in receiving water bodies. Subwatersheds with high amounts of impervious cover are more likely to have degraded stream systems and are larger contributors to water quality problems in a watershed than those that are less developed as discussed in Appendix E, Chapter 2.3.3. Removing impervious cover and converting to pervious or forested land will help promote infiltration of runoff and reduce pollutant loads from overland runoff. There were no areas identified for impervious cover removal in Area I. While not included in pollutant reduction calculations, awareness and outreach tools could be used to inform residents of the water quality impacts associated with large impervious parking lots, driveways or patios and the options available for conversion to or incorporating more permeable surfaces. Homeowners can reduce the stormwater runoff from impervious cover around their homes by disconnecting downspouts, installing permeable pavement in driveway, and installing Bayscaping.

3.2.4 Stream Corridor Restoration

Stream restoration practices are used to enhance the appearance, stability, and aquatic function of urban stream corridors. Stream restoration practices range from routine stream cleanups and simple stream repairs such as vegetative bank stabilization and localized grade control to comprehensive repairs such as full channel redesign and realignment. Stream corridor assessments (SCAs) performed in the Area I watershed showed opportunities for stream repair and buffer reforestation. Stream segments identified during the SCAs with significant erosion and channel alteration are used to estimate pollutant load reductions which would result from stream repair efforts. Stabilizing the stream channel improves water quality by preventing soils, and the pollutants contained in them, from eroding from the bank and entering the watershed. Lengths of eroded and altered channel segments were recorded during the SCAs.

3.3 Urban 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 water bodies within the watershed that would otherwise not be possible.

Citizen participation is critical to the implementation and long-term maintenance of restoration activities. Key citizen-based strategies proposed for restoring the Area I watershed are discussed in the following sections.

3.3.1 Reforestation

Trees help improve water quality by capturing and removing pollutants in runoff including excess nutrients through their roots before the pollutants enter groundwater and streams. Tree leaves and branches also intercept precipitation which helps to reduce the energy of raindrops and prevent erosion resulting from their impact on the ground. In addition to water quality improvements, 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 which reduces cooling costs in the summer. Incentive programs, such as Tree-Mendous Maryland http://www.dnr.state.md.us/forests/treemendous, the State Highway Administration's Partnership Program for public property, and the Baltimore County Growing Home Campaign for private property http://www.baltimorecountymd.gov/Agencies/environment/growinghome, can help increase successful planting efforts. Several areas throughout the watershed are targeted for reforestation opportunities that are described in the following sections.

Riparian Buffer

Stream riparian buffers are critical to maintaining healthy streams and rivers. Forested buffer areas along streams can improve water quality and prevent flooding since they can filter pollutants, reduce surface runoff, stabilize stream banks, trap sediment, and provide habitat for various types of terrestrial and aquatic life including fish. Buffer encroachment from development was noted during 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. Urban open pervious (lawn) areas identified within the 100-foot stream buffer areas during the stream assessment and through a GIS analysis discussed in Appendix E 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 water bodies and reduce erosion. Publicly-owned lands requiring minimal site preparation are targeted for initial reforestation efforts.

Tree Plantings

Opportunities for tree planting were identified at several institutional sites in the watershed. Trees provide aesthetic value, and air and water quality benefits. They can provide shade and absorb nutrients through their root systems while also providing habitat for wildlife. Tree planting incentive programs mentioned previously can also help increase the success of planting efforts. Areas for tree plantings were identified during the institutional site assessment.

3.3.2 Urban Nutrient Management

Many common activities around homes can have a negative effect on water quality. Yards and lawns typically represent a significant portion of the pervious cover in an urban subwatershed and therefore, can be a major source of nutrients, pesticides, sediment, and runoff. Maintenance behaviors tend to be similar within individual neighborhoods and certain activities can impact subwatershed quality such as fertilizer, herbicide and pesticide use, lawn watering, landscaping, and trash/yard waste disposal. Urban nutrient management efforts related to lawn maintenance and Bayscaping can help reduce nutrient loads to nearby streams. Citizen awareness and behavior change is key to improved urban nutrient management.

Lawn Maintenance Education

Lawn maintenance activities often involve over-fertilization, improper use of herbicides and pesticides, and over-watering resulting in polluted runoff to local streams. Lawns with a dense, uniform grass cover or signs designating poisonous lawn care indicate high lawn maintenance activities. Neighborhoods identified as having high lawn maintenance issues are targeted for awareness programs emphasizing responsible fertilizing techniques such as proper application rates and time of year for fertilization, soil testing for nutrient requirements and keeping fertilizers off impervious surfaces. Lawn maintenance education can be achieved through door-to-door canvassing, informational brochures/mailing, 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. During the Neighborhood Source Assessment, neighborhoods where 20 percent or more of the homes employ high lawn maintenance practices were identified for a fertilizer reduction/education program.

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, fertilizer, herbicides and pesticides to maintain as compared to non-native or exotic plants. This means that there will be 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 the Neighborhood Source Assessment.

Maryland Fertilizer Use Act of 2011

This act, which will ban phosphorus and provide a greater percentage of slow release nitrogen in fertilizer, will take effect in October of 2013. Fertilizer bags sold in hardware stores and nurseries will have better labeling and large applicators will have to be certified in proper fertilizer application. The acres of pervious urban land that this act applies to were calculated using GIS.

3.4 Agricultural Best Management Practices

There are many agricultural practices used by farmers to reduce soil loss, trap nutrients, and minimize the amounts of nutrients and pesticides used on the land. Key agricultural BMPs proposed for restoring the Area I watershed are discussed in the following sections.

3.4.1 Farm Conservation Plans

A Soil Conservation and Water Quality Plan (SCWQP) is a comprehensive plan that addresses natural resource management on agricultural lands and describes BMPs which will be used to control erosion and sediment loss and manage runoff. SCWQPs include management practices such as crop rotations, and structural practices such as sediment basins and grade stabilization structures. At the request of a farmer, a Soil Conservation District, Maryland Department of Agriculture (MDA) or USDA professional provides assistance to determine the practices needed to address specific runoff concerns on the farm. The practices are designed to control erosion within acceptable levels and to be compatible with management and cropping systems. A SCWQP can be used for up to ten years without revision if substantial changes in management do not occur. Nutrient reduction is only one of many benefits derived from SCWQPs. Also included in a SCWQP are recommendations concerning forestry management, wildlife habitat and plantings, pond construction and management, and other natural resource management practices. Based on data obtained from the Baltimore County Soil Conservation District, there are four SCWQP's in the Area I watershed. Best Management Practices that can be included in a SCWQP that apply to Area I are discussed below.

Streamside Forest Buffers

Streamside forest buffers are wooded areas along rivers and streams that help filter nutrients, sediments and other pollutants from runoff as well as remove nutrients from groundwater and reduce erosion. In addition to their ability to improve water quality, their value at enhancing terrestrial and aquatic habitat make forest buffers an important BMP for natural resources managers. Agricultural open pervious areas identified within the 100-foot stream buffer areas during the stream assessment and through a GIS analysis in Appendix E are good candidates for tree planting and are targeted for initial buffer reforestation efforts as identified in Appendix A.

Stream Protection with Fencing

Stream protection with fencing incorporates both alternative watering and installation of fencing along streams to exclude livestock. The fenced areas may be planted with trees or grass, but are typically not wide enough to provide the benefits of buffers. Stream fencing should be implemented so as to substantially limit livestock access to streams; however, it can allow for the use of limited hardened crossing areas where necessary to accommodate access to additional pastures or for livestock watering. By preventing or limiting access of livestock to streams, erosion from hooves and bacteria/nutrient contamination from cows in the stream is reduced. An assessment of acres for fencing is based on a GIS analysis of a cattle farm in the watershed.

Off-Stream Watering

Off-stream watering provides cattle an alternative drinking water source away from streams. By providing an off-stream watering source, cattle will reduce the time they spend near and in streams and stream banks. This will reduce animal waste deposition and heavy traffic areas near streams to more upland locations. This practice works in conjunction with the practice of stream protection with fencing. An assessment of acres for off-stream watering is based on a GIS analysis of a cattle farm in the watershed.

3.4.2 Nutrient Management Plans

Nutrient management plan (NMP) implementation refers to a comprehensive plan that describes the optimal use of nutrient inputs for crop yield to minimize loss of excess nutrients to the environment. A NMP details the type, rate, timing, and placement of nutrients for each crop. Soil, plant tissue, manure and/or sludge tests are used to assure optimal application rates. Plans are prepared by either the University of Maryland Extension or certified private consultants and are typically revised every year but may be written for up to three years to incorporate management, fertility and technology changes.

Data on the number of NMP's in Area I was obtained from the Maryland Department of Agriculture.

3.5 Pollutant Loading

This section presents results of the watershed pollutant loading analysis performed to estimate current nutrient loads generated by the various non-point sources within the Area I watershed. Also discussed are the pollutant removal calculations for proposed BMPs in Area I to help ensure that TMDL requirements will be met for the Loch Raven Reservoir.

3.5.1 Pollutant Loading Analysis

A pollutant loading analysis was performed to estimate total nitrogen and phosphorus loads currently generated by all non-point sources (i.e. runoff from all land uses) present within the Area I watershed. Estimates were based on Maryland Department of Planning's (MDP) 2007 Land Use/Land Cover (LU/LC) GIS layer and pollutant loading rates based on the following sources: technical guidance provided by the Maryland Department of the Environment's (MDE) User's Guide for Nutrient Load Analysis Spreadsheet in Support of the Water Resources Element (WRE), and the Chesapeake Bay Program (CBP) – Watershed Model Phase 4.3 and Phase 5.2 (CBP, 1998). Urban pervious and impervious nutrient loading rates are from CBP Model 5.2. The pollutant loading analysis is described in detail in Chapter 3.3 of the Watershed Characterization Report (Appendix E). Table 3-1 provides a summary of the results from the watershed pollutant loading analysis including areas, nutrient loading rates, and annual nutrient loads for each nonpoint source/land use type.

Table 3-1: Area I Total Nitrogen and Total Phosphorus Loads

WRE Land Cover	Area (Acres)	Total Nitrogen		Total Phosphorus	
		Rate (lbs/acre/yr)	Load (lbs/yr)	Rate (lbs/acre/yr)	Load (lbs/yr)
Impervious Urban	539	14.1	7,600	2.26	1,218
Pervious Urban	3,905	7.25	28,311	0.429	1,675
Cropland	1,095	16.55	18,122	0.72	789
Pasture/Orchards/Agricultural Buildings	312	7.35	2,293	0.73	228
Livestock	0	24.87	0	1.18	0
Forest	2,499	1.41	3,524	0.02	50
Water	0	10.05	0	0.57	0
Wetlands	0	1.41	0	0.02	0
Septic Systems	--	8.92	19,798	--	--
Total	**8,350**		**79,648**		**3,960**

As discussed in Chapter 1, the TMDL goal for total phosphorus in the Loch Raven Watershed is a reduction of 50%. In Area I, the total phosphorus urban load is 2,893 pounds and 1,017 pounds for the agriculture load. To achieve the total phosphorus TMDL target, a total of 1,980 pounds must be reduced. Although there isn't a local TMDL for total nitrogen in Area I, the Chesapeake Bay TMDL will allocate a load reduction for total nitrogen, total phosphorus and total suspended solids. Table 3-2 provides a summary of the total phosphorus and total nitrogen loads for the Area I watershed that were calculated in Table 3-1.

Table 3-2: Area I Total Phosphorus Load Reduction Requirements

Area (Acres)	Total Phosphorus Load (lbs/yr)	Total Phosphorus Source	Total Nitrogen Load (lbs/yr)	Total Nitrogen Source
8,350	3,960	Urban, Agriculture and Forest	79,648	Urban, Agriculture, Forest, and Septic Systems
50% TP Reduction:	**1,980**		**0**	

3.6 Pollutant Removal Analysis

This section presents a quantitative analysis of pollutant removal capabilities of proposed BMPs to determine if the 50 percent reduction in total phosphorus loads from Area I can be achieved. Note that many of the removal efficiencies used to estimate pollutant reductions are based on the Phase 5.2 CBP Watershed Model efficiencies that are provided 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.

3.6.1 Existing Urban Stormwater Management (SWM)

As described in detail in Section 2.3.6 of the *Watershed Characterization Report* (Appendix E), there are 67 existing SWM facilities in Area I including dry and wet ponds, infiltration/filtration practices, wetlands, extended detention ponds, and one proprietary BMP. 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 using one of two methods, depending on whether the drainage area (DA) to the facility has been digitized in GIS. Sixty of the facilities have had their drainage areas digitized, and therefore actual pollutant loads from the drainage areas are known. Pollutant reductions for the remaining seven facilities are calculated based on the approximate pollutant load received from the drainage area. Removal efficiencies used for all facilities are those 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:

$$[8.08\ (\text{lbs/ac/yr}) \times \text{DA (acres)}] \times \text{efficiency (\%)}$$

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

$$[0.65\ (\text{lbs/ac/yr}) \times \text{DA (acres)}] \times \text{efficiency (\%)}$$

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, 8.08 lbs TN/ac/yr and 0.65 lbs TP/ac/yr, represent the weighted average of impervious and pervious urban rates used in the pollutant loading analysis since this represents the likely sources of runoff being treated by SWM. 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 3-3.

Table 3-3: Existing SWM Load Reductions

SWM Facility Type	No. (#)	DA (Acres)	TN Load from DA (lbs/yr)	TN Removal Efficiency (%)	Max. Potential TN Load Reduction (lbs/yr)	TP Load from DA (lbs/yr)	TP Removal Efficiency (%)	Max. Potential TP Load Reduction (lbs/yr)
Dry Pond and Hydrodynamic Structure	9	243.4	2,207.1	5%	110.4	151.6	10%	15.2
Wet Pond and Wetland	3	92.1	589.5	20%	117.9	43.2	45%	19.4
Infiltration	10	27.1	184.5	80%	156.9	14.3	85%	12.2
Filtration	25	270.7	2,166.2	40%	866.5	174.2	60%	174.2
Extended Detention	20	319.6	2,687.3	20%	537.5	210.1	20%	42.0
Totals:	67	952.9	7,834.6		1789.2	593.4		263.0

3.6.2 Existing Agricultural Best Management Practices

As described in Section 2.3 of the *Watershed Characterization Report* (Appendix E), Area I contains 1,407 acres of agricultural land use that includes cropland, pasture/orchards/agricultural buildings, and livestock (Table 3-1). In the future, any additional agricultural acreage put into a Soil Conservation and Water Quality Plan (SCWQP) or Nutrient Management Plan (NMP) will be credited toward the nutrient reduction goal.

Existing Soil Conservation and Water Quality Plans

According to the Maryland Department of Agriculture's Conservation Tracker System, there were four existing SCWQP within Area I from January of 2001 to May of 2011 covering 303.1 acres. As described in Chapter 5 of the *Watershed Characterization Report* (Appendix E), a SCWQP is a comprehensive plan that addresses natural resource management on agricultural lands and describes BMPs which will be used to control erosion and sediment loss and manage runoff. The pollutant removal capability of existing SCWQPs in the watershed is accounted for in the pollutant removal analysis. Pollutant reductions for the implementation of a SCWQP is calculated based on the acres of agricultural land managed under a SCWQP and the reduction efficiency of a conservation plan based on the Baltimore County Agricultural Reduction summary table. The equation used to estimate total nitrogen (TN) load reductions for a SCWQP is expressed as:

0.93 (lbs/ac/yr) x SCWQP area (acres)

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

0.14 (lbs/ac/yr) x SCWQP area (acres)

A summary of SCWQP load reduction calculations and results is shown in Table 3-4.

Table 3-4: Existing SCWQP Load Reductions

Pollutant	Agriculture Reduction Rate (lbs/ac/yr)	SCWQP (acres)	Max. Potential Load Reduction (lbs/yr)
TN	0.93	303.1	281.8
TP	0.14	303.1	42.4

Existing Nutrient Management Plans

Nutrient Management Plans (NMP) refers to a comprehensive plan that describes the optimal use of nutrient inputs for crop yield to minimize loss of excess nutrients to the environment. One NMP was reported by the Maryland Department of Agriculture on

614.47 acres of agriculture land in Area I. Pollutant reductions for the implementation of a NMP is calculated based on the acres of agricultural land managed under a NMP and NMP reduction efficiency provided in the Baltimore County Agricultural Reduction summary table. The equation used to estimate total nitrogen (TN) load reductions for a NMP is expressed as:

3.11 (lbs/ac) x NMP area (acres)

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

0.30 (lbs/ac) x NMP area (acres)

The reduction in pollutant loading rates, 3.11 lbs/ac of TN and 0.30 lb/ac of TP represent nutrient reductions based on Baltimore County Agricultural Reduction summary table shown in Appendix C. A summary of NMP load reduction calculations and results are shown in Table 3-5.

Table 3-5: Existing Nutrient Management Plan Load Reductions

Pollutant	Agricultural Reduction Rate (lbs/ac/yr)	NMP (acres)	Max. Potential Load Reduction (lbs/yr)
TN	3.11	614.5	1,911.1
TP	0.30	614.5	184.4

3.6.3 Urban Restoration Practices

3.6.3.1 Stormwater Management Conversions

As described in Section 3.7 of the *Watershed Characterization Report* (Appendix E), four out of the five existing dry detention ponds were identified during the SWM facility assessment as having potential for conversion to a SWM practice that provides greater water quality treatment. Table 3-6 provides an overview for each of the five dry ponds assessed. Pollutant reductions for SWM conversions are calculated by applying the increase in removal efficiency to the estimated pollutant load from the contributing drainage area to the facility. SWM facilities 65 and 69 are identified for conversion to wetlands, and 67 and 68 for bioretention. These efficiencies are based on CBP guidance shown in Appendix C under Urban BMPs. SWM conversion load reduction results are shown in Table 3-7.

Table 3-6: Dry Ponds Assessed for Conversion Potential

Pond Number	Ownership	Acres	Total Score	Rank	Subwatershed
SWM-69	Public	19.1	25	High	Beaverdam Run
SWM-68	Private	3.0	23	High	Oregon Branch
SWM-67	Private	21.5	22	High	Beaverdam Run
SWM-65	Public	43.6	10	Medium	Beaverdam Run
SWM-66	Public	173.3	0	Low	Beaverdam Run

Table 3-7: Stormwater Management Conversion Load Reductions

SWM Pond #	Drainage Area (acres)	Total Nitrogen (pounds)			Total Phosphorus (pounds)		
		Load to Facility	Load Discharged from Current Facility	Load Discharged from Converted Facility	Load to Facility	Load Discharged from Current Facility	Load Discharged from Converted Facility
65	43.56	246.08	233.77	196.86	17.97	16.18	9.89
67	21.49	137.46	130.59	82.48	10.08	9.07	4.03
68	3.02	47.31	44.95	28.39	2.06	1.85	0.82
69	19.11	154.85	147.11	123.88	12.99	11.69	7.15
Total	**87.18**	**585.71**	**556.42**	**431.61**	**43.10**	**38.79**	**21.89**

The pollutant removal from the conversion of all four stormwater facilities totals 154.1 lbs/yr of TN and 21.21 lbs/yr of TP.

3.6.3.2 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., streets, parking lots) which are currently untreated. While specific types of stormwater retrofit practices were not identified, sites were noted for retrofit potential during the uplands surveys for neighborhoods and included cul-de-sacs, roadway medians, and swales. Pollutant reductions for stormwater retrofits are calculated based on the approximate pollutant load received from the impervious drainage area (DA) and removal efficiency of infiltration type BMPs. The equation used to estimate total nitrogen (TN) load reductions for stormwater retrofits is expressed as:

$$[14.1 \text{ (lbs/ac/yr)} \times \text{DA (acres)}] \times 80\%$$

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

$$[2.26 \text{ (lbs/ac/yr)} \times \text{DA (acres)}] \times 85\%$$

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 14.1 lbs TN/ac/yr and 2.26 lbs TP/ac/yr, are the impervious urban rates used in the pollutant loading analysis (Table 3.1) since this represents the source of runoff being treated. Pollutant removal efficiencies are those reported for infiltration practices based on the CBP guidance shown in Appendix C under Urban BMPs. A summary of stormwater retrofit load reduction calculations and results are shown in Table 3-8.

