Upper Back River
Small Watershed Action Plan

Volume 1

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Final

Prepared by:
Baltimore County Department of Environmental Protection
and Resource Management

In Consultation with:
Upper Back River SWAP Steering Committee

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ACKNOWLEDGEMENTS

UPPER BACK RIVER STEERING COMMITTEE

The Upper Back River Small Watershed Action Plan was developed with cooperation and input from citizen organizations and local agencies that represent the interests of the Upper Back River watershed.

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TECHNICAL ASSISTANCE/REPORTS

Development of the Upper Back River Small Watershed Action Plan was supported technically by the following assessments and technical reports:

Technical Report	*