Table 3-8: Stormwater Retrofit (Infiltration Practices) Load Reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	Impervious Area for SW Retrofits (acres)	Load from DA (lbs/yr)	Removal Efficiency (%)	Max. Potential Load Reduction (lbs/yr)
TN	14.1	10.2	143.8	80%	115.1
TP	2.26	10.2	23.1	85%	19.6

3.6.3.3 Urban Stream Buffer Reforestation

The current vegetative condition of the urban stream riparian buffer (100 feet on either side of the stream system) was identified during the stream assessment in 1997 and 2011. In addition, buffer conditions were classified as impervious, open pervious or forested areas (Appendix E, Chapter 2). Open pervious areas are the best areas to initially target for restoration.

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

Land Use Conversion (TN) = [7.25 (lbs/ac/yr) – 1.41 (lbs/ac/yr)] x OpenBufferArea (acres)

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

Land Use Conversion (TP) = [0.429 (lbs/ac/yr) – 0.02 (lbs/ac/yr)] x OpenBufferArea (acres)

The first expression in brackets in the equations above represents the difference between pervious urban and forest loading rates used in the watershed pollutant loading analysis. This reduction in loading rate is then multiplied by the available open pervious area for reforestation to determine the load 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. Based on the BMP performance guidance in Appendix C, one acre of buffer treats one acre of upland area with a TN reduction efficiency of 25% for forest buffers. The TN load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

Buffer BMP Removal (TN) = [OpenBufferArea (acres) x 9.54 (lbs/ac/yr)] x 25%

Similarly, an efficiency of 50% for TP for buffers is applied to the buffer acreage being reforested. The TP load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

Buffer BMP Removal (TP) = [OpenBufferArea (acres) x 0.47 (lbs/ac/yr)] x 50%

The loading rates shown in the equations above, 9.54 lbs/ac/yr TN and 0.47 lbs/ac/yr TP represent the overall watershed loading rates. This is estimated as the total watershed nutrient load (79,650 lbs/ac/yr TN and 3,960 lbs/ac/yr TP) divided by the total watershed area (8,350 acres). These are used to calculate the pollutant load from the upland area that would be treated by buffer reforestation. As mentioned, the land use conversion and additional removal efficiency are added to yield a total pollutant load reduction. A summary of stream buffer reforestation reduction calculations and results are shown in Table 3-9.

Table 3-9: Stream Buffer Reforestation Load Reductions

Pollutant	Open Pervious Area (acres)	Land Use Conversion		Buffer BMP Removal			Max. Potential Load Reduction (lbs/yr)
		Reduced Loading Rate (lbs/ac/yr)	Land Use Conversion Reduction (lbs/yr)	Reduction Efficiency (%)	Overall Watershed Loading Rate (lbs/ac/yr)	Efficiency Load Reduction (lbs/yr)	
TN	205.59	5.84	1,200.6	25	9.54	490.3	1,690.9
TP	205.59	0.409	84.1	50	0.47	48.3	132.4

3.6.3.4 Stream Corridor Restoration

Stream corridor restoration practices are used to enhance the appearance, stability, and aquatic function of stream corridors. Practices include simple stream stabilization (including vegetative bank stabilization and grade control) and stream restoration (including redesign and re-alignment). Similar projects such as the Minebank Run stream restoration have been successfully completed by Baltimore County.

Several potential stream restoration sites were identified during the stream corridor assessments (See Appendix E) to improve water quality and address stream stability issues, such as significant erosion and channel alterations. Pollutant reductions for stream corridor restoration are calculated based on the load reduction factors provided by CBP (Appendix C) multiplied by the linear feet of identified significant erosion, and channel alteration sites. The equation used to estimate total nitrogen (TN) load reductions for stream corridor restoration is expressed as:

$$0.02\ (\text{lbs/ft}) \times \text{stream corridor length (ft)}$$

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

$$0.0035\ (\text{lbs/ft}) \times \text{stream corridor length (ft)}$$

The analysis is based on the stream corridor assessments that identified 2,606.1 ft of severe erosion sites and 852.5 feet of very severe erosion sites in Baisman Run, and 2,784.8 feet of severe erosion sites in Beaverdam Run. There were no very severe or severe channel alteration sites identified in Oregon Branch. A summary of stream restoration calculations and results are shown in Table 3-10.

Table 3-10: Stream Corridor Restoration Load Reductions

Pollutant	Reduction in Loading Rate (lbs/ft/yr)	Estimated Stream Restoration Length (ft)	Max. Potential Load Reduction (lbs/yr)
TN	0.02	6,243.4	124.9
TP	0.0035	6,243.4	21.9

3.6.3.5 Institutional Tree Plantings

None of the neighborhoods were identified for street tree planting or open space shade trees. However, tree planting opportunities were identified at many institutional sites. The number of trees to be planted was estimated based on a spacing of one tree per 15 to 20 feet. Pollutant reductions for pervious area reforestation are calculated based on a land use conversion from pervious urban to forest. An approximation of 200 trees per acre is used to calculate the converted acreage. The equation used to estimate TN load reductions for tree plantings is expressed as:

$$[7.25\ (\text{lbs/ac/yr}) - 1.41\ (\text{lbs/ac/yr}) \times [\#\ \text{Trees} \times 1(\text{acre})/200(\text{trees})]$$

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

$$[0.429 \text{ (lbs/ac/yr)} - 0.02 \text{ (lbs/ac/yr)} \times [\# \text{ Trees} \times 1\text{(acre)}/200\text{(trees)}]$$

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

Table 3-11: Institution Tree Planting Load Reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Forest Loading Rate (lbs/ac/yr)	Reduced Loading Rate (lbs/ac/yr)	Estimated # Trees for ISIs (#)	New Forested Area (acres)	Max. Potential Load Reduction (lbs/yr)
TN	7.25	1.41	5.85	1,240	6.2	36.3
TP	0.429	0.02	0.41	1,240	6.2	2.5

3.6.3.6 Urban Nutrient Management – Maryland Fertilizer Use Act of 2011

The state of Maryland recently passed the Maryland Fertilizer Use Act of 2011 (the Act) that will take effect in October 2013. The Act will ban phosphorus and provide a greater percentage of slow release nitrogen in fertilizer. The fertilizer bags will have better labeling and lawn care professionals will be required to be certified in proper fertilizer application. In Area I, this reduction will apply to 3,162.01 acres, which is estimated to equal the acreage of managed turf that includes the total number of residential lawns, pervious area of the golf course, open urban areas, institutional and commercial areas. Pollutant reductions applied for the Act are calculated based on the urban pervious pollutant load multiplied by the acres of managed turf. A reduction of 15% for phosphorus and 1% for nitrogen is then applied.

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

[7.25 (lbs/acre/yr) x managed turf (acres)] x 1%

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

[0.429 (lbs/acre/yr) x managed turf (acres)] x 15%

The pollutant load received from the urban pervious area that the Act will be applied to is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 7.25 lbs/ac/yr of TN and 0.429 lbs/ac/yr of TP, are the pervious urban rates used in the pollutant loading analysis. Pollutant removal efficiencies are those reported by the State to be applied from the Act. A summary of fertilizer load reduction calculations and results are shown in Table 3-12.

Table 3-12: Maryland Fertilizer Use Act of 2011 Load Reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Acres of Managed Turf (acres)	Removal Efficiency (%)	Max. Potential Load Reduction (lbs/yr)
TN	7.25	3,162.0	1	229.2
TP	0.429	3,162.0	15	203.5

3.6.4 Agricultural Restoration Practices

3.6.4.1 Streamside Forest Buffers

The current vegetative condition of the agricultural stream riparian buffer (100 feet on either side of the stream system) was identified during the stream assessment in 1997 and 2011. In addition, buffer conditions were classified as impervious, open pervious or forested areas. Open pervious areas are the best areas to initially target for restoration.

Pollutant reductions for agricultural streamside forest buffers are calculated based on the load reduction provided by the Baltimore County Agricultural Reduction summary table (Appendix C) multiplied by the acres of open pervious land available for conversion to streamside forest buffers. The equation used to estimate total nitrogen (TN) load reductions for streamside forest buffers is expressed as:

28.72 (lbs/acre) x streamside forest buffers (acres)

The equation used to estimate total phosphorus (TP) load reductions for streamside forest buffers is expressed as:

1.94 (lbs/acre) x streamside forest buffers (acres)

The analysis is based on the stream corridor assessments that identified 100.0 acres of stream buffers available for conversion to forest buffers on agricultural lands. A summary of agricultural streamside forest buffer calculations and results are shown in Table 3-13.

Table 3-13: Agricultural Streamside Forest Buffer Load Reductions

Pollutant	Agriculture Reduction Rate (lbs/acre)	Estimated Agricultural Streamside Forest Buffer Area (acres)	Max. Potential Load Reduction (lbs)
TN	28.72	100.0	2,872.0
TP	1.94	100.0	194.0

3.6.4.2 Stream Protection with Fencing

Stream protection with fencing to exclude cattle from the stream was identified as a recommendation at a farm in the watershed. The fence would enclose a 50 foot streamside buffer adjacent to the stream for a total of 8.7 acres. The livestock for this section were identified in the field and not included in the data provided by the state of Maryland used to develop Table 3-1. Pollutant reductions for streamside fencing are calculated based on the load reduction provided by the Baltimore County Agricultural Reduction summary table (Appendix C) multiplied by the acres of land protected along the stream with fencing. The equation used to estimate total nitrogen (TN) load reductions for streamside fencing is expressed as:

6.79 (lbs/acre) x stream protection area (acres)

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

6.79 (lbs/acre) x stream protection area (acres)

A summary of agricultural streamside fencing calculations and results are shown in Table 3-14.

Table 3-14: Agricultural Streamside Fencing Load Reductions

Pollutant	Agriculture Reduction Rate (lbs/acre)	Estimated Agricultural Streamside Fencing Area (acre)	Max. Potential Load Reduction (lbs)
TN	6.79	8.7	59.1
TP	0.91	8.7	7.9

3.6.4.3 Off-Stream Watering

Off-stream watering provides cattle an alternative drinking water source away from streams. By providing an off-stream watering source, cattle will reduce the time they spend near and in streams and stream banks. This will reduce animal waste deposition and heavy traffic areas near streams and divert associated impacts to more upland locations. This practice works in conjunction with the practice of stream protection with fencing.

Pollutant reductions for off-stream watering are calculated based on the load reduction provided by the Baltimore County Agricultural Reduction summary table (Appendix C) multiplied by the acres of land on the cattle farm in the watershed (45.1 acres). The equation used to estimate total nitrogen (TN) load reductions for off-stream watering is expressed as:

3.4 (lbs/acre) x stream protection area (acres)

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

0.46 (lbs/acre) x stream protection area (acres)

A summary of agricultural off-stream watering calculations and results are shown in Table 3-15.

Table 3-15: Agricultural Off-Stream Watering Load Reductions

Pollutant	Agriculture Reduction Rate (lbs/acre)	Estimated Agricultural Off-Stream Watering (acres)	Max. Potential Load Reduction (lbs)
TN	3.4	45.1	154.0
TP	0.46	45.1	20.8

3.6.5 Overall Pollutant Load Reductions

The sum of the 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). Projected participation factor assumptions are described in Table 3-16.

Table 3-16: Projected Participation Factors

BMP	Projected Participation	Basis of Assumption
Urban		
Existing Urban Stormwater Management	100%	Existing – BMPs already implemented
Stormwater Management Conversions	100%	Complete all four conversions
Stormwater Retrofits	100%	Install retrofits on 10.2 acres of impervious cover
Urban Stream Buffer Reforestation	100%	Convert 205.59 acres from open pervious to forest land use

BMP	Projected Participation	Basis of Assumption
Stream Corridor Restoration	100%	Restore 6,243.4 linear feet of stream
Institutional Tree Planting	100%	Plant 1,240 trees
Urban Nutrient Management – Maryland Fertilizer Use Act of 2011	100%	Act will be implemented in 2013
Agricultural		
Existing Soil Conservation and Water Quality Plan	100%	Existing – BMPs already implemented
Existing Nutrient Management Plans	100%	Existing – BMPs already implemented
Streamside Forest Buffers	100%	Convert 100.0 acres from pervious open to forest land use
Streamside Fencing	100%	Fence 8.7 acres along streams
Off-Stream Watering	100%	Provide alternative water source for cattle on 45.1 acres

Table 3-17 presents a summary of estimated pollutant load reductions including how reductions were credited, pollutant removal efficiencies, maximum potential load reductions, units available for restoration, projected participation, and projected load reductions. For Area I, in order to reach the 50 percent reduction of TP load goal, it was assumed that 100% participation is achieved.

The projected implementation of practical BMP restoration projects, shown in Table 3-17, shows a TP reduction of 31% and TN reduction of 14% will be achieved. This will not meet the 50 percent reduction of TP loads needed to meet water quality standards for the watershed as specified by the TMDL (Appendix F). The 50 percent reduction of TP applies to the entire Loch Raven watershed. Greater reductions may also be achieved through restoration actions not included in this analysis such as public education/outreach efforts (e.g. pet waste pickup, and septic system maintenance). These types of actions are not included in the pollutant removal analysis because reduction efficiencies are not well known and difficult to estimate. In addition, an increase in the amount of agricultural land under Soil Conservation and Water Quality Plans or Nutrient Management Plans would assist in approaching the nutrient reduction goal.

The Chesapeake Bay TMDL will include an urban nutrient load requirement for the watershed. The restoration strategy presented in this SWAP will be reevaluated to determine whether it is sufficient to meet the nutrient reduction requirements for the Chesapeake Bay TMDL.

Table 3-17: Summary of Pollutant Load Reduction Estimates

BMP	How Credited	TN Efficiency	TP Efficiency	Max. Potential TN Load Reduction (lbs/yr)	Max. Potential TP Load Reduction (lbs/yr)	Units Available		Projected Participation	Projected TN Load Reduction (lbs/yr)	Projected TP Load Reduction (lbs/yr)
Urban										
Existing Urban Stormwater Management	Efficiency	Varies	Varies	1,715.0	199.8	952.9	Acres	100%	1,715.0	199.8
Stormwater Management Conversions	Efficiency	15% (wetlands) 35% (filtration)	35% (wetlands) 50% (filtration)	1,911.1	184.4	87.18	Acres	100%	1,911.1	184.4
Stormwater Retrofits (infiltration practices)	Efficiency	80%	85%	115.1	19.6	10.2	Acres	100%	115.1	19.6
Urban Stream Buffer Reforestation	LU Conversion +Efficiency	25%	50%	1,690.9	132.4	205.6	Acres	100%	1,690.9	132.4
Stream Corridor Restoration	Load Reduction Rate	0.02 lbs/ft/yr	0.0035 lbs/ft/yr	124.9	21.9	6,243.4	Feet	100%	124.9	21.9
Institutional Tree Planting	LU Conversion	N/A	N/A	36.3	2.5	1,240	Trees	100%	36.3	2.5

BMP	How Credited	TN Efficiency	TP Efficiency	Max. Potential TN Load Reduction (lbs/yr)	Max. Potential TP Load Reduction (lbs/yr)	Units Available		Projected Participation	Projected TN Load Reduction (lbs/yr)	Projected TP Load Reduction (lbs/yr)
Urban Nutrient Management – Maryland Fertilizer Use Act of 2011	Efficiency	1%	15%	229.2	203.5	N/A	N/A	100%	229.2	203.5
Agricultural										
Existing Soil Conservation and Water Quality Plan	Load Reduction Rate	0.93 lbs/ac/yr	0.14 lbs/ac/yr	281.8	42.4	303.1	Acres	100%	281.8	42.4
Existing Nutrient Management Plans	Load Reduction Rate	3.11 lbs/ac/yr	0.30 lbs/ac/yr	1,911.1	184.4	614.5	Acres	100%	1,911.1	184.4
Streamside Forest Buffers	Load Reduction Rate	28.72 lbs/ac	1.94 lbs/ac	2,872.0	194.0	100.0	Acres	100%	2,872.0	194.0
Streamside Fencing	Load Reduction Rate	6.79 lbs/ac	6.79 lbs/ac	59.1	7.9	8.7	Acres	100%	59.1	7.9
Off-Stream Watering	Load Reduction Rate	3.4 lbs/ac	0.46 lbs/ac	154.0	20.8	45.1	Acres	100%	154.0	20.8

BMP	How Credited	TN Efficiency	TP Efficiency	Max. Potential TN Load Reduction (lbs/yr)	Max. Potential TP Load Reduction (lbs/yr)	Units Available		Projected Participation	Projected TN Load Reduction (lbs/yr)	Projected TP Load Reduction (lbs/yr)
Total Load Reduction (lbs/yr):				**11,100.5**	**1,213.6**				**11,100.5**	**1,213.6**
Total Existing Urban Load (lbs/yr):				79,650	3,960				79,650	3,960
Reduction Achieved:				**13.9%**	**30.6%**				**13.9%**	**30.6%**

CHAPTER 4.0

Subwatershed Management Strategies

4.1 Introduction

This chapter describes the criteria and methodology used to rank the three subwatersheds comprising the Area I watershed (Figure 4-1) based on restoration and protection potential. The subwatershed ranking provides a tool for targeting restoration and protection actions by location/waterbody. This chapter also provides subwatershed summaries that include key subwatershed characteristics, management strategies and implementation priorities within each subwatershed. Subwatershed recommendations were made based on the stream assessment data, upland assessment data and available agricultural data. More detailed information on each subwatershed is located in the Area I Characterization Report (Appendix E).

4.2 Subwatershed Prioritization

A ranking methodology was developed to prioritize subwatersheds in terms of restoration and protection need and potential. In general, restoration is prioritized for subwatersheds where degradation has occurred, and protection is prioritized for less impacted subwatersheds. Prioritization ranking for restoration and protection are described for each criterion below. The total prioritization score for a subwatershed is comprised of the following restoration and protection ranking criteria:

Restoration Ranking Criteria

- Total Nitrogen and Total Phosphorus Loads
- Biological Indicators
- Impervious Surfaces
- Institutional Site Investigation
- Neighborhood Restoration Opportunity/Pollution Severity Indexes

Protection Ranking Criteria

- Total Nitrogen and Total Phosphorus Loads
- Biological Indicators
- Impervious Surfaces
- Stream Buffer Improvement
- Agricultural Land

- Neighborhood Lawn Fertilization Reduction/Awareness
- Municipal Stormwater Conversions
- Stream Buffer Improvement
- Stream Corridor Restoration
- Septic Systems

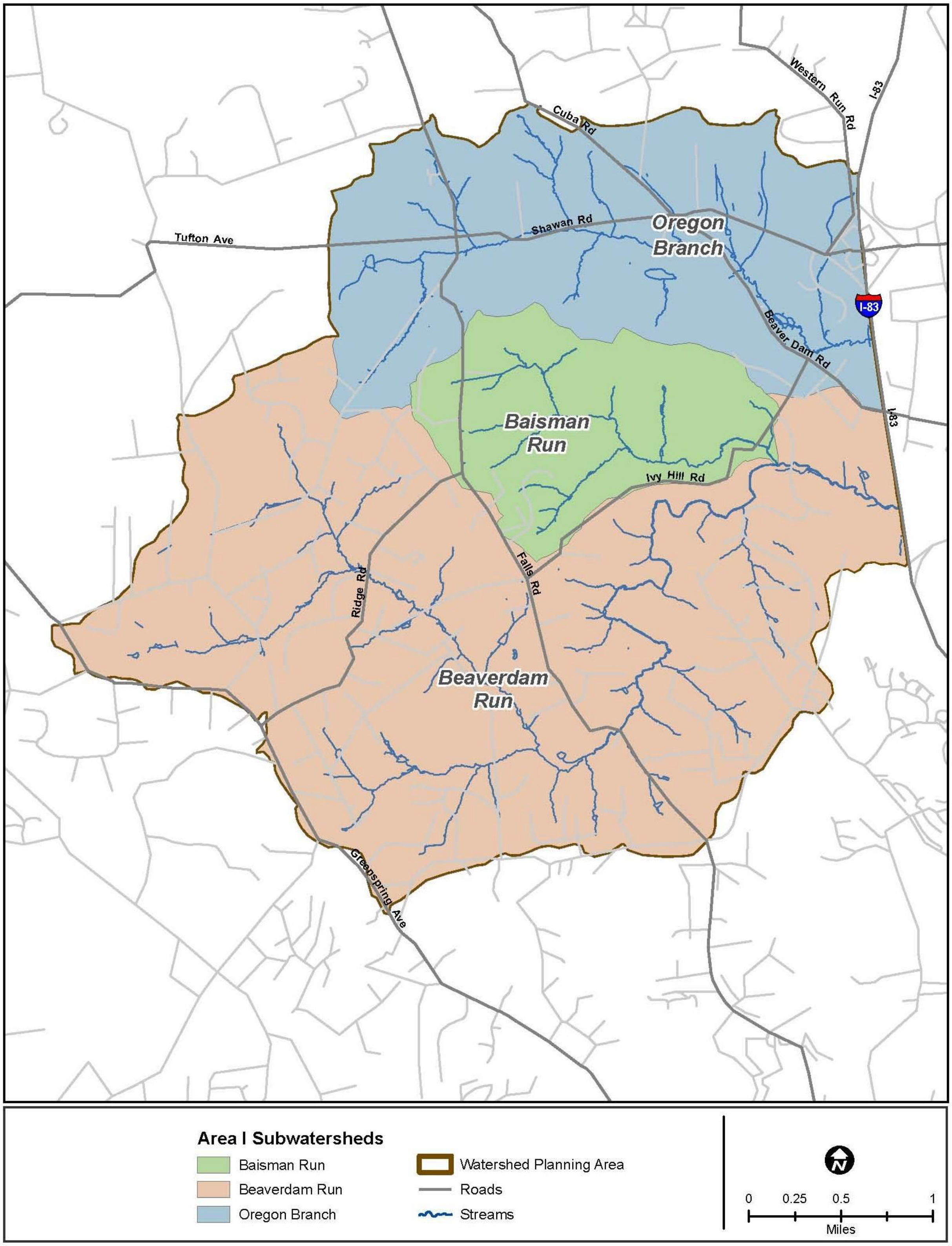

Figure 4-1: Area I Subwatersheds

Each criterion has a maximum possible score of 4. In general, subwatersheds were ranked and grouped based on supporting criterion data to yield a clear distribution of the subwatersheds per possible score (i.e., 1, 2, 3, 4). In some cases, not all scoring values were used to rank the subwatersheds. Examples include cases where zero values were assigned to subwatersheds with no recommended action for a particular criterion.

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

4.2.1 Total Nitrogen and Total Phosphorus Loads

One of the objectives to improve and maintain water quality and meet TMDLs in the Loch Raven Reservoir Watershed is to reduce annual average total phosphorus loads. Both total nitrogen and total phosphorus are important to meet the Chesapeake Bay TMDL goals. Annual pollutant loads (lbs/yr) for total nitrogen and total phosphorus were calculated for each subwatershed based on loading rates established by MDE and the Chesapeake Bay Program (CBP) for various land use types and subwatershed land use distributions. The pollutant loading analysis for the Area I watershed is explained in further detail in Appendix E, Chapter 3.3.

For each subwatershed, annual total nitrogen and total phosphorus loads were divided by the subwatershed area. This represents pollutant loading rates (lbs/acre/year) and allows a direct comparison between the three subwatersheds since they vary in size. Subwatersheds with higher pollutant loading rates are higher priorities for restoration within Area I. Therefore, for restoration prioritization, higher pollutant loading rates are assigned high scores to denote greater water quality impacts and restoration need. In contrast, a higher protection priority was given to a subwatershed with a lower pollutant loading rate. For protection prioritization, lower pollutant loading rates are assigned higher scores to indicate areas to be protected from further degradation. The point system for both total nitrogen and total phosphorus are adapted from Frink, 1991 and MDNR, 2005.

Total Nitrogen

Subwatershed total nitrogen loading rates ranged from 5.5 to 10.1 lbs/acre/year. Table 4-1 provides the point system used to assign for total nitrogen load restoration and protection scores to the three subwatersheds based on the range and distribution of subwatershed total nitrogen loading rates.

Table 4-1: Total Nitrogen Point System and Restoration and Protection Scores

Point System	Restoration Scores	Protection Scores
≥ 7.0 lbs/acre/year	4 pts	1 pt
6.0 – 6.9 lbs/acre/year	3 pts	2 pts
5.0 – 5.9 lbs/acre/year	2 pts	3 pts
< 5.0 lbs/acre/year	1 pt	4 pts

Total Phosphorus

Subwatershed total phosphorus loading rates ranged from 0.26 to 0.51 lbs/acre/year. Table 4-2 provides the point system used to assign total phosphorus load restoration and protection scores to the three subwatersheds based on the range and distribution of subwatershed total phosphorus loading rates.

Table 4-2: Total Phosphorus Point System and Restoration and Protection Scores

Point System	Restoration Scores	Protection Scores
≥ 0.50 lbs/acre/year	4 pts	1 pt
0.40 – 0.49 lbs/acre/year	3 pts	2 pts
0.30 – 0.39 lbs/acre/year	2 pts	3 pts
< 0.30 lbs/acre/year	1 pt	4 pts

Total nitrogen and total phosphorus loading rates and corresponding protection/restoration scores are summarized by subwatershed in Table 4-3.

Table 4-3: Total Nitrogen and Total Phosphorus Loading Rate Scores

Subwatershed	Total Nitrogen Loading Rate (lbs/acre/year)	Total Nitrogen Restoration Load Score	Total Nitrogen Protection Load Score	Total Phosphorus Loading Rate (lbs/acre/year)	Total Phosphorus Restoration Load Score	Total Phosphorus Protection Load Score
Baisman Run	5.5	2	3	0.26	1	4
Beaverdam Run	10.1	4	1	0.50	4	1
Oregon Branch	10.1	4	1	0.51	4	1

4.2.2 Biological Indicators

Fish populations and stream biological health are important indicators of water quality. Area I maintains a population of reproducing trout that includes native brook trout and brown trout. Native brook trout are extremely sensitive to environmental disturbance such as elevated temperatures, and their presence indicates good water quality. A Fish Index of Biological Integrity (FIBI) score and a benthic Index of Biological Integrity (IBI) were determined based on sampling data collected from EPS and MD DNR Fisheries Service. Chapter 3 in Appendix E provides a detailed discussion of the data.

For each subwatershed, average FIBI and IBI scores were calculated using the data provided by EPS and MD DNR Fisheries Service. FIBI and IBI scores range from good (4.0 – 5.0) denoting minimally impacted conditions to very poor (1.0 – 1.9) indicating severe degradation. For restoration prioritization, lower biological indicator scores are assigned higher restoration scores to denote greater restoration need. In contrast, lower scores were given to a subwatershed with a high biological indicator score. For protection prioritization, higher scores are provided for subwatersheds with a high biological indicator score and lower scores are provided for subwatersheds with a low biological indicator score. The point system for both FIBI and IBI scores are adapted from Maryland Biological Stream Survey Protocols.

Fish Index of Biological Integrity (FIBI)

The average FIBI point score for each subwatershed ranged from 2.22 to 3.83. Table 4-4 provides the total point system used to assign FIBI restoration and protection scores to the three subwatersheds based on the range and distribution of subwatershed FIBI.

Table 4-4: Fish Index of Biological Integrity and Restoration and Protection Scores

Point System	Restoration Scores	Protection Scores
3.1 – 4.0	1 pt	4 pts
2.1 – 3.0	2 pts	3 pts
1.1 – 2.0	3 pts	2 pts
0.0 – 1.0	4 pts	1 pt

Benthic Index of Biological Integrity (IBI)

The average IBI point score for each subwatershed ranged from 3.61 to 4.44. Table 4-5 provides the total point system used to assign IBI restoration and protection scores to the three subwatersheds based on the range and distribution of subwatershed IBI.

Table 4-5: Benthic Index of Biological Integrity and Restoration and Protection Scores

Point System	Restoration Scores	Protection Scores
$\geq$ 4.0	1 pt	4 pts
3.1 – 4.0	2 pts	3 pts
2.1 – 3.0	3 pts	2 pts
$\leq$ 2	4 pts	1 pt

FIBI and IBI point scores and corresponding protection/restoration scores are summarized by subwatershed in Table 4-6.

Table 4-6: FIBI and IBI Scores

Subwatershed	FIBI Average Score	FIBI Restoration Score	FIBI Protection Score	IBI Average Score	IBI Restoration Score	IBI Protection Score
Baisman Run	2.25	2	3	4.44	1	4
Beaverdam Run	2.22	2	3	3.61	2	3
Oregon Branch	3.83	1	4	3.89	2	3

4.2.3 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. Stormwater runoff is concentrated and conveyed directly to the stream system from impervious surfaces, which can cause stream erosion and habitat degradation from the high energy flow and is typically more polluted than runoff generated from pervious areas. Undeveloped watersheds with small amounts of impervious cover typically have better water quality in local streams than urbanized watersheds with greater amounts of impervious cover.

Research has found that Native Brook Trout populations decline at 2 percent impervious cover and Brown trout populations decline at 4 percent impervious cover (MD DNR, 1999).

As described in Appendix E, Chapter 2.3.3, road and building GIS data was used to calculate the impervious surface area and the percent impervious area for each subwatershed. Similar to the pollutant load criteria, the percentage of impervious area was used to assign scores as it allows a direct comparison between the three subwatersheds. Subwatersheds with higher percentages of impervious cover exhibit greater water quality and restoration need and are assigned higher restoration scores as they are higher priorities within Area I. For protection prioritization, subwatersheds with lower impervious cover exhibit better water quality and are assigned higher protection scores.

Impervious cover represents about 6.5 percent of the overall Area I. Subwatershed percent impervious values range from 4.0 to 7.7 percent. Table 4-7 provides the point system used to assign percent impervious restoration and protection scores to the three subwatersheds in Area I.

Table 4-7: Percent Impervious Point System and Restoration and Protection Scores

Point System	Restoration Scores	Protection Scores
≥ 9 percent impervious	4 pts	1 pt
6 – 8 percent impervious	3 pts	2 pts
3 – 5 percent impervious	2 pts	3 pts
≤ 2 percent impervious	1 pt	4 pts

The percentage of impervious area and protection/restoration score ratings are summarized for each subwatershed in Table 4-8.

Table 4-8: Percent Impervious Scores

Subwatershed	Total Area (acres)	Roads (acres)	Buildings (acres)	Total Impervious Area (acres)	% Impervious	% Impervious Restoration Score	% Impervious Protection Score
Baisman Run	1,056.0	28.2	14.6	42.8	4.05	2	3
Beaverdam Run	4,984.6	247.6	136.2	383.8	7.70	3	2
Oregon Branch	2,309.4	92.8	19.4	112.2	4.86	2	3

4.2.4 Neighborhood Restoration Opportunity/Pollution Severity Indexes

As described in the Appendix E, Chapter 4, neighborhood restoration potential and pollution severity were rated during the neighborhood source assessments (NSA). The severity of pollution generated by a neighborhood is denoted by the Pollution Severity Index (PSI) and was rated as severe, high, moderate or none. A neighborhood's potential for residential restoration projects was also rated as high, moderate or low according to the Restoration Opportunity Index (ROI). Of the 27 neighborhoods assessed, several neighborhoods crossed subwatershed boundaries. In cases where the neighborhood has substantial area in more than one subwatershed it is counted in each subwatershed in which it falls. This resulted in a total of 34 unique neighborhoods by subwatershed and is reflected in Table 4-9.

For this section, a total of 27 neighborhoods were counted individually and not counted in each subwatershed in which it falls. Out of the 27 neighborhoods assessed, one was rated with both a high PSI and ROI, two were rated with a high PSI and a moderate ROI, one was rated with a moderate PSI and a high ROI and three were rated with a moderate PSI and a low ROI. The remaining 20 neighborhoods were considered as having a moderate PSI and a moderate ROI. The areas in the subwatershed where efforts should be targeted received high PSI ratings and either a high or moderate ROI rating; there were three neighborhoods that met these criteria. The majority of neighborhoods received moderate PSI and moderate ROI ratings.

Restoration prioritization was rated with the highest score (4 points) given to subwatersheds with one or more neighborhoods with both a high PSI and ROI and one or more neighborhoods with a high PSI and moderate ROI score. The second highest score (3 points) was given to subwatersheds with one or more neighborhoods with a high PSI and a moderate ROI. The third highest score (2 points) was given to subwatersheds with four or more neighborhoods with a both a moderate PSI and a moderate ROI. The remaining subwatersheds were assigned the lowest possible score (1 point). The number of neighborhoods associated with various PSI/ROI ratings and corresponding NSA PSI/ROI scores are summarized by subwatershed in Table 4-9. Several neighborhoods cross subwatershed boundaries; in cases where there is a substantial area in more than one subwatershed it is counted in each subwatershed in which it falls. This resulted in a total of 34 unique neighborhoods by subwatershed. Protection prioritization was not rated for this criterion because neighborhood restoration activities do not provide protection potential.

Table 4-9: NSA PSI/ROI Restoration Scores

Subwatershed	Number of Neighborhoods for PSI/ROI Ratings						NSA PSI/ROI Restoration Score
	High/ High	High/ Moderate	High/ Low	Moderate/ High	Moderate/ Moderate	Moderate/ Low	
Baisman Run	0	1	0	1	1	0	3
Beaverdam Run	1	2	0	0	19	3	4
Oregon Branch	0	0	0	1	5	0	2

4.2.5 Neighborhood Lawn Fertilizer Reduction/Awareness

Lawn maintenance activities often involve over-fertilization, poor pest-management, and overwatering resulting in polluted stormwater runoff to local water bodies. Lawns with a dense, uniform grass cover or signs designating poisonous lawn care were indicators of high lawn maintenance activities and sources of nutrients originating from lawn fertilizer. Neighborhoods where 20 percent or more of the homes appeared to employ high lawn maintenance practices were recommended for fertilizer reduction/education during the NSAs. This criterion was issued for subwatershed restoration prioritization because it has a quantitative pollution reduction efficiency related to nutrient reduction goals. In addition, this criterion is the major restoration practice that was identified during the neighborhood assessments. Protection prioritization was not rated for this criterion because neighborhood lawn fertilizer reduction/awareness activities do not provide protection potential.

The acres of lawn addressed if lawn fertilizer reduction/education were initiated in the recommended neighborhoods were calculated in Appendix E, Chapter 4. The percentage of each subwatershed area addressed by lawn fertilizer reduction/education was also calculated and was used to compare the restoration potential among the three subwatersheds. Subwatersheds with the highest percentages of high maintenance lawns denote greatest restoration potential and therefore, were scored the highest. Percentages of subwatershed areas addressed through lawn fertilizer reduction range from 6 to 23 percent. Table 4-10 provides the point system used to assign fertilizer reduction restoration scores in each subwatershed based on the distribution and range of percentages of subwatershed area addressed.

Table 4-10: Neighborhood Lawn Fertilizer Reduction/Awareness Point System and Restoration Scores

Point System	Restoration Scores
≥ 30 percent high maintenance lawns	4 pts
20 – 29 percent high maintenance lawns	3 pts
10 – 19 percent high maintenance lawns	2 pts
< 10 percent high maintenance lawns	1 pt

The percentage of area addressed by lawn fertilizer reduction/awareness and corresponding scores are summarized by subwatershed in Table 4-11.

Table 4-11: Neighborhood Lawn Fertilizer Reduction/Awareness Restoration Scores

Subwatershed	% of Subwatershed Addressed	NSA Lawn Fertilizer Reduction Restoration Score
Baisman Run	18%	2
Beaverdam Run	23%	3
Oregon Branch	6%	1

4.2.6 Institutional Site Investigation

Institutions offer unique opportunities for watershed restoration as described in Appendix E, Chapter 4. Typically, institutional properties encompass considerable portions of land including various natural resources. In addition, they offer the opportunity to engage in a wide range of citizen restoration activities. This raises citizen awareness while also providing water quality improvement benefits in the watershed. A total of four institutions were surveyed during the Institutional Site Investigations (ISIs) including faith-based facilities and a golf course. The focus of the ISIs is to identify potential restoration opportunities, promote awareness to 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, etc.) and encouraging citizen participation. Subwatershed restoration prioritization for ISIs was based on the institutional acres within each subwatershed. Protection prioritization was not rated for this criterion because the institutional site investigation doesn’t provide protection potential.

Table 4-12 provides the point system used to assign institutional site restoration scores to the three subwatersheds based on the ISIs acreage.

Table 4-12: Institutional Site Investigation Point System and Restoration Scores

Point System	Restoration Scores
> 300 institutional acres	4 pts
201 – 300 institutional acres	3 pts
101 – 200 institutional acres	2 pts
1 – 100 institutional acres	1 pt

Baisman Run was not provided a score as there were no institutions identified in the subwatershed. The total number of institutional acres and the corresponding institutional site investigation scores are summarized by subwatershed in Table 4-13.

Table 4-13: Institutional Site Restoration Scores

Subwatershed	ISI Acres	ISI Restoration Score
Baisman Run	0	0
Beaverdam Run	247.43	3
Oregon Branch	23.98	1

4.2.7 Municipal Stormwater Conversions

The existing stormwater management (SWM) facilities located within Area I were investigated for potential conversion for increased water quality management. The Baltimore County Department of Environmental Protection and Sustainability (EPS) database on stormwater management facilities indicated that a total of 67 stormwater management facilities were built in the watershed as described in Appendix E, Chapter 2. These include dry and wet ponds, extended detention ponds, filtration and infiltration systems, proprietary systems, and wetlands. Filtration/infiltration practices and extended detention facilities are considered to have higher pollutant removal capabilities, since stormwater has a chance to infiltrate into the ground or through plant roots, compared to traditional SWM techniques which are designed for quantity control without water quality improvement features.

Of the 67 existing SWM facilities, there are five dry detention ponds which are typically designed to address water quantity only (flood control) and therefore, provide almost no pollutant removal. Dry ponds have the greatest potential for conversion to a type of facility that provides water quality benefits in addition to quantity control. The County EPS assessed the five dry detention pond facilities for their potential to be converted to an extended detention facility or other practice that provides greater water quality benefit. Data was collected on the pond condition and the potential for conversion. Of the five SWM facilities assessed, four were found to have good potential for conversion. The remaining facility is an in-stream dry detention pond with low potential for conversion to a water quality facility as impacts to the surrounding wetlands and forest would be significant.

The total drainage area to the ponds with good potential for conversion was determined for each subwatershed and the resulting total nitrogen and total phosphorus removal was calculated to prioritize the SWM facility conversions. Subwatersheds with the largest drainage area to the facilities have the highest potential for pollutant removal and therefore, were scored the highest. Table 4-14 provides the point system used to assign municipal stormwater conversion restoration scores for each subwatershed based on the drainage area to facilities with conversion potential. Protection prioritization was not rated for this criterion because municipal stormwater conversions don't provide protection potential.

Table 4-14: Municipal Stormwater Conversion Point System and Restoration Scores

Point System	Restoration Scores
≥ 60 acres of drainage area	4 pts
40 – 59 acres of drainage area	3 pts
20 – 39 acres of drainage area	2 pts
0.1 – 20 acres of drainage area	1 pt

Baisman Run was not provided a score as there were no stormwater dry ponds identified for conversion potential. The subwatershed breakdown of stormwater facilities recommended for conversion, total drainage area, increase in total nitrogen and total phosphorus removal and conversion points awarded are in Table 4-15.

Table 4-15: Municipal Stormwater Conversion Restoration Scores

Subwatershed	# of Facilities	TN Removal (lbs/yr)	TP Removal (lbs/yr)	Drainage Area (Acres)	Stormwater Conversion Restoration Score
Baisman Run	0	0	0	0	0
Beaverdam Run	3	122.1	17.9	68.1	4
Oregon Branch	1	23.1	4.3	19.1	1

4.2.8 Stream Buffer Improvements

Forested buffer areas along streams play a crucial role in increasing water quality, reducing surface runoff, stabilizing stream banks, trapping sediment, mitigating floods and providing the required habitat for all types of stream life and fish. Tree roots capture and remove pollutants including excess nutrients from shallow flowing water, and their structure helps prevent erosion and slow down water flow, reducing sediment load and the risk of flooding. Shading from the tree canopy provides the cooler water temperatures necessary for much stream life, especially cold-water species like trout that are found in Area I. In streams, terrestrial plant material falling into the stream is the primary source of food for stream life at the base of the food chain. Trees provide seasonal food in the form of leaves and plant parts. Fallen tree branches and trunks provide a more consistent, slow-release food source throughout the year. Tree roots and snags also provide important habitat for fish and other aquatic species. Maintaining healthy streams and forest buffers are important for reducing the nutrient and sediment loadings to the Chesapeake Bay. When stream buffers are converted from forests to agriculture or residential development, many of these benefits are lost and the health of the stream may decline.

The vegetative condition of the riparian buffer based on 100 feet of buffer on either side of the stream was analyzed by subwatershed as described in Appendix E, Chapter 2. This GIS analysis encompasses the results from the 1997 Water Quality Management Plan for Loch Raven Watershed (Tetra Tech, 1997) and 2010-2011 stream assessments. The condition of the stream buffer was classified into three conditions: impervious, forested or open pervious. Impervious areas were determined by overlaying the GIS layers for roads and buildings over the 100-foot stream buffer layer. Similarly, the forested areas were determined using the forested GIS layer and removing any impervious area footprint. The remaining areas within the 100-foot stream buffer were classified as open pervious area. 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 for restoration prioritization. Subwatersheds with lower percentages of open pervious buffer areas have a higher percentage of forested buffer that are key areas for protection and are scored highest for protection prioritization.

Open pervious buffer areas range from 23 to 206 acres for the three subwatersheds. Table 4-16 provides the point system used to assign stream buffer restoration and protection scores to the three subwatersheds based on the distribution and range of open pervious buffer area percentages.

Table 4-16: Stream Buffer Improvement Point System and Restoration Scores

Point System	Restoration Scores	Protection Scores
≥ 60 percent open pervious	4 pts	1 pt
40 – 59 percent open pervious	3 pts	2 pts
20 – 39 percent open pervious	2 pts	3 pts
< 20 percent open pervious	1 pt	4 pts

The acreage and percentage of forested, impervious and open pervious buffer area is summarized by subwatershed in Table 4-17.

Table 4-17: Stream Buffer Improvement Scores

Subwatershed	Forested		Impervious		Open Pervious		Stream Buffer Improvement Restoration Score	Stream Buffer Improvement Protection Score
	Acres	%	Acres	%	Acres	%		
Baisman Run	144.8	85.1	1.6	0.9	23.8	14.0	1	4
Beaverdam Run	398.7	70.6	6.8	1.2	159.5	28.2	2	3
Oregon Branch	176.8	44.2	16.8	4.2	206.1	51.6	3	2

4.2.9 Stream Corridor Restoration

Stream Corridor Assessments (SCAs) were conducted based on the Maryland Department of Natural Resources (DNR) survey protocols to quickly assess physical stream conditions and identify common environmental problems in the stream corridor. This included documentation of erosion sites, inadequate stream buffers, fish migration barriers, exposed pipes and pipe outfalls, channelized or altered stream sections, trash dumping sites, in or near stream construction, and unusual conditions (e.g., algae). SCAs were conducted for a subset of stream reaches in Area I that covered parts of the watershed that had not been assessed as part of the 1997 Water Quality Management Plan for Loch Raven Watershed (Tetra Tech, 1997). Data from both the 1997 and 2010-2011 stream assessments are included in the stream buffer improvement prioritization in this section. A summary of the 1997 and 2010-2011 stream assessments are provided in Appendix E, Chapter 3.

During the 2010- 2011 stream assessment approximately 41.6 miles of stream were assessed. The most severe problems observed were inadequate stream buffers, erosion, and unusual conditions. Because stream buffer improvement is addressed in a separate criterion (section 4.2.8), it is not included in the stream corridor restoration ranking criterion. The remaining two most severe problems observed, erosion and unusual conditions, were evaluated/scored separately and then combined to determine an overall stream corridor restoration score. Protection prioritization was not rated for this criterion because stream corridor restoration doesn't provide protection potential. Each problem category and overall stream corridor restoration criterion scores from the 2010-2011 stream assessment are described below.

Erosion

Erosion can destabilize stream banks, impact habitat, and cause sediment pollution problems downstream. Significant erosion problems are often a result of land use changes in a watershed. Since erosion is also a natural process, it was not the purpose of the SCA survey to identify every occurrence of erosion. Erosion was documented for unstable stream reaches with significant amounts of erosion along the stream's banks such as vertical stream banks and where vegetative roots along a reach were unable to hold soil onto the banks (Appendix E). Very severe and severe eroded stream length percentages (based on surveyed stream miles) were used to directly compare and rank subwatersheds. A higher percentage of stream length that is significantly eroded represents a greater need and potential for stream corridor restoration.

The percentages of significant erosion within each subwatershed range from 0 to 7.4 percent. Oregon Branch was not provided a score as there are no very severe or severe erosion sites identified. Table 4-18 provides the point system used to assign significant erosion restoration scores to the three subwatersheds based on the percentage of erosion.

Table 4-18: Significant Erosion Point System and Restoration Scores

Point System	Restoration Scores
≥ 9 percent erosion	4 pts
6 – 8 percent erosion	3 pts
5 – 3 percent erosion	2 pts
0.1 – 2 percent erosion	1 pt

Table 4-19 summarizes the percentages of eroded stream lengths in surveyed stream corridors and the corresponding erosion scores by subwatershed.

Table 4-19: Stream Erosion Restoration Scores

Subwatershed	% Erosion	Erosion Restoration Score
Baisman Run	7.4	3
Beaverdam Run	5.1	2
Oregon Branch	0	0

Unusual Conditions

During the stream assessment, unusual conditions were documented on problems that were considered out of the ordinary. An unusual condition was ranked as very severe if the potential problem was considered to have a direct and wide-reaching impact on the stream's aquatic resources. The four severely rated unusual conditions were observations of excessive algae. These observations of excessive algae were made during a cold period in December and January, when biological activity is usually relatively slow. The higher number of severe unusual conditions identified in each subwatershed represents a greater need for stream corridor investigation of the sources of excessive algae.

The number of severe unusual conditions range from one to two within each subwatershed. Table 4-20 provides the point system used to assign unusual condition scores to the three subwatersheds based on the number of unusual conditions found in each subwatershed.

Table 4-20: Severe Unusual Conditions Point System and Restoration Scores

Point System	Restoration Scores
> 5 severe unusual conditions	4 pts
4 – 5 severe unusual conditions	3 pts
2 – 3 severe unusual conditions	2 pts
0 – 1 severe unusual conditions	1 pt

Table 4-21 summarizes the number of severe rated unusual conditions observed during the stream corridor assessment and the corresponding unusual condition scores by subwatershed. There are no very severe unusual conditions identified in Area I.

Table 4-21: Unusual Condition Restoration Scores

Subwatershed	Number of Severe Rated Unusual Conditions	Unusual Condition Restoration Score
Baisman Run	1	1
Beaverdam Run	1	1
Oregon Branch	2	2

Overall Stream Corridor Restoration Score

Stream corridor restoration may involve addressing the environmental problem categories of erosion and unusual conditions. Therefore, to determine the overall score for the stream corridor restoration criterion the subwatersheds were ranked according to the sum of the sub-criterion scores. Table 4-22 provides the point system used to assign stream corridor restoration scores to the three subwatersheds.

Table 4-22: Overall Stream Corridor Point System and Restoration Scores

Point System	Restoration Scores
Sub-criterion score total > 5	4 pts
Sub-criterion score total 4 – 5	3 pts
Sub-criterion score total 2 – 3	2 pts
Sub-criterion score total 0 – 1	1 pt

Subwatersheds with the highest total sub-criteria score received the highest ranking (4 points). The subwatershed with the lowest total sub-criteria score received the lowest ranking for this criterion (1 point). Table 4-23 summarizes the sub-criteria totals and overall stream corridor restoration scores by subwatershed.

Table 4-23: Stream Corridor Restoration Scores

Subwatershed	Total of Sub-Criteria Scores	Overall Stream Corridor Restoration Score
Baisman Run	4	3
Beaverdam Run	3	2
Oregon Branch	2	2

4.2.10 Septic Systems

Area I is located outside the Urban Rural Demarcation Line (URDL) where there is no public sewer in use in Area I and therefore septic systems are numerous. Properly functioning septic systems provide treatment for pathogens and phosphorus present in wastewater, but can discharge nitrogen in the form of nitrates. Depending on the location of the system the nitrates may either be reduced or eliminated through denitrification as the water passes through riparian buffers, particularly forested riparian buffers. Failing systems can release nitrogen, phosphorus, and other chemicals, contaminating the aquatic environment. They can also result in increased bacterial contamination of nearby streams and are therefore a human health concern.

The number of septic systems in each subwatershed was determined using the Baltimore County Bay Restoration Fund tracking that indicates the presence of approximately 2,138 septic systems in Area I. Subwatersheds with a greater number of septic systems exhibit the potential for greater water quality and restoration need and are assigned higher restoration scores as they are higher restoration priorities within Area I. The number of septic systems in each subwatershed range from 186 to 1,763. Table 4-24 provides the point system used to assign septic system restoration scores to the three subwatersheds in Area I.

Table 4-24: Septic Systems Point System and Restoration Scores

Point System	Restoration Scores
≥1,500 septic systems	4 pts
1,000 – 1,499 septic systems	3 pts
500 – 999 septic systems	2 pts
<500 septic systems	1 pt

The number of septic systems in each subwatershed and septic system restoration score are provided in Table 4-25.

Table 4-25: Septic Systems Restoration Scores

Subwatershed	Number of Septic Systems	Septic System Restoration Score
Baisman Run	186	1
Beaverdam Run	1,763	4
Oregon Branch	189	1

4.2.11 Agricultural Land

Agricultural practices (cropland, orchards, and pasture including horse farms) make up the third largest land use (14.7 percent) in Area I and represent an important part of the heritage of the rural community in northern Baltimore County. Conservation easements are used to help sustain the rural character and keep agricultural land from being sold and developed. A conservation easement ensures the protection of significant natural resources on a property. Placing a property under easement may allow the landowner to receive income, or estate and property tax benefits while still maintaining ownership of the property. Although there is not adequate inspection of farms, the more farms that are under an easement, the more land that is protected from development.

Area I contains several conservation easements held under various preservation programs. These include properties held under local land trusts, Maryland Agricultural Land Preservation Foundation or Maryland Environmental Trust and open space on properties that are situated in areas zoned by Baltimore County as watershed protection (RC-4). The percent of agricultural land that is not held in an easement was calculated for each subwatershed. Subwatersheds with a higher percent of agricultural land not held in easement are assigned higher protection scores as they have higher protection potential. Table 4-26 provides the point system used to assign agricultural land protection scores to the three subwatersheds in Area I. The acres of agricultural land not in an easement and the protection score for each subwatershed is provided in Table 4-27.

Table 4-26: Agricultural Land Point System and Protection Scores

Point System	Protection Scores
≥ 91 percent	4 pts
81 – 90 percent	3 pts
71 – 80 percent	2 pts
≤ 70 percent	1 pt

Table 4-27: Agricultural Land Scores

Subwatershed	Acres of Agriculture	Percent of Agriculture in easement	Percent of Agriculture not in easement	Agricultural Land Protection Score
Baisman Run	4.2	0%	100%	4
Beaverdam Run	338.9	13.2%	86.8%	3
Oregon Branch	877.5	24.4%	75.6%	1

4.2.12 Subwatershed Restoration and Protection Prioritization Summary

The three subwatersheds comprising Area I are ranked according to the total restoration and protection prioritization score (i.e., the sum of prioritization criterion scores). Subwatershed ranking results for restoration and protection are summarized in Tables 4-28 and 4-29 respectively including criterion scores, total scores and rankings. Table 4-30 provides a summary of the restoration and protection prioritization for each subwatershed.

Restoration Prioritization

Subwatersheds were placed into one of three restoration priority categories, high, medium and low, based on ranking results. These results are summarized in Table 4-28 and Table 4-30 and illustrated in Figure 4-2. Subwatersheds with a total prioritization score greater than 28 received a high priority rating for restoration. The Beaverdam Run subwatershed scored the highest and is the best target for improving water quality in the watershed. A medium rating was assigned to subwatersheds with total prioritization scores ranging from 20 to 27 (Oregon Branch subwatershed). A low rating was assigned to the subwatershed with total prioritization scores less than 20 (Baisman Run subwatershed).

Table 4-28: Subwatershed Restoration Ranking Results

Subwatershed	Total Nitrogen Load	Total Phosphorus Load	Fish IBI	Biological IBI	Impervious Surfaces	NSA PSI/ROI	NSA Lawn Fertilizer Reduction	ISI Site Investigation	Municipal Stormwater Conversion	Stream Buffer Improvement	Stream Corridor Restoration	Septic Systems	TOTAL SCORE	SUBWATERSHED RANK
Baisman Run	2	1	2	1	2	3	2	0	0	1	3	1	18	**Low**
Beaverdam Run	4	4	2	2	3	4	3	3	4	2	2	4	37	**High**
Oregon Branch	4	4	1	2	2	2	1	1	1	3	2	1	24	**Medium**

Protection Prioritization

Subwatersheds were placed into one of three protection priority categories, high, medium and low, based on ranking results. These results are summarized in Table 4-29 and Table 4-30 and illustrated in Figure 4-2. Subwatersheds with a total prioritization score greater than 20 received a high priority rating for protection. The Baisman Run subwatershed scored the highest and is the best target for protecting water quality in the watershed. A medium rating was assigned to subwatersheds with total prioritization scores ranging from 16 to 19 (Beaverdam Run subwatershed). A low rating was assigned to the subwatershed with total prioritization scores less than 16 (Oregon Branch subwatershed).

Restoration and protection actions will have to occur throughout the entire Area I in order to meet environmental goals and requirements. However, subwatershed prioritization provides a tool/framework for focusing initial restoration and protection efforts.

Table 4-29: Subwatershed Protection Ranking Results

Subwatershed	Total Nitrogen Load	Total Phosphorus Load	Fish IBI	Biological IBI	Impervious Surfaces	Stream Buffer Improvement	Agricultural Land	TOTAL SCORE	SUBWATERSHED RANK
Baisman Run	3	4	3	4	3	4	4	25	**High**
Beaverdam Run	1	1	3	3	2	3	3	16	**Medium**
Oregon Branch	1	1	4	3	3	2	1	15	**Low**

Table 4-30: Subwatershed Restoration and Protection Prioritization

Subwatershed	Total Restoration Score	Restoration Prioritization Category	Total Protection Score	Protection Prioritization Category
Baisman Run	18	Low	25	High
Beaverdam Run	37	High	16	Medium
Oregon Branch	24	Medium	15	Low

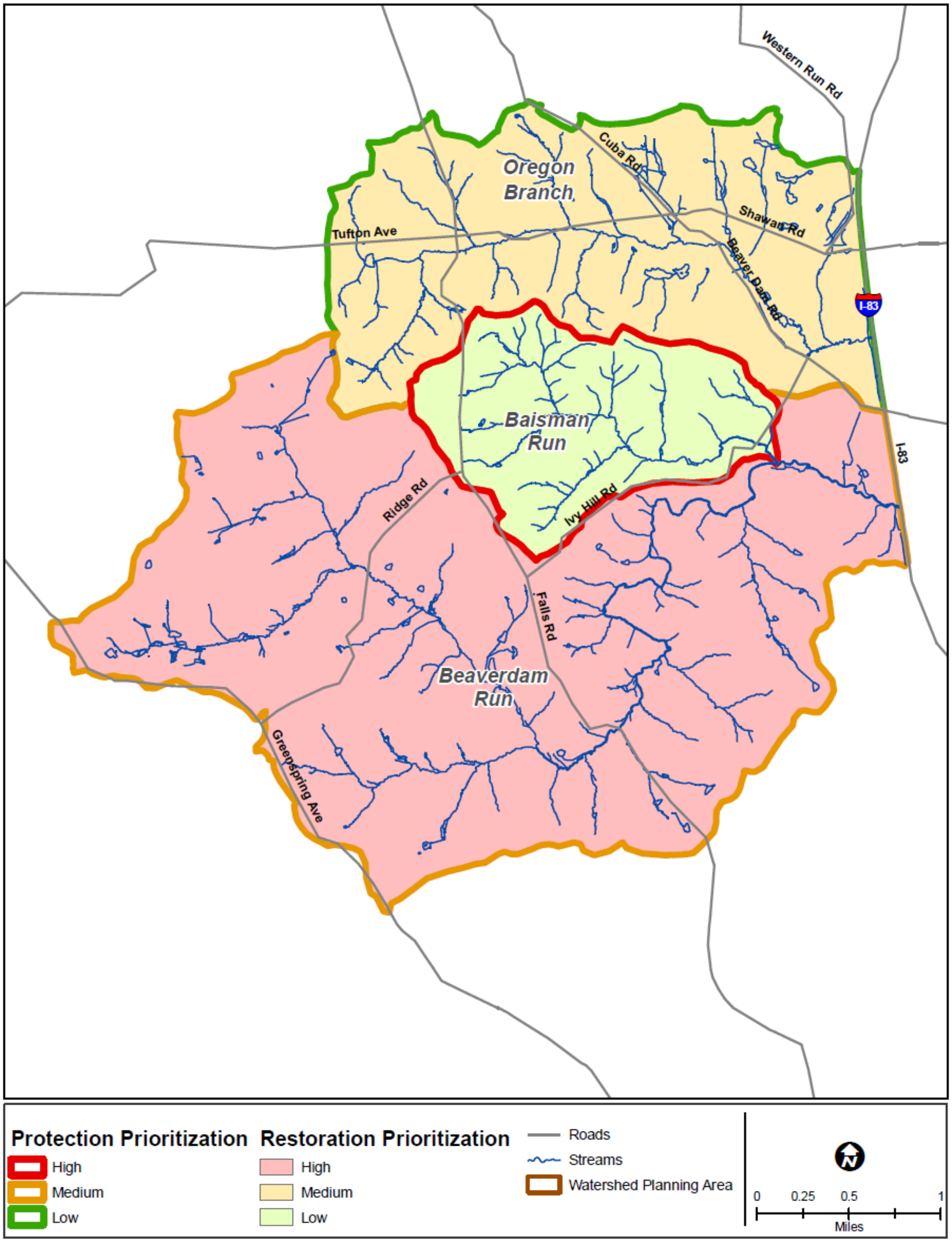

Figure 4-2: Subwatershed Prioritization

4.3 Subwatershed Restoration and Protection Strategies

Restoration and protection management strategies for each subwatershed are presented in the following subsections. Appendix A presents measurable actions that correspond to each strategy and the goals and objectives described in Chapter 2. This section includes the results of the stream assessment and upland assessments (Appendix E) and available agricultural data. For each subwatershed, key characteristics are presented that include drainage area, stream length, total population, land use/land cover, land in easement, impervious cover, hydrologic soil group, stormwater management (SWM) facilities and restoration and protection priority ranking. A summary of assessment results for neighborhoods, hotspots, institutions, stream corridors and stormwater conversions are provided for each subwatershed. Although a detailed assessment was not conducted, recommendations are made for agricultural lands in each subwatershed. Finally, a subwatershed management strategy including recommended citizen and municipal actions are presented at the end of each section.

4.3.1 Baisman Run

Baisman Run is the smallest subwatershed in Area I with a drainage area of just over one and a half square miles (1.65 mi^2) and is located entirely within Area I. This subwatershed was ranked as the lowest priority for restoration and the highest priority for protection in Area I. The existing land use consists primarily of forest containing a significant portion of the Oregon Ridge Park and low density residential land use. Most of the development in the subwatershed occurred in the 1970s through the 1990s and includes the residential communities of Jonathan's Delight, Spring Hill Farms, and Shawan Valley. While only 6.3 acres (0.5%) of the subwatershed is held in easements through local land trusts, more than half of the area, 554.7 acres (52.5%), is located within the Oregon Ridge Park. Baisman Run contains two long term ecological research sites that are extensively monitored by the Baltimore Ecosystem Study (BES). Included in this research is a forested reference site, Pond Branch, a smaller drainage area within Baisman Run that is located in Oregon Ridge Park. Baisman Run subwatershed drains into Beaverdam Run just west of the intersection of Ivy Hill Road. Table 4-31 summarizes the key subwatershed characteristics of Baisman Run.

Table 4-31: Baisman Run Subwatershed Key Characteristics

Drainage Area	1,056.0 acres (1.65 mi^2)	
Stream Length	11.4 miles	
Total Population	432 (2000 Census) 0.4 people/acre	
Land Use / Land Cover	Very Low Density Residential (Agriculture):	0.9%
	Very Low Density Residential (Forested):	6.7%
	Low Density Residential:	36.0%
	Commercial:	0.0%
	Industrial:	0.0%
	Institutional	0.5%
	Open Urban Land:	0.0%
	Agriculture:	0.4%
	Forest:	55.6%
	Transportation:	0.0%
Land in Easement	6.3 acres (0.5%)	
Impervious Cover	4.1% of Subwatershed	
Hydrologic Soil Group	A Soils (low runoff potential):	0.0%
	B Soils:	76.0%
	C Soils:	21.8%
	D Soils (high runoff potential):	2.2%
SWM Facilities	2 Facilities 4.1% of urban land use treated	
Restoration/Protection Priority Rating	Low/High	

Neighborhood Source Assessment

A total of three distinct neighborhoods were identified and assessed within the Baisman Run subwatershed during the uplands assessment of Area I. Characteristics such as lot size, age, and type were used to delineate neighborhoods rather than subwatershed boundaries. Several neighborhoods cross subwatershed boundaries; in cases where there is a substantial area in more than one subwatershed it is counted in each subwatershed in which it falls. Recommendations for addressing stormwater volume and pollutants within this subwatershed include increasing tree canopy on lots, and public awareness (i.e. Bayscaping, fertilizer reduction, storm drain marking, etc.). The results of the Neighborhood Source Assessments (NSA) are presented in Table 4-32.

Table 4-32: Baisman Run NSA Summary of Results

Site ID	Lot Size (acres)	Storm Drain Marking	Bayscaping	Increase Lot Canopy	Fertilizer Reduction	Stormwater Retrofit	Notes
NSA_I_100	>1	X	X	X	X		
NSA_I_101	>1	X	X	X	X		
NSA_I_102	>1	X	X	X	X		

All of the neighborhoods assessed in Baisman Run have high maintenance lawns that could be reduced through additional tree planting and/or Bayscaping. Figure 4-3 shows typical lawns in the area.


Figure 4-3: Large, managed lawns in neighborhoods in Baisman Run (NSA_I_100).

Hotspot Site Investigation and Institutional Site Investigation

There are no hotspots or institutional sites identified in the Baisman Run subwatershed.

Stream Corridor Assessment

Baisman Run is classified by the Maryland Department of the Environment (MDE) as a Use III-P, defined as Nontidal Cold Water and Public Water Supply. Based on data from EPS, native brook trout and wild brown trout were found in Baisman Run.

During the 2010-2011 stream assessment, field crews walked 11.2 miles of stream (98.2% of total stream miles) within the Baisman Run subwatershed to identify water quality problems and restoration opportunities. The survey included an assessment of all streams in the Baisman Run as none were assessed during the 1997 stream assessment. A total of 50 potential environmental problems were identified in Baisman Run with the majority rated as moderate to minor severity and four rated as severe. The severe rated problems include an erosion site, an unusual condition identified as a pond with excessive algae near a drainage swale, a fish migration barrier located at the USGS gauging station near Ivy Hill Road, and an exposed 48-inch pipe that is being undercut by the stream that is creating an extended area of scour on the downstream side of the pipe (Figure 4-4). Table 4-33 summarizes the results of all the SCA survey and restoration opportunities for Baisman Run.

Figure 4-4: Severe problems identified in Baisman Run; Erosion site (top left), excessive algae (top right), fish migration blockage (bottom left), and exposed pipe (bottom right).

Table 4-33: Summary of Baisman Run Stream Conditions

Subwatershed	Channel Alterations	Erosion Sites	Exposed Pipes	Fish Barriers	Inadequate Buffers	In or Near Stream construction	Pipe Outfalls	Trash Dumping	Unusual Conditions	Comment Sheets	Totals
Baisman Run	2	23	2	3	6	0	4	0	4	6	50

Subwatershed	Length of Channel Alteration (ft)	Length of Erosion (ft)	Length of Inadequate Buffer (ft)
Baisman Run	261	10,319	2,773

Stormwater Conversion Assessment

There were no stormwater ponds assessed for potential conversion in Baisman Run.

Subwatershed Management Strategy

Restoration and protection strategies are outlined below. Figure 4-5 provides a map of the restoration opportunities in Baisman Run.

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

1. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-32.

2. Promote awareness of the benefits of Bayscaping, tree planting, and proper lawn care in the neighborhoods indicated in Table 4-32.

3. Educate citizens on the importance of septic system maintenance.

4. Encourage citizens to volunteer with trail maintenance and other activities at the Oregon Ridge Park.

5. Promote awareness of and participation in the stream watch Adopt-a-Stream program.

Municipal Actions

1. Work with a fish biologist to analyze the condition of the USGS gauging station that is acting as a fish migration barrier and implement feasible corrective measures.

2. Investigate the cause of the excessive algae in the stream as indicated in Figure 4-4 and implement corrective measures.

3. Explore options for stream buffer enhancements and pursue implementation of feasible enhancements projects.

4. Investigate the exposed 48-inch pipe that is being undercut by the stream and creating an eroded area of scour on the downstream side of the pipe as indicated in Figure 4-4 and implement corrective measures.

5. Work with the Gunpowder Valley Conservancy and the Valleys Planning Council to preserve land in the subwatershed.

6. Identify sources of fecal coliform through monitoring or inspections of septic systems by the Baltimore County Health Department and implement corrective measures.

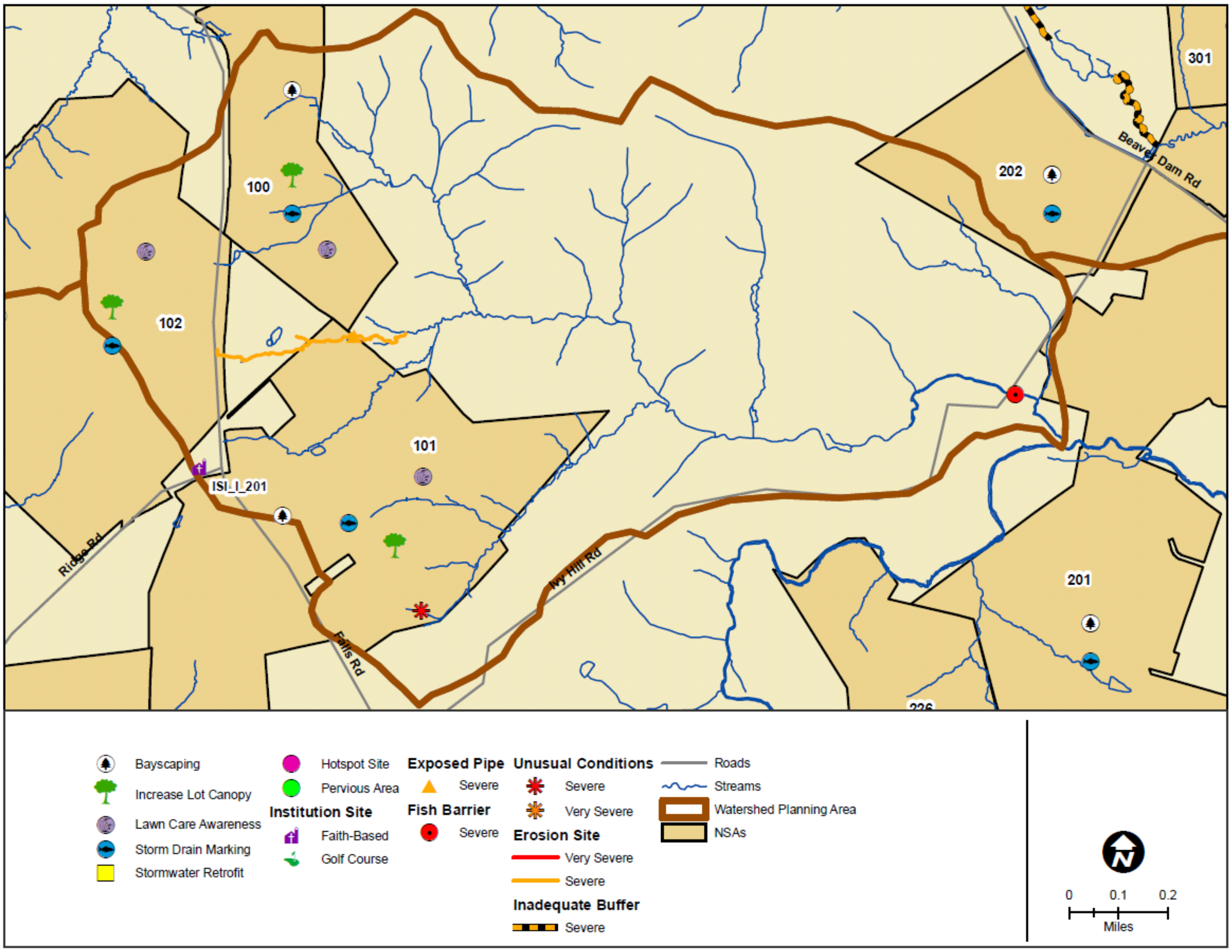

Figure 4-5: Restoration Opportunities in Baisman Run

4.3.2 Beaverdam Run

Beaverdam Run subwatershed is the largest subwatershed in Area I at just under eight square miles (7.79 mi^2) and the most developed subwatershed with approximately eight percent impervious cover (7.7%). This subwatershed was ranked as the highest priority for restoration in Area I and a medium priority for protection. While the boundary of Beaverdam Run ends at the western edge of I-83 for the purposes of this study, portions of the subwatershed extend to the east of I-83 into areas with more urban land use that will be included in the SWAP for Planning Area O. Beaverdam Run drains directly into the west side of the Loch Raven Reservoir. The existing land use consists primarily of forest, low density residential and very low density residential that is mostly forested. Most of the development in the subwatershed occurred over the past six decades from the 1950s to the 2000s with a considerable amount built before 1900. This development consists of many residential communities that include Worthington Ridge, Tufton Ridge Estates, Beaverbrook, Green Valley North, Hickory Meadow, and Laurelford. There are 257.3 acres (5.2%) of the subwatershed that are held in easements through local land trusts, the Maryland Environmental Trust and watershed protection zoning (C-4). Table 4-34 summarizes the key subwatershed characteristics of Beaverdam Run.

Table 4-34: Beaverdam Run Key Subwatershed Characteristics

Drainage Area	4,984.6 (7.79 mi^2)	
Stream Length	33.6 miles	
Total Population	4,405 (2000 Census) 0.9 people/acre	
Land Use / Land Cover	Very Low Density Residential (Agriculture):	1.9%
	Very Low Density Residential (Forested):	10.1%
	Low Density Residential:	63.7%
	Commercial:	1.2%
	Industrial:	0.1%
	Institutional	0.0%
	Open Urban Land:	1.3%
	Agriculture:	6.8%
	Forest:	14.4%

	Transportation:	0.3%
Land in Easement	257.3 acres (5.2%)	
Impervious Cover	7.7% of Subwatershed	
Hydrologic Soil Group	A Soils (low runoff potential):	0.0%
	B Soils:	63.9%
	C Soils:	28.2%
	D Soils (high runoff potential):	7.7%
SWM Facilities	59 Facilities 22.8% of urban land use treated	
Restoration/Protection Priority Rating	High/Low	

Neighborhood Site Assessment

A total of 24 distinct neighborhoods were identified and assessed within the Beaverdam Run subwatershed during the uplands assessment of Area I. Characteristics such as lot size, age, and type were used to delineate neighborhoods rather than subwatershed boundaries. Several neighborhoods cross subwatershed boundaries; in cases where there is a substantial area in more than one subwatershed it is counted in each subwatershed in which it falls. Recommendations for addressing stormwater volume and pollutants within this subwatershed include increasing lot canopy, installing stormwater retrofits, and public awareness (i.e. Bayscaping, fertilizer reduction, storm drain marking, etc.). The results of the Neighborhood Source Assessments (NSA) are presented in Table 4-35 and Figure 4-6.

Table 4-35: Beaverdam Run NSA Summary of Results

Site ID	Lot Size (acres)	Storm Drain Marking	Bayscaping	Increase Lot Canopy	Fertilizer Reduction	Stormwater Retrofit	Notes
NSA_I_101	>1	X	X	X	X		
NSA_I_102	>1	X	X	X	X		

Site ID	Lot Size (acres)	Storm Drain Marking	Bayscaping	Increase Lot Canopy	Fertilizer Reduction	Stormwater Retrofit	Notes
NSA_I_200	>1	X	X	X	X		
NSA_I_200B	>1	X	X	X	X		
NSA_I_201	1	X	X		X		
NSA_I_204	>1	X	X	X	X		
NSA_I_205	½	X	X	X	X		
NSA_I_207	>1	X	X	X	X	X	
NSA_I_208	1	X	X	X	X		
NSA_I_209	>1	X	X	X	X	X	
NSA_I_211	>1	X	X	X	X		
NSA_I_212	>1	X	X	X	X		
NSA_I_214	>1	X	X	X	X		
NSA_I_215	>1		X	X	X		
NSA_I_216	>1	X	X	X	X		
NSA_I_217	>1	X	X	X	X		
NSA_I_218	>1	X			X		
NSA_I_220	>1	X	X	X	X	X	Buffer Impact
NSA_I_221	>1	X	X	X	X	X	
NSA_I_222	>1		X	X	X	X	
NSA_I_223	>1						
NSA_I_224	>1				X	X	
NSA_I_225	>1	X	X	X	X		
NSA_I_226	>1	X					

The majority of neighborhoods in Beaverdam Run would benefit from reducing the use of fertilizer on lawns, increasing tree canopy and Bayscaping in yards. A stormdrain stenciling program could be implemented throughout the subwatershed. In addition, several stormwater retrofits were identified that would provide water quality treatment for stormwater runoff. In neighborhood NSA_I_220, a stream that was mowed to the edge was noted in a residential yard for stream buffer restoration. Several stormwater retrofit opportunities were identified that include the conversion of grass ditches to wet or dry swales (NSA_I_221 and NSA_I_222), bioretention retrofits in cul-de-sacs (NSA_I_207 and NSA_I_209), roadway medians (NSA_I_207 and NSA_I_220), or at storm drain inlets (NSA_I_220). Neighborhood 224 identified several stormwater retrofit options (infiltration, sand filter, bioretention) to catch street runoff. In addition, in neighborhood NSA_I_200, pet waste was indicated as a pollution source and education should be provided on cleaning up pet waste.

Figure 4-6: Potential swale retrofit in NSA_I_222 (left) and high management lawn NSA_I_225 (right).

Hotspot Site Investigation

There are no hotspots in this subwatershed.

Institutional Site Investigation

Two faith-based facilities were assessed for restoration opportunities in Beaverdam Run during the Institutional Site Investigations (ISI) portion of the upland assessments in Area I. An opportunity for planting approximately 120 trees was identified at ISI_I_200 and the use of rain barrels was identified at site ISI_I_201. Table 4-36 summarizes the results for the ISI performed in Beaverdam Run and Figure 4-7 shows the sites investigated.

Table 4-36: Beaverdam Run ISI Results Summary

Site ID	Type	Name of Site	Public/ Private	Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Tree Planting	Stormwater Retrofit
ISI_I_200	Faith-based	Hunt Valley Presbyterian Church	Private	N	N	N	Y (120 trees)	N
ISI_I_201	Faith-based	Baltimore Chinese Baptist Church	Private	Y	Y	N	N	N

Figure 4-7: Opportunity for tree planting at ISI_I_200 (left) and rain barrels at ISI_I_201 (right).

Stream Corridor Assessment

Beaverdam Run is classified by the Maryland Department of the Environment (MDE) as a Use III-P, defined as Nontidal Cold Water and Public Water Supply. Based on data from EPS, native brook trout were found within the uppermost reaches of the mainstem of Beaverdam Run in addition to wild brown trout.

During the 2010-2011 stream assessment, field crews walked 19.8 miles of stream (58.9% of total stream miles) within the Beaverdam Run subwatershed to identify water quality problems and restoration opportunities. Because a total of 11.1 miles of stream were previously assessed during a 1997 study, the 2010-2011 assessment focused on mainly the first and forth order streams not surveyed in the prior study. The total combined miles of stream assessed is 31.0 or 92.3 percent of total stream miles.

The 1997 stream assessment in Beaverdam Run encompassed the larger subwatershed drainage area to the east of I-83 that is not included in the Area I study. The assessment identified two stream reaches within Area I as impaired (0.56 mi). One of the impaired stream reaches has fair to good riparian buffer ratings and the other has a poor riparian buffer rating. These stream reaches are included in the stream buffer improvement prioritization criterion (section 4.2.8).

The 2010-2011 stream assessment identified a total of 138 potential environmental problems in Beaverdam Run with the majority rated as moderate to minor severity. The top rated problems include one severe rated unusual condition identified as excessive algae, a very severe rated erosion site downstream of a large stormwater basin, in addition to five severe rated erosion sites, and a severe rated inadequate buffer site that is an old golf course in upper Beaverdam Run being converted into a large lot subdivision (Figure 4-8). In addition, 23 minor outfalls (<36 inches in diameter) with flow present were noted as moderate to minor severity during the stream assessment. Table 4-37 summarizes the results of all the 2010-2011 SCA survey and restoration opportunities for Beaverdam Run.

Figure 4-8: Problems identified in Beaverdam Run; very severe erosion site (left photo), severe inadequate stream buffer (right photo).

Table 4-37: Summary of Beaverdam Run Stream Conditions

Subwatershed	Channel Alterations	Erosion Sites	Exposed Pipes	Fish Barriers	Inadequate Buffers	In or Near Stream construction	Pipe Outfalls	Trash Dumping	Unusual Conditions	Comment Sheets	Totals
Beaverdam Run	8	53	0	0	15	0	42	0	3	17	138

Subwatershed	Length of Channel Alteration (ft)	Length of Erosion (ft)	Length of Inadequate Buffer (ft)
Beaverdam Run	1,673	10,873	9,332

Stormwater Conversion Assessment

Three of the four dry detention ponds assessed in Beaverdam Run subwatershed were identified as potential candidates for conversion to water quality facilities. One pond was identified as a potential candidate for conversion to a bioretention system (Pond #67) and two were identified as potential candidates for conversion to a wetland system (Pond #65 and 69). Two of the ponds (Pond #69 and #67) were ranked high for overall conversion potential with Pond # 65 ranked as medium potential.

Pond #69 scored the highest for conversion potential out of all the dry detention ponds in Beaverdam Run. Pond #69 is a publicly owned pond with two primary inflows that are located in close proximity to the existing concrete riser structure, and are likely short-circuiting the majority of the pond. Recommendations for pond #69 include providing low-flow berms between the inflows and the riser to increase these flow paths. Additionally, if groundwater is not in close proximity to the facility, water balance calculations should be performed to determine if a shallow wetland is feasible within the facility.

Pond # 67 is a privately owned pond that is in good condition but has significant groundhog activity along the side slopes and low flow channels that are short-circuiting the pond. Recommendations for this facility include removal of the riprap channels, the addition of plunge pools to reduce velocities from the inflow pipes, and increasing the flow path. Conversion of the facility to either a modified sand filter or bioretention is recommended.

Pond #65 is a publicly owned pond that overtime has developed a permanent pool with wetland characteristics. It has a corrugated metal pipe riser that is leaning substantially and will eventually collapse and several trees along the upstream and downstream side of the embankment. Recommendations for this facility include making immediate repairs to the riser, slip lining and/or replacing the barrel, removing the woody vegetation from the embankment, and investigating the hydraulics of the facility to determine if capacity and freeboard are adequate. If the hydraulics is found to be acceptable the retrofit should include permanent conversion to a wetland. Table 4-38 summarizes the potential candidates for dry detention pond conversion in the Beaverdam Run and Figure 4-9 shows the sites investigated.

Pond #66 was field assessed but not identified as a potential candidate for conversion to a water quality facility. This publicly owned dry detention pond is located within a wooded area bounded by single family residential development and Barthel Court. The control structure consists of a large concrete headwall, with attached weir wall on the upstream side of a corrugated metal culvert. The weir wall has a vertical opening that is partially clogged, resulting in a stream channel elevation approximately eighteen inches higher than the culvert invert, creating a fish migration blockage. There is little opportunity within this facility for conversion to a water quality facility due to impacts to adjacent wetlands and forested areas during conversion. In addition, current regulations discourage construction of instream facilities, and approval may be difficult. Efforts should focus on correcting the fish passage problems and stabilizing the upstream channel. Table 4-38 summarizes the potential candidates for dry detention pond conversion in the Beaverdam Run and Figure 4-9 shows the sites investigated.

Table 4-38: Beaverdam Run Dry Detention Pond Conversions

Pond Number	Ownership	Acres	Total Score	Rank	Subwatershed
69	Public	19.1	25	High	Beaverdam Run
67	Private	21.5	22	High	Beaverdam Run
65	Public	43.6	10	Medium	Beaverdam Run
66	Public	173.3	0	Low	Beaverdam Run

Figure 4-9. Pond #67 riprap channels (top left), Pond #65 leaning riser and trees on embankment (top right), Pond #66 weir wall (bottom left), and Pond # 69 concrete riser structure (bottom right).

Subwatershed Management Strategy

Restoration and protection strategies are outlined below. Figure 4-10 provides a map of the restoration opportunities in Beaverdam Run.

Engaging Citizens & Watershed Groups

1. Educate citizens on the importance of septic system maintenance.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-35.

3. Promote awareness of the benefits of Bayscaping, tree planting, and proper lawn care in the neighborhoods indicated in Table 4-35.

4. In neighborhood NSA_I_200, educate homeowners on the benefits of picking up pet waste.

5. Promote awareness of and participation in the stream watch Adopt-a-Stream program as described in Appendix E.

Municipal Actions

1. Convert the dry detention ponds identified in Table 4-38 to bioretention systems or wetland systems.

2. Conduct illicit discharge monitoring for potential septic system impacts at the 23 minor outfalls identified with flow as indicated in Appendix E and implement corrective measures.

3. Work with the faith-based institution to implement restoration projects as indicated in Table 4-36.

4. Investigate the installation of stormwater retrofits identified in the neighborhoods indicated in Table 4-35 and implement corrective measures.

5. Explore options for stream buffer enhancements specifically at the severe rated site at an old golf course in upper Beaverdam Run that is being converted into a large lot subdivision and implement corrective measures.

6. Investigate the cause of the excessive algae in the stream described in Chapter 3 of the Characterization Report and implement corrective measures.

7. Investigate the very severe rated erosion site downstream of a large stormwater basin and implement corrective measures.

8. Investigate stream restoration potential at the sites identified with severe erosion problems in Table 4-37 and implement corrective measures.

9. Identify sources of fecal coliform through monitoring or inspections of septic systems by the Baltimore County Health Department and implement corrective measures.

10. Continue to work with the Baltimore County Soil Conservation District to support Soil Conservation and Water Quality Plans (SCWQP) and horse management on farms in the subwatershed.

11. Conduct a build-out analysis for the subwatershed and identify areas for potential preservation of agricultural land through conservation easements.

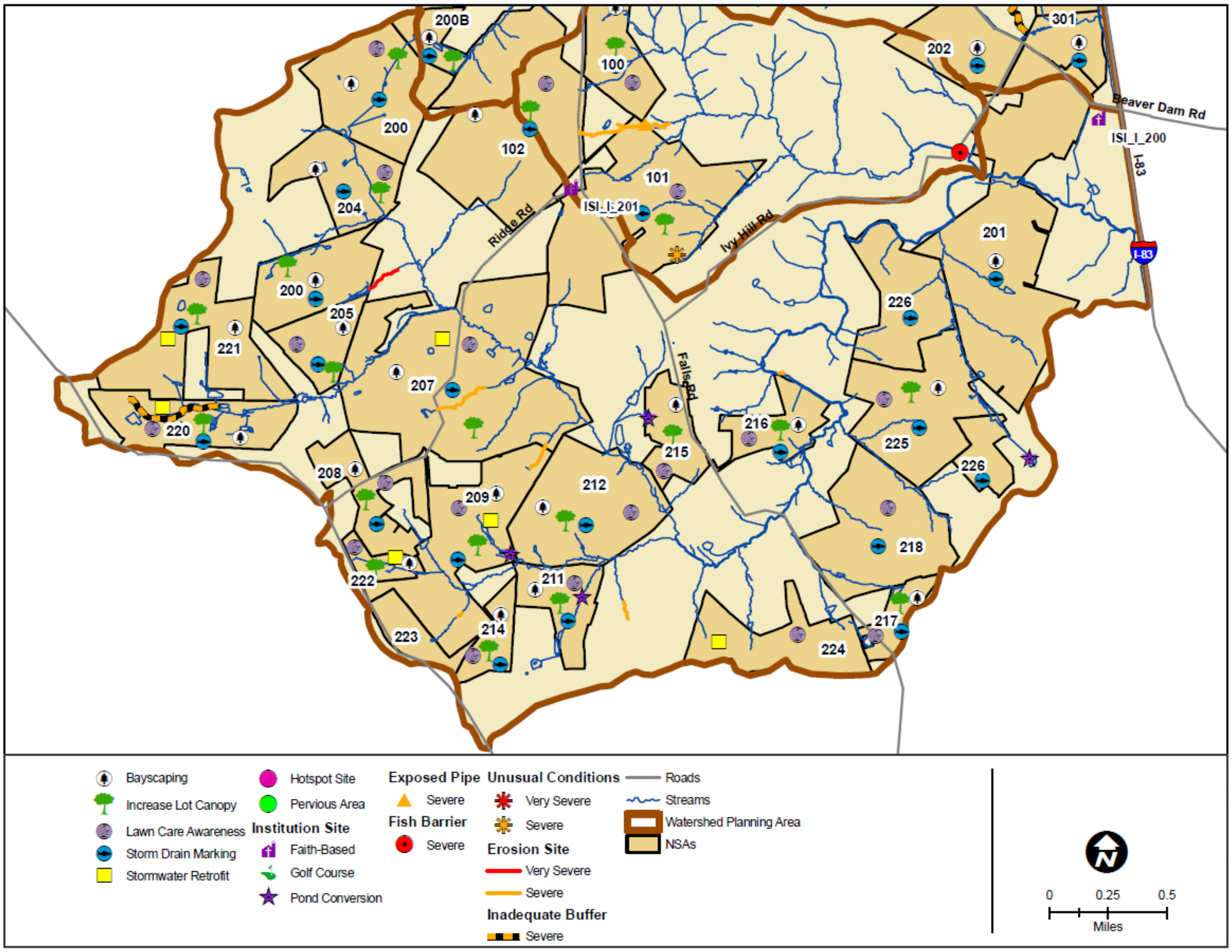

Figure 4-10: Restoration Opportunities in Beaverdam Run

4.3.3 Oregon Branch

Oregon Branch subwatershed is the second largest subwatershed in Area I at 3.61 square miles. This subwatershed was ranked as medium priority for restoration and low priority for protection in Area I. While the boundary of Oregon Branch ends at I-83 for the purposes of this study, portions of the subwatershed extend to the east of I-83 into areas with more urban land that will be included in the SWAP for Planning Area O. Oregon Branch drains into Beaverdam Run just west of I-83. The existing land use consists primarily of agriculture, forest, and low density residential. Most of the development in the subwatershed occurred over three decades from the 1970's to the 1990's with a considerable amount built before 1900. This development includes the residential communities of Shawan at Hunt Valley, Ivy Hill, and Briarwood Farms. Oregon Branch has the largest number of acres in easement (316.2 acres or 13.7%) held through the Maryland Environmental Trust and the Maryland Agricultural Land Preservation Foundation**.** Additionally, 524.0 acres (22.7%), of the area is located within the Oregon Ridge Park. Table 4-39 summarizes the key subwatershed characteristics of Oregon Branch.

Table 4-39: Oregon Branch Key Subwatershed Characteristics

Drainage Area	2,309.4 (3.61 mi^2)	
Stream Length	21.2 miles	
Total Population	712 (2000 Census) 0.3 people/acre	
Land Use / Land Cover	Very Low Density Residential (Agriculture):	3.0%
	Very Low Density Residential (Forested):	6.7%
	Low Density Residential:	13.9%
	Commercial:	0.5%
	Industrial:	0.0%
	Institutional	0.2%
	Open Urban Land:	11.5%
	Agriculture:	38.0%
	Forest:	24.8%
	Transportation:	1.4%

Land in Easement	316.2 (13.7%)
Impervious Cover	4.9% of Subwatershed
Hydrologic Soil Group	A Soils (low runoff potential): 0.0% B Soils: 48.0% C Soils: 47.9% D Soils (high runoff potential): 0.4%
SWM Facilities	12 Facilities 2.8% of urban land use treated
Restoration/Protection Priority Rating	Medium/Medium

Neighborhood Site Assessment

A total of seven distinct neighborhoods were identified and assessed within the Oregon Branch subwatershed during the uplands assessment of Area I. Characteristics such as lot size, age, and type were used to delineate neighborhoods rather than subwatershed boundaries. Several neighborhoods cross subwatershed boundaries; in cases where there is a substantial area in more than one subwatershed it is counted in each subwatershed in which it falls. Recommendations for reducing stormwater volume and pollutants within this subwatershed include public awareness (i.e. Bayscaping, fertilizer reduction, storm drain marking, etc.). The results of the Neighborhood Source Assessments (NSA) are presented in Table 4-40.

Table 4-40: Oregon Branch NSA Summary of Results

Site ID	Lot Size (acres)	Storm Drain Marking	Bayscaping	Increase Lot Canopy	Fertilizer Reduction	Stormwater Retrofit	Notes
NSA_I_100	>1	X	X	X	X		
NSA_I_102	>1	X	X	X	X		
NSA_I_200	>1	X	X	X	X		

Site ID	Lot Size (acres)	Storm Drain Marking	Bayscaping	Increase Lot Canopy	Fertilizer Reduction	Stormwater Retrofit	Notes
NSA_I_200B	>1	X	X	X	X		
NSA_I_201	1	X	X		X		
NSA_I_202	>1	X	X		X		
NSA_I_301	>1	X	X	X	X	X	

All of the neighborhoods in Oregon Branch were identified for the use of Bayscaping, fertilizer reduction, and storm drain marking. These recommendations can be implemented by providing awareness sessions to homeowners on their impact to the local streams. Five neighborhoods, NSA_I_102, NSA_I_200B, NSA_I_100, NSA_I_200, and NSA_I_301 were identified for increasing lot tree canopy. In addition, there is one opportunity for a stormwater retrofit in NSA_I_301 that converts grass ditches to wet or dry swales that would provide water quality treatment (Figure 4-11).

Figure 4-11. Opportunity for increased tree canopy and Bayscaping in NSA_I_301 (left) and stormwater retrofit opportunity (right) in NSA_I_301.

Hotspot Site Investigation

Two hotspot candidates were investigated during the Hotspot Site Investigation performed in Oregon Branch. Both sites were commercial establishments (i.e. restaurants) investigated primarily for opportunities to improve waste management, parking areas, downspouts, landscaping or stormwater management. Neither site investigated was determined to be a hotspot. However, the sites could be improved by better waste management (i.e. dumpsters and grease traps at HSI_I_ 300) and adding rain barrels at downspouts (HSI_I_301). Additionally, a drain pipe was found flowing directly to the stream at HSI_I_301) from an unknown source. This should be investigated further and could be an additional improvement at this site. Figure 4-12 provides photos of the two hotspots and Table 4-41 summarizes the results for hotspots assessed in Oregon Branch.

Table 4-41: Oregon Branch HSI Results Summary

Site ID	HSI Status	HSI Category	Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf /Landscaping	Notes
HSI_I_300	Low	Commercial			X			
HSI_I_301	Low	Commercial			X			Rain barrels at downspouts

Figure 4-12: Hotspot Sites Investigated: HSI_I_301 (left) and HSI_I_300 (right)

Institutional Site Investigation

Two facilities were assessed for restoration opportunities in Oregon Branch during the Institutional Site Investigations (ISI) portion of the upland assessments in Area I and include a faith-based facility and a golf course. Both sites provide opportunities for tree planting with a total of 1,120 identified trees to plant. Figure 4-13 provides photos and Table 4-42 summarizes the results for the Institutional Site Investigations (ISI) performed in Oregon Branch.

Table 4-42: Oregon Branch ISI Result Summary

Site ID	Type	Name of Site	Public/ Private	Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Tree Planting	Stormwater Retrofit
ISI_I_300	Faith-Based	Catholic Community of St. Francis Xavier	Private	N	N	N	Y (520 trees)	N
ISI_I_301	Golf Course	Hayfields Golf Course	Private	N	N	N	Y (600 trees)	N


Figure 4-13: Opportunity for Tree Planting at ISI_I_300 (left) and ISI_I_301 (right)

Stream Corridor Assessment

Oregon Branch is classified by the Maryland Department of the Environment (MDE) as a Use III-P, defined as Nontidal Cold Water and Public Water Supply. Based on data from EPS, wild brown trout are present in Oregon Branch.

During the 2010-2011 stream assessment, field crews walked 10.6 miles of stream (50% of total stream miles) within the Oregon Branch subwatershed to identify water quality problems and restoration opportunities. Because a total of 4.9 miles of stream were previously assessed during a 1997 study, the 2010-2011 assessment focused on mainly the first and forth order streams not surveyed in the prior study. The total combined miles of stream assessed is 15.5 or 73.1 percent of total stream miles in Oregon Branch.

The 1997 stream assessment in Oregon Branch identified six stream reaches as impaired. All of the impaired stream reaches have poor to very poor riparian buffer ratings that total 0.68 miles. These stream reaches are included in the stream buffer improvement prioritization criterion (section 4.2.8). Three stream segments (0.48 mi) identified unrestricted cattle access to the stream resulting in severe bank erosion and water quality impacts.

The 2010-2011 stream assessment identified a total of 31 potential environmental problems in Oregon Branch with the majority rated as moderate to minor severity. The top rated problems include two severe rated unusual conditions identified as the presence of excessive algae and a severe fish migration barrier at the Shawan Road crossing. In addition, four severe inadequate stream buffers were noted where residential homeowners mow up to the stream edge (Figure 4-14). Table 4-43 summarizes the results of the 2010-2011 SCA survey and restoration opportunities for Oregon Branch.

Figure 4-14: Stream problems identified in Oregon Branch; excessive algae (left) and inadequate stream buffer (right).

Table 4-43: Summary of Oregon Branch Stream Conditions

Subwatershed	Channel Alterations	Erosion Sites	Exposed Pipes	Fish Barriers	Inadequate Buffers	In or Near Stream construction	Pipe Outfalls	Trash Dumping	Unusual Conditions	Comment Sheets	Totals
Oregon Branch	1	4	1	3	14	0	4	0	4	0	31

Subwatershed	Length of Channel Alteration (ft)	Length of Erosion (ft)	Length of Inadequate Buffer (ft)
Oregon Branch	131	2,006	13,618

Stormwater Conversion Assessment

One dry detention pond was assessed in the Oregon Branch subwatershed that was identified as a potential candidate for conversion to water quality facilities. Pond #68 scored the second highest for conversion potential out of all the dry detention ponds assessed in Area I. Pond #68 is a privately owned pond with a recommendation to install a trash rack on top of the existing riser structure and conversion to a bioretention facility. Table 4-44 summarizes the potential candidate for dry detention pond conversion in the Oregon Branch subwatershed. Figure 4-15 shows the site investigated.

Table 4-44: Oregon Branch Dry Detention Pond Conversions

Pond Number	Ownership	Acres	Total Score	Rank	Subwatershed
68	Private	3.0	23	High	Oregon Branch

Figure 4-15: Pond #68 with concrete riser

Subwatershed Management Strategy

Restoration and protection strategies are outlined below. Figure 4-16 provides a map of the restoration opportunities in Oregon Branch.

Engaging Citizens & Watershed Groups

1. Educate citizens on the importance of septic system maintenance.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-40.
3. Promote awareness of the benefits of Bayscaping, tree planting, and proper lawn care in the neighborhoods indicated in Table 4-40.
4. Promote awareness of and participation in the stream watch Adopt-a-Stream program.

Municipal Actions

1. Investigate the installation of stormwater retrofits identified in the neighborhoods indicated in Table 4-40 and implement corrective measures.

2. Investigate the cause of the excessive algae in the stream described in Chapter 3 of the Characterization Report and implement corrective measures.

3. Work with a fish biologist to analyze the severe fish migration barrier at Shawan Road to determine if removal or modification is necessary.

4. Work with the faith-based institutions and golf course to implement restoration projects as indicated in Table 4-42.

5. Explore options for stream buffer enhancements specifically at the severe rated sites and implement corrective measures.

6. Continue to work with the Baltimore County Soil Conservation District to support Soil Conservation and Water Quality Plans (SCWQP) and horse management on farms in the subwatershed.

7. Convert the dry detention pond identified in Table 4-44 to a bioretention system.

8. Identify sources of fecal coliform through monitoring or inspections of septic systems by the Baltimore County Health Department and implement corrective measures.

9. Work with the Baltimore County Soil Conservation District to provide fencing and alternative watering to keep livestock out of streams.

10. Conduct a build-out analysis for the subwatershed and identify areas for potential preservation of agricultural land through conservation easements.

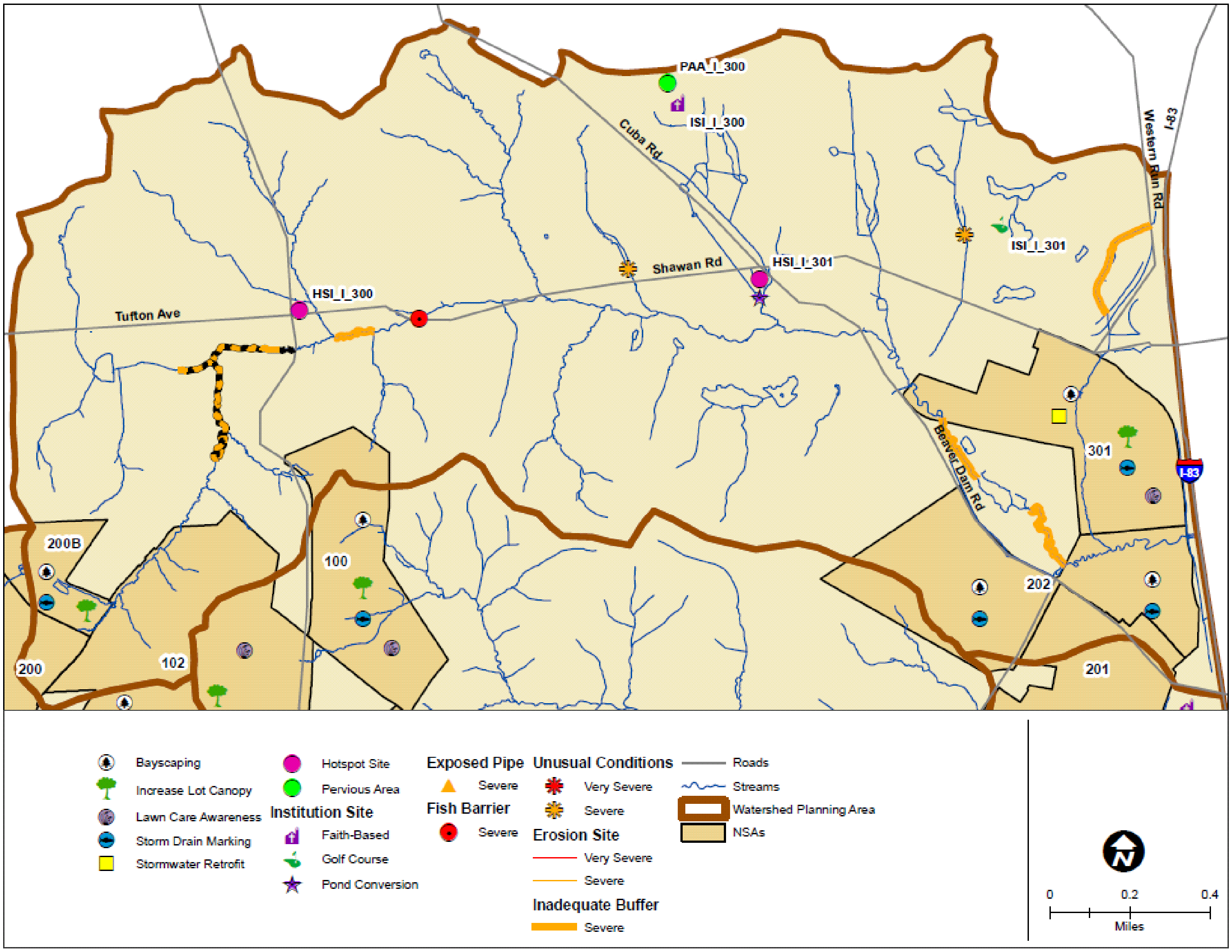

Figure 4-16: Restoration Opportunities in Oregon Branch

CHAPTER 5.0

PLAN EVALUATION

5.1 Introduction

The Area I SWAP is based on a 9-year implementation schedule (2020 endpoint) that aligns with the timeframe for the Maryland pollutant reduction targets for the Chesapeake Bay TMDL. This timeframe is necessary to implement restoration measures and meet the Area I total phosphorus, fecal coliform, and sediment TMDLs. The ability to implement this plan within the 9-year timeframe is dependent upon the availability of staff and sufficient funding. The Area I SWAP Implementation Committee (an outgrowth of the Steering Committee) will meet twice per year to assess progress in meeting watershed goals and objectives and to discuss funding options. In addition, an annual progress report and a biennial report on water quality monitoring results will be produced. Currently, the Chesapeake Bay TMDL is finalized with draft pollutant load allocations and reduction targets by 2017 and 2020 in Maryland. Two-year milestones are established to track progress and ensure all practices are in place by 2020. The EPA will review the two-year milestones and determine if milestones are met using the Bay Tracking and Accountability System. An adaptive watershed management approach will be used to adjust actions as necessary based on implementation success. Progress and success of the Area I SWAP will be evaluated during implementation based on the following: interim measurable milestones, pollutant load reduction criteria, implementation tracking, and monitoring. These evaluation components are described in the following sections.

5.2 Interim Measurable Milestones

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

5.3 Pollutant Load Reduction Criteria

Current pollutant load reduction scenarios and calculations for proposed actions are presented in Chapter 3. These are mainly based on pollutant removal efficiencies approved by the Chesapeake Bay Program (CBP) for various nonpoint source BMPs.

These pollutant removal efficiencies will continue to be used to measure progress in meeting the nutrient TMDL reduction goal (i.e., 50% reduction in total phosphorus loads from urban stormwater discharges). CBP-approved BMP removal efficiencies are summarized in the tables included as Appendix C. Actions and associated pollutant load reductions will be reevaluated if CBP revises/updates pollutant removal efficiencies within the 10-year timeframe to ensure that the nutrient TMDL reductions are met.

5.4 Implementation Tracking

Implementation of restoration actions for SWAP I 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 Area I SWAP implementation committee will initiate revisions of the plan.

Progress and success of the Area I 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 Area I watershed. Additional monitoring is anticipated to assess the effectiveness of restoration projects and progress in meeting total phosphorus, bacteria, and sediment TMDL reductions.

Existing Monitoring

Several sources of monitoring data exist for the Area I watershed that includes Baltimore County, Baltimore Ecosystem Study, and the Maryland Biological Stream Survey. These are described in detail in Appendix E, Chapter 3.2 and listed below:

Baltimore County:

- County Trend Monitoring Program – One monitoring site in the Baisman Run subwatershed. Twelve samples are taken each year that measure nutrients, suspended solids, metals, chlorides, oxygen demand, temperature, pH, and discharge.

- County Biological Monitoring Program – Randomly selected locations in the Area I watershed that monitors benthic macroinvertebrates as a water quality indicator.

- County Reference Site Monitoring Program – Baisman Run upstream of Ivy Hill Road is sampled annually for benthic macroinvertebrates in the spring index period using MBSS sampling protocols. Fish sampling is done only periodically to reduce stress to the naturally reproducing trout populations inhabiting these streams.

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

Baltimore Ecosystem Study – Two sampling locations, in Baisman Run and Pond Branch (located in Baisman Run). Each location is continuously monitored for discharge and sampled weekly for nutrients, suspended solids, temperature, and dissolved oxygen.

Maryland Biological Stream Survey – A statewide program that randomly selects locations to assess benthic macroinvertebrate and fish habitat conditions.

SWAP Implementation Monitoring

SWAP implementation monitoring activities will focus on project specific monitoring and targeted subwatershed monitoring. Project specific monitoring needs will be identified as restoration progresses. It will not be possible to monitor all restoration projects due to the number of actions proposed. Project specific monitoring will target activities with limited data regarding removal efficiencies such as lawn care education. Subwatershed monitoring will measure overall improvement in water quality as a result of multiple restoration activities within a subwatershed. This will also be developed as restoration progresses. There is potential to coordinate a citizen-based stream watch program since there is many existing water quality monitoring stations in the Area I watershed. Monitoring activities will be coordinated among SWAP participants (Baltimore County and the Gunpowder Valley Conservancy) through participation in the Area I SWAP Implementation Committee.

REFERENCES

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APPENDIX A:

Area I Action Strategies

APPENDIX A

Area I Action Strategies

This appendix presents the actions related to the goals and objectives presented in Chapter 2 of the Area I SWAP. The Goals and Objectives are summarized in Table A-1. A complete list of actions proposed for the watershed including timelines, performance measures, unit cost estimates, and responsible parties is included in Table A-2. In many cases, actions relate to multiple goals and objectives. Some of the key columns included in Table A-2 are briefly described below.

Goals and Objectives

Table A-1 indicates the goals and objectives targeted for each action. Each is further explained in Chapter 2 of the Area I SWAP.

Goal	Objectives
1. Improve and Maintain Stream Conditions	1. Effectively communicate the mission of the SWAP and the importance of a healthy watershed to community groups and leaders. 2. Implement stream and habitat restoration projects to stabilize streams, reduce erosion, and reconnect streams to floodplains. 3. Promote and increase use of Bayscaping, Bay-Wise landscape management, and rain gardens on existing and proposed properties.
2. Reduce Pollution from Stormwater Runoff	1. Meet TMDL goal to reduce phosphorus by 50%. 2. Meet TMDL goal to reduce sediment by 25%. 3. Convert old stormwater management (SWM) facilities to more efficient best management practices (BMPs) and implement stormwater control practices throughout the watershed to the maximum extent practicable. 4. Create riparian buffer where it is lacking and enhance existing riparian buffers to filter runoff and provide habitat. 5. Reduce fertilizer/pesticide/herbicide use on lawns throughout the watershed.
3. Decrease Bacterial Contamination in Streams	1. Meet TMDL goal to reduce bacteria by 80%. 2. Promote proper disposal of pet waste to reduce bacteria from the watershed. 3. Promote proper maintenance of septic systems. 4. Promote the use of agricultural Best Management Practices to reduce

Goal	Objectives
	bacteria.
4. Protect High Quality Streams	1. Monitor aquatic populations and, if needed, implement habitat restoration projects including fish blockage removal and riparian buffer enhancement to remove biological impairments. 2. Monitor for sources of water pollution and trends over time. 3. Promote preservation of riparian and upland forest cover to reduce pollutant loads in runoff. 4. Perform stream restoration and stabilization projects to connect high quality stream reaches.
5. Promote Environmentally Sensitive Development	1. Continue to apply Baltimore County's forest buffer regulations to enhance and protect streams. 2. Continue to enforce sediment and erosion control practices and, when required by MD law, apply new sediment and erosion control regulations to projects. 3. Continue to apply forest conservation regulations to enhance and protect natural resources. 4. Continue implementing stormwater management regulations that increase the use of non-structural techniques using Environmental Site Design (ESD) guidelines to the maximum extent possible.
6. Promote Tree Planting, Reforestation and Forest Sustainability	1. Work with rural residential landowners and the multiple owners of contiguous forest patches to increase the tree canopy and forest health through implementation of Forest Management Plans. 2. Plant native trees on institutional properties identified in the upland assessment. 3. Reforest open pervious areas to increase riparian buffers where possible, and promote natural habitats. 4. Increase riparian forest buffer on agricultural land. 5. Control exotic invasive plants in forest areas and encourage residents, institutions and businesses to remove invasive species from their properties and replace with native species. 6. Maintain and restore the health of watershed forests and promote sustainable forest management. 7. Encourage native tree and vegetation planting on residential properties. 8. Implement the Forest Health Assessment and Management Plan for Oregon Ridge Park.

Goal	Objectives
7. Restore and Maintain Aquatic and Terrestrial Biodiversity	1. Restore and protect portions of the stream network, such that conditions can support diverse aquatic and riparian communities. 2. Protect and enhance native brook trout habitat. 3. Monitor for sources of water pollution and aquatic habitat degradation and trends over time. 4. Create riparian buffers and enhance existing riparian buffers to provide quality understory and forest canopy to provide habitat and improve water quality. 5. Investigate and promote deer population management strategies.
8. Promote Implementation of Conservation Practices on Agricultural Lands	1. Continue to promote agricultural conservation/best management practices designed to improve water quality by way of outreach, education and technical support to the farming community through existing agencies such as, University of Maryland Extension Baltimore County and the Soil Conservation District. 2. Provide outreach to small horse farms, and home gardeners. 3. Educate the agricultural community on the need to improve the quality of stream buffers. 4. Encourage preservation and stewardship through conservation easements.
9. Support Environmental Stewardship	1. Promote conservation practices for homeowners. 2. Provide environmental awareness and stewardship opportunities for the public. 3. Maintain trails to prevent erosion and encourage recreation in Oregon Ridge Park. 4. Promote stream stewardship, particularly on catch and release trout streams.

Actions

Actions developed to achieve watershed goals and objectives are grouped in Table A-2 according to the type of activity. Actions are grouped according to the following categories and subcategories:

- Restoration and Preservation Actions
    - Clean Water

    - Stream Protection
    - Forest and Habitat
    - Agricultural Practices
    - Stewardship
- Monitoring
- Funding
- Reporting

Basis for Performance Measure

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

Timeline

This column denotes the timeline over which an action will be performed.

Performance Measure

This column describes how the success/completion of a given action will be measured. In many cases, it is the numeric 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 (EPS)
2. Gunpowder Valley Conservancy (GVC)
3. Baltimore County Soil Conservation District
4. Area I SWAP Implementation Committee

Table A-2: Area I Action Strategies

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Responsible Party
RESTORATION AND PRESERVATION ACTIONS							
Clean Water							
1 2 4 7	2 1,2 4 1,2	Evaluate the restoration potential and feasibility of restoring very severe and severe eroded stream banks identified in the stream corridor assessments.	Identify water quality improvement opportunities.	2 years	Feasible projects identified	Existing staff	1
1 2 4 7	2 1,2 4 1,2	Complete stream restoration projects at feasible sites based on 1.18 miles of very severe and severe erosion sites identified during the SCA.	Stabilize and restore 1.18 miles (6230.4 linear feet) of unstable streams in Beaverdam Run and Baisman Run subwatersheds to provide water quality improvement.	9 years	0.15 miles (694 linear feet) per year	$350/linear foot	1
1 6 9	3 7 1,2	Promote Bayscaping in the 24 neighborhoods identified.	Conduct 6 Bayscaping awareness events targeting 4 recommended neighborhoods per event.	6 years	1 event per year	$500/event	1, 2
3 9	1,3 1,2	Educate citizens on the importance of septic system maintenance based on the estimated 2,138 existing systems.	Conduct 9 septic system maintenance awareness events targeting approximately 120 households per event.	9 years	1 event per year	$500/event	1,2
1 4 7	2 4 1	Investigate the exposed 48-inch pipe in Baisman Run that is being undercut by the stream and creating an eroded area of scour on the downstream side of the pipe.	Provide an investigation of the exposed pipe.	2 years	Investigation completed	Existing Staff	1
2	1,2,3	Investigate and convert the four existing dry detention ponds identified in Beaverdam Run and Oregon Branch subwatersheds to bioretention systems or wetland systems.	Four existing dry detention ponds treating 87.1 acres identified as having conversion potential to a bioretention or wetland system x100% projected participation = 87.1 acres treated.	9 years	1 conversion per 2 years	$3,200/acre	1
1 9	3 1,2	Work with institutional partners to disconnect downspouts at the one institutional site identified (1 faith based).	Disconnect downspouts at one faith-based institution.	2 years	All downspouts disconnected	$500/ event	1,2,4
2	3	Investigate the feasibility of implementing stormwater retrofits to treat runoff from 2 faith-based institutional sites identified.	2 faith-based institutional sites identified for location of potential stormwater retrofits.	2 years	Feasible retrofit sites identified	$3,200/acre	1,2
2	3	Investigate the feasibility of implementing stormwater retrofits to treat runoff from 7 identified neighborhoods.	7 identified neighborhoods investigated for the feasibility of implementing stormwater retrofits, including curb cuts and roadside swales.	5 years	Feasible retrofit sites identified	$3,200/acre	1,2
2	3	Design and implement stormwater retrofits at all feasible sites.	7 neighborhoods + 2 faith-based institutional sites x 100% participation rate = 9 stormwater retrofits.	9 years	1 retrofit per year	$3,200/acre	1
5	2	Baltimore County shall continue to require and enforce sediment and erosion control practices for all new and redevelopment.	On-going.	On-going	Acres regulated	Existing staff	1
5	4	Baltimore County shall continue to implement stormwater management regulations that use ESD.	On-going.	On-going	# of ESD practices installed	Existing staff	1
Stream Protection							
4 7	1 1,2	Work with a fish biologist to analyze the condition of the USGS gauging station that is acting as a fish migration barrier.	Provide an investigation of the USGS gauging station.	2 years	Investigation completed	Existing Staff	1
4 7	1 1,2	Work with a fish biologist to analyze the condition of the severe fish migration barrier at Shawan Road crossing that is acting as a fish migration barrier.	Provide an investigation of the fish barrier.	2 years	Investigation completed	Existing Staff	1
4 5	3 1,3	Baltimore County shall continue to require riparian buffers and forest conservation for all new and	On-going, keep track of existing riparian buffer and forest preserved.	On-going	Acres preserved	Existing staff	1

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Responsible Party
		redevelopment.					
		Forest and Habitat					
7	1,2,3	Investigate the cause of the excessive algae in all three subwatersheds.	Conduct water quality sampling to determine the potential source.	2 years	Investigation completed and corrective action taken	Existing Staff	1
1 2 4 6 7	2 4 1 1,4 1,2,4	Investigate the feasibility of planting riparian stream buffers on open pervious land.	205.5 acres of open pervious land identified within the 100-foot stream buffer through GIS analysis.	2 years	Feasible buffer planting sites identified	Existing Staff	1,2
1 2 4 6 7	2 4 1 1,4 1,2,4	Restore stream buffer at feasible sites with a minimum width of 100 feet	205.5 acres of open pervious land identified within the 100-foot stream buffer through GIS analysis x 100% participation rate = 205.5 acres.	10 years	Reforest 20.5 acres per year	$15,000/acre	1,2
2 7	1,2 1	Investigate the very severe rated erosion site downstream of a large public stormwater basin (structure number 3705) in Beaverdam Run subwatershed	Investigate erosion site.	2 years	Investigation conducted and corrective action taken	Existing Staff	1
1 6 9	1 1,5,7 1,2	Educate and promote tree planting in the 21 neighborhoods identified	Conduct 3 tree planting awareness events targeting 7 recommended neighborhoods per event.	3 years	1 event per year	$500/event	1,2,4
6	2,3	Encourage institutions to plant trees on available open space at the 4 faith-based sites identified	Maximum potential of 1,240 trees x 100% participation rate = 1,240 trees.	6 years	Plant one acre of trees per year	$6,000/acre	1,2,4
6	6	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: 2.6+205.5+183.8=391.9 acres.	5 years	Maintain 41.6 acres per year	$1,300/acre for 5 years	1,2
6	5,6	Improve forest habitat by organizing exotic invasive species removal activities every year.	Organize 1 exotic species removal activity addressing 2 acres per year.	9 years	Exotic species removed from 2 acres per year	$5,000	2
6	8	Implement the Forest Health Assessment and Management Plan for Oregon Ridge Park.	On-going.	9 years	On-going	Existing staff	1
7	5	Investigate deer population management.	On-going.	9 years	On-going	Existing staff	1
		Agricultural Practices					
8	1,2,3	Continue to work with the Baltimore County Soil Conservation District to increase Soil Conservation and Water Quality Plans (SCWQP) and horse management on farms.	Work with interested land owners, and generally promote use of SCWQP.	On-going	Support provided	Existing staff	1,3
8	4	Conduct a build-out analysis for Beaverdam Run and Oregon Branch subwatersheds and identify areas for potential preservation of agricultural land through easements.	Conduct analysis.	2 years	Analysis completed	Existing staff	1,2
1 2 3 8	1 1,2 1,4 1,3	Work with the Baltimore County Soil Conservation District to provide fencing and alternative watering for livestock operation.	Install fencing and alternative watering for livestock.	2 years	Practices installed	$4.70/lf for fencing $6,000/site for off-stream watering	1,3
1	2	Investigate the feasibility of planting riparian stream	100 acres of open pervious land identified within the 100-foot	2 years	Feasible buffer	Existing	1,2

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Responsible Party
2 4 6 7 8	4 1 1,4 1,2,4 1,3	buffers on agricultural land.	stream buffer through GIS analysis		planting sites identified	Staff	
1 2 4 6 7 8	2 4 1 1,4 1,2,4 1,3	Restore stream buffer at feasible agricultural sites with a minimum width of 100 feet.	100 acres of open pervious land identified within the 100-foot stream buffer through GIS analysis x 100% participation rate = 100 acres.	10 years	Reforest 10 acres per year	$15,000/acre	1,2
			Stewardship				
1 9	1 1,2	Work with community groups to install storm drain markers in the 23 recommended neighborhoods.	Mark storm drains in the 23 neighborhoods identified.	5 years	4.6 neighborhoods per year	$500/event	1,2,4
6 9	8 2,3	Encourage citizens to volunteer with trail maintenance and other activities at the Oregon Ridge Park.	Distribute information on upcoming events to watershed stakeholders.	On-going	1 event per year	$500/event	4 , Oregon Ridge Park
9	2,4	Promote awareness of the stream watch Adopt-a-Stream program.	Adopt a section of stream within Area I.	9 years	Host 2 events per year	$500/event	2
4 8 9	3 4 2	Work with the Gunpowder Valley Conservancy and the Valleys Planning Council to preserve land in the Baisman Run subwatershed.	Investigate properties interested in land preservation.	9 years	Investigation completed	Existing staff	1,2
3 9	1,2 1,2	Educate homeowners on the benefits of picking up pet waste in one identified neighborhood in Beaverdam Run subwatershed.	Provide outreach in the one identified neighborhood.	2 years	Education and Outreach completed	$500/event	1,2,4
1 2 3 6 9	1,3 5 1,2 1,7 1,2	Develop a community outreach campaign to raise awareness about homeowner actions aimed towards nutrient reduction.	Publicize several actions in E-News Stream and other media.	On-going	4 announcements per year	Existing staff	1,2
1 2	1 3	Form partnerships with institutions and discuss the BMP recommendations from the institutional assessments and implementation options.	2 institutions assessed with potential for stormwater management retrofit.	4 years	1 institution per two years	Existing staff	1
			Monitoring				
3	1	Continue to remove illicit connections when discovered through the Illicit Connect Program.	NPDES Permit.	On-going	Reported annually in NPDES permits	Existing staff	1
3	1	Continue the illicit connection monitoring at the major outfalls in the watershed and complete inspections at each of the minor outfalls.	3 major outfall locations and 55 minor outfall locations = 58 outfall inspections.	5 years	11.6 outfalls per year	Existing staff	1
3 4 7	1 2 3	Conduct illicit discharge monitoring for potential septic system impacts at the 23 minor outfalls identified with flow in Beaverdam Run subwatershed.	Investigation and follow-up at 23 minor outfalls.	2 years	12 outfalls investigated per year	Existing Staff	1
3 7	1,3 3	Identify sources of fecal coliform (E. coli) through monitoring.	Continue on-going water quality monitoring.	On-going	Investigation completed and sources identified	Existing staff	1
2	3	Conduct inspection of BMPs and provide on-going maintenance for all public facilities.	Assure that each facility is inspected every 3 years.	On-going	Inspections completed	Existing staff	1
4 7	1 3	Continue County biological monitoring program.	Biological monitoring stations in Area I are monitored in odd numbered years and a report produced.	Odd numbered years	Stations monitored, report produced	Existing staff	1
1	1	Collaborate with state and federal agencies to develop	Provide an accounting of nutrient reductions.	5 years	Monitoring	Existing	1, MDA

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Responsible Party
2	1,2,5	a method to measure and monitor residential fertilizer use.			protocols developed for fertilizer use	staff	
4 7	1 3	Continue to monitor the fish populations in coordination with DNR.	Annual monitoring.	On-going	Annual Monitoring	Existing staff	1, DNR
			Funding				
1	2	Coordinate grant funding requests to secure funding and implement restoration and protection projects to meet TMDL nutrient reduction requirements.	Seek a minimum of 1 grant per year to meet the TMDL requirements within 9 years.	9 years	1 grant proposal per year	Existing staff	1,2,3,4
9	1,2	The SCDs will seek funding for one additional staff member to provide planning/technical assistance to farmers and to help them obtain cost-share grants for BMPs.	Provides the additional staffing for increased implementation of agricultural BMPs.	1 year	New staff hired	$80,000 per year	1,3
7	2	Seek grant funding for preservation easements of forested land in subwatersheds containing brook trout to maintain sustainable brook trout populations.	Provides protection for brook trout.	9 years	Acres of forested land preserved to protect brook trout	Existing staff	1
			Reporting				
All	All	Area I SWAP Implementation Committee will meet to discuss implementation progress and assess any changes needed to meet the goals.	Meet on a semi-annual basis.	9 years	2 meetings per year	Existing staff	3
All	All	Coordinate restoration and protection activities between and among Baltimore County and the Gunpowder Valley Conservancy.	NPDES annual report.	On-going	NPDES annual report	Existing staff	1, 2
All	All	Produce State of Our Watersheds report in conjunction with the Baltimore Watershed Agreement.	Report is produced bi-annually.	2 years	Report is produced every 2 years	$11,000 per 2 years	1
All	All	Implement a unified restoration tracking system to track progress toward meeting TMDL reduction requirements.	Tracking systems currently being developed for similar SWAPs.	2 years	Tracking system developed	Existing staff	1
1 2 3	1 1,2 1	Continue to update status of county capital budget restoration projects and BMPs.	Provide update of progress made in annual NPDES report.	On-going	NPDES annual report	Existing staff	1

APPENDIX B:

Cost Analysis and Potential Funding Sources

APPENDIX B

Cost Analysis and Potential Funding Sources

Cost estimates and potential funding sources for the implementation of proposed restoration BMPs for the Area I SWAP are described below.

Cost Analysis

The cost analysis is based on the actions detailed in Appendix A. Table B-1 presents cost estimates based on the implementation scenario described in Chapter 3 with the goal of achieving the 50 percent reduction in total phosphorus loads from urban runoff, also described in Chapter 3. For this scenario, estimates represent total cost estimates for the anticipated 9-year implementation timeframe. Unit costs are based on a combination of local information and previous SWAPs completed for other local watersheds (e.g., Upper Gwynns Falls). BMP costs are not annualized over the 9-year implementation timeframe and do not include costs of existing staff. Costs are also presented in dollars per pound of nitrogen and phosphorus removal for those BMPs where pollutant removal calculations are 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 $7,969,204 for maximum implementation.

Potential Funding Sources

Funding sources for the implementation of the Area I SWAP include local government funding for Baltimore County, monetary and time contributions to the Area I SWAP Implementation Committee and various grants as described below.

Baltimore County uses general funds to support staff, whose responsibility is to monitor and improve water quality through implementation of various programs including capital restoration projects. Baltimore County has a Waterway Improvement Capital Program that is funded by a combination of general funds and bonds. Approximately $4 million per year is allocated for environmental restoration projects throughout the county. The capital budget is projected for six years, with a two-year cycle for changes. 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-1, additional funding from grants will be required. Table B-2 presents potential funding sources to support the implementation of the Area I 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-1: Maximum Estimated Costs for Area I SWAP Implementation

BMP or Action	Cost	Unit	Projected	Quantity	Project Total Cost	Project TN Load Reduction (lbs)	Project Cost / Lb of TN Removal	Project TP Load Reduction (lbs)	Project Cost/Lb of TP Removal
Promote Bayscaping	$500	/ event	6	events	$3,000	NA	NA	NA	NA
Institutional Downspout Disconnection (rain barrels)	$500	/ event	1	event	$500	NA	NA	NA	NA
SWM Conversions	$3,200	/ acre	87.1	acres	$278,720	1,911.1	$146	184.4	$2
Adopt-a-Stream Program Events	$500	/ event	18	events	$9,000	NA	NA	NA	NA
Citizen Volunteer Trail Maintenance	$500	/ event	9	events	$4,500	NA	NA	NA	NA
SWM Retrofits	$3,200	/ acre	10.2	acres	$32,640	115.1	$284	19.6	$1,165
Urban Stream Buffer Reforestation	$15,000	/ acre	205.5	acres	$3,082,500	1,690.9	$1,823	132.4	$23,282
Institutional Tree Planting	$175	/ tree	1,240	trees	$217,000	36.3	$5,978	2.5	$86,800
Neighborhood Tree Planting Events	$500	/ event	3	events	$1,500	NA	NA	NA	NA
Baltimore County Soil Conservation District Staff	$80,000	/ year	1	year	$80,000	NA	NA	NA	NA
Tree Maintenance	$1300	/ acre / year	391.9	acres	$509,470	NA	NA	NA	NA
Exotic/Invasive Species Removal	$250	/ acre	18	acres	$4,500	NA	NA	NA	NA

BMP or Action	Cost	Unit	Projected	Quantity	Project Total Cost	Project TN Load Reduction (lbs)	Project Cost / Lb of TN Removal	Project TP Load Reduction (lbs)	Project Cost/Lb of TP Removal
Pet Waste Education Event	$500	/ event	1	Event	$500	NA	NA	NA	NA
Stream Corridor Restoration	$350	/ linear foot	6,230	linear foot	$2,180,500	124.9	$17,458	21.9	$99,566
Storm Drain Markers	$500	/ event	4.6	event	$2,300	NA	NA	NA	NA
Fencing for Livestock Operation	$4.70	/ linear foot	3,789.7	linear foot	$17,811	59.1	$301	7.9	$2,255
Alternative Watering for Livestock Operation	$6,000	/ site	1	site	$6,000	154.0	$39	20.8	$288
Agricultural Streamside Forest Buffers	$15,000	/acre	100	acres	$1,500,000	2,872.0	$522	194.0	$7,732
State of Our Watersheds Report	$11,000	/ 2 years	9	years	$49,500	NA	NA	NA	NA
Septic System Maintenance Events	$500	/event	9	events	$4,500	NA	NA	NA	NA
				Total:	$7,969,204				

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

Table B-2: Area I SWAP Potential Funding Sources

Managing Agency	Funding Source	Application Eligibility	Eligible Projects
American Forests	Global ReLeaf Program (American Forests)	All public lands or public accessible lands Local government State government	Public Lands Restoration Projects which include local organizations; use innovative restorative practices with potential for general application; minimum 20 acre project area
Chesapeake Bay Trust	Targeted Watershed Initiative Grant Program	Non-profits 501(c) Institutions Soil/Water Conservation Districts Local government	Involve local organizations; address non-point source pollution; projects related to water quality and habitat restoration
Chesapeake Bay Trust	Capacity Building Initiative Grant Program	Non-profit 501(c) with a board on which half the members participate meaningfully and at least one paid staff (or a part-time paid volunteer)	Strengthen an organization through management operations, technology, governance, fundraising and communications
Chesapeake Bay Trust	Stewardship Grant Program	Non-profits 501(c) Schools/universities Soil/Water Conservation Districts Local government State government	Raise awareness about watershed restoration; design plans which educate citizens on things they can do to aid watershed restoration; educate students about local watersheds, projects geared towards watershed restoration and protection
DNR	Clean Water Action Plan Nonpoint Source Program 319 Grant	Non-profits 501(c) Universities Soil/Water Conservation Districts Local 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

Managing Agency	Funding Source	Application Eligibility	Eligible Projects
		State government	
MDE/DNR	Chesapeake and Atlantic Coastal Bays Trust Fund	Non-profits 501(c) Local government	Non-point source best management practices reducing nitrogen, phosphorous and sediment
NFWF	Chesapeake Bay Small Watersheds Grant Program	Non-profits 501(c) Local government	Community-based projects that improve the condition of local watersheds while building stewardship among citizens; watershed restoration, conservation, and planning
NFWF	Chesapeake Bay Targeted Watersheds Grant Program	Non-profits 501(c) Universities Local government State government	Innovative demonstration type restoration projects
NRCS	Watersheds Operations Program	Local government State government Tribes	Address watershed protection, flood mitigation, water quality, soil erosion, sediment control, habitat enhancement, and wetland creation and restoration
USEPA	Targeted Watersheds Grant Program – Capacity Building Grant Program	Non-profits 501(c) Institutions Local government State government	Promote organizational development of local watershed partnerships; provide training and assistance to local watershed groups
USEPA	Targeted Watersheds Grant Program – Implementation Grant Program	Non-profits 501(c) Universities Local government State government	Watershed restoration and/or protection projects (must include a monitoring component)

APPENDIX C:

Chesapeake Bay Program Pollutant Load Reduction Efficiencies

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

Values in parentheses are in progress of official approval

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

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

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

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

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

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

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

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

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

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

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

Baltimore County Agricultural Reduction Summary Table

Gap	101,725	3,442		
Current	11,821	1,613		
Goal	89,904	1,829	Goal	22,476	457
Remaining	59,031	317		

				6/30/2009			7/1/2009 - 3/31/2011			2020			2 yr milestone (12-13)			
BMP	**Units**	**N Red* lb/unit**	**P Red* lb/unit**	**Impl**	**N Red**	**P Red**	**Impl**	**N Red**	**P Red**	**Impl**	**N Red**	**P Red**	**Impl**	**N Red**	**P Red**	**Notes**
Conservation Tillage	acres	4.61	1.13	25,997	119,848	29,377		0	0		0	0		0	0	2000 info
Continuous No-Till	acres/yr				0	0		0	0		0	0		0	0	
Cover Crops - Commodity	acres/yr	2.88		2,185	6,293	0		0	0		0	0		0	0	
Cover Crops - Traditional Private	acres/yr	8.92	0	1,785	15,922	0		0	0	2,000	17,840	0		0	0	
Dairy Manure Incorporation	acres	8.8	0		0	0		0	0		0	0		0	0	SCD consider purchase of turbo till for rental program
Decision/Precision Agriculture	acres	4.04	0.48		0	0		0	0		0	0		0	0	
Manure Transport	tons/yr	12			0	0		0	0		0	0		0	0	
Manure Transport Alt Use Out of Watershed	tons/yr			149	0	0		0	0		0	0		0	0	
Nutrient Mgmnt Plan Impl	acres/yr	3.11	0.3	39,577	123,084	11,873		0	0		0	0		0	0	2010 MDA AIR Submissions
Poultry Manure Incorporation	acres	5.2	0		0	0		0	0		0	0		0	0	
Water Irrigation Mgmnt	acres	6.89	0	868	5,981	0		0	0		0	0		0	0	2007 Ag Census Data
Heavy Use Area -Poultry Pad	operation	330	0		0	0		0	0		0	0		0	0	
Heavy Use Area -Livestock	acres	330	0	3.4	1,122	0	1.5	495	0	1	330	0		0	0	
Livestock Waste Structures	structures	531	104	4	2,124	416	2	1,062	208	8	4,248	832		0	0	need funding for 5 small horse operations (less than 6 horses)
Poultry Waste Structures	structures	210	42		0	0		0	0		0	0		0	0	
Retirement of Highly Erodible Land - Private	acres	9.55	0.03	172	1,646	5	6	59	0	24	229	1		0	0	
Runoff Control Systems	systems	69	13	27	1,863	351	8	552	104	16	1,104	208		0	0	
Soil Conservation & Water Quality Plans	acres/yr	0.93	0.14	27,351	25,437	3,829	6,597	6,135	924		0	0		0	0	crease plan acreage need additional planner (13700 ac) need marketing/outreach for e
Stream Protection with Fencing	acres	6.79	0.91	847	5,753	771	188	1,274	171	118	798	107		0	0	
Stream Protection without Fencing	acres	3.4	0.46	2,505	8,517	1,152	240	816	110	360	1,224	166		0	0	
Stream Restoration(Ag) in Non-Coastal Plain	lf	0.02	0.0035		0	0		0	0	1,400	28	5		0	0	
Streamside Forest Buffers Private	acres	28.72	1.94	211	6,066	410	0	0	0	100	2,872	194		0	0	
Streamside Grassed Buffers - Private	acres	17.06	0.82	22	367	18	0	0	0		0	0		0	0	
Water Control Structures	acres/yr	3	0	400	1,200	0		0	0		0	0		0	0	Average 200 ac/structure
Wetland Restoration - Private	acres	28.72	1.94	26	735	50	50	1,427	96		0	0		0	0	
Alt crops/switchgrass		17.06	0.82		0	0		0	0		0	0		0	0	
Ammonia emission reduction (PLT)	operation				0	0		0	0		0	0		0	0	
Animal Mortality Composter	structures															need funding for implementation
Assmnt Non CS BMPs	acres				0	0		0	0		0	0		0	0	need staff to capture this
Horse Pasture Management	acres			21			3			20						need for forage specialist and study of species for horses
Livestock Pasture Management	acres															
Loss of Ag Land	acres	11			0	0		0	0	200	2,200	0		0	0	need to confirm with co permit office
Structural, vegetative, & non-structural shore erosion	miles				0	0		0	0		0	0		0	0	
Vegetated Open Channels	linear ft				0	0		0	0		0	0		0	0	
Vegetative Environmental Buffer	operation	26	0		0	0		0	0		0	0		0	0	
Total					325,957	48,252		11,821	1,613		30,873	1,512		-	-	

* based on CBP 4.3 model reductions

APPENDIX D:

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

APPENDIX D

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

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

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

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

This appendix will provide information on how the development of the Area I Small Watershed Action Plan addresses the USEPA A through I criteria for watershed planning. It will serve as a guide to the location within the document, including appendices, where each criterion is addressed. Table B-1 provides the location information for each of the A through I Criteria and describes how the document meets the A through I Criteria.

The text box below provides a description of each element of the EPA Watershed Planning Criteria.

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

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

b) *A description of the NPS management measures that will need to be implemented*

c) *An estimate of the amount of technical and financial assistance needed to implement the plan*

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

e) *A schedule for implementing the NPS management measures*

f) *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 D-1 is a guide to the location within the document, including appendices, where each criterion is addressed.

Table D-1: Where to Locate Information for Each USEPA's A-I Criteria Element

Report Section	USEPA A-I Criteria								
	A	B	C	D	E	F	G	H	I
Chapter 1. Introduction		X							
Chapter 2. Vision, Goals and Objectives		X							
Chapter 3. Restoration Strategies	X	X	X		X				
Chapter 4. Subwatershed Management Strategies			X		X				
Chapter 5. Plan Evaluation						X	X	X	X
Appendix A. Area I Action Strategies			X	X	X	X	X		X
Appendix B. Cost Analysis and Potential Funding Sources				X					

Report Section	USEPA A-I Criteria								
	A	B	C	D	E	F	G	H	I
Appendix C. Chesapeake Bay Program Pollutant Load Reduction Efficiencies		X						X	
Appendix D. U.S. Environmental Protection Agency A Through I Criteria for Watershed Planning									
Appendix E. Area I Watershed Characterization Report	X								
Appendix F. TMDL for phosphorus and sediment for the Loch Raven Reservoir	X								
Appendix G. TMDL for Fecal Bacteria for the Loch Raven Reservoir	X								
Appendix H. TMDL for Mercury in Loch Raven Reservoir	X								
Appendix I. Baltimore County Synoptic Survey Results	X								
Appendix J. Biological Assessment of Beaverdam Run Watershed	X								
Appendix K. Stream Corridor Assessment Survey Data	X								
Appendix L. Uplands Survey Data	X								

The following provides a discussion on how the development of the Area I Small Watershed Action Plan addresses the US Environmental Protection Agency (USEPA) A through I criteria for watershed planning. It serves as a guide to the location within the document, including the appendices, where each criterion is addressed.

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 this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (b) below.

The Loch Raven Reservoir watershed (8-digit watershed) is listed as impaired in the Maryland 303(d) list of impaired waters for various pollutants of concern including: fecal coliform, methylmercury, sedimentation and siltation, total phosphorous and impacts to benthic/fish communities (MDE, 2008). The Loch Raven Reservoir impoundment is impaired for sedimentation and siltation, methylmercury, and total phosphorus. The Loch Raven Reservoir watershed streams are impaired for impacts to benthic and fish communities (first through fourth order streams) and fecal coliform (mainstem river).

Three TMDLs have been completed and approved for the Loch Raven Reservoir watershed. In the Area I subwatersheds, the impairment that is most relevant is the impact on benthic/fish communities in first through fourth order streams. According to MDE the stream biological community impairment listing has a low priority and a TMDL will be developed at some point in the future (MDE, 2008). While the impairment documented in Area I subwatersheds is a lower priority, it may also be contributing to the downstream impairments in the river mainstem and the reservoir impoundment. In addition, it is important that measures are taken in Area I to help meet the TMDL's for phosphorous, sediment and fecal coliform, which are a problem in the reservoir and mainstem river. These TMDL documents can be found in:

- Appendix F: Total Maximum Daily Loads of Phosphorus and Sediments for Loch Raven Reservoir and Total Maximum Daily Loads of Phosphorus for Prettyboy Reservoir, Baltimore, Carroll and Harford Counties, MD and York County, PA (MDE, 2006)

- Appendix G: Total Maximum Daily Loads of Fecal Bacteria for the Loch Raven Reservoir Basin in Baltimore, Carroll, and Harford Counties, Maryland (MDE, 2009)

- Appendix H: Total Maximum Daily Load of Mercury for Loch Raven Reservoir in Baltimore County, Maryland (MDE, 2002)

In addition, to further refine the sources of pollutants upland source assessments and stream corridor assessments were performed. The upland assessment results are presented in Appendix E, Chapter 4. The stream corridor assessment results are presented in Appendix E, Chapter 3.

Further analysis of pollution sources are provided by a GIS analysis of potential landscape indicators of pollution presented in Appendix E, Chapter 2. Further pollutant load analysis is provided in Appendix E, Chapter 3.3.

b. An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded streambanks).

Expected nitrogen and phosphorus load reductions were based on the EPA - Chesapeake Bay Program load reduction criteria used in their Phase 5.2 model for the water quality impairments of the non-tidal Chesapeake Bay and the Baltimore County Agricultural Reduction Summary Table. These load reductions are presented in Appendix C. Using the information in Appendix C, the nitrogen and phosphorus load reductions for the various actions were calculated and summarized in Chapter 3 (Table 3-17).

c. A description of the NPS management measures that will need to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

The management measures that will need to be implemented to achieve the goals are detailed in Appendix A. Information on the achievement of the phosphorus and nitrogen reduction goals is provided in Chapter 3.5. Chapter 4 details the management measures for each subwatershed in the SWAP study area.

d. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and the authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their 319 programs, State Revolving Funds, USDA's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.

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

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

The educational activities to enhance public understanding and encourage participation in restoration implementation planning and the installation of best management practices are detailed in Appendix A. Chapter 3.4 details specific education/awareness focus areas, and Chapter 4 details specific education/awareness activities for each subwatershed.

f. A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious.

A schedule for each activity is provided in Appendix A. It is anticipated that the restoration will require a 9-year timeframe. Some actions have a shorter time frame based on sequencing of actions, or on the urgency of the actions. However, most management measures have annual performance measures that will determine if the restoration is on pace to be completed within the time frame. The limitations on the pace of the implementation include staffing, and funding. Increases in staffing and funding will be used to accelerate the restoration timeline. Chapter 5 presents an adaptive management approach to implementation.

g. A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

Appendix A provides the annual interim measurable milestones for determining the implementation status of the NPS management measures. In addition, semi-annual meetings with the implementation committee will update the status on implementation progress.

h. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water

quality standards, and, if not, the criteria for determining whether this watershed based plan needs to be revised or, if a NPDES TMDL has been established, whether the NPS TMDL needs to be revised.

The load reductions due to the restoration activities will be calculated via a spreadsheet using the EPA Chesapeake Bay Program – Best Management Practice Pollutant Reduction Efficiencies (Appendix C). These efficiencies will be used in conjunction with the implementation tracking to calculate the load reductions being achieved. The efficiencies used will be modified based on any modifications of the EPA Chesapeake Bay Program efficiencies.

i. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

Chapter 5 details the monitoring that will occur to evaluate the effectiveness of implementation. The monitoring results will be compared to the predicted load reductions determined under item (*h*) above.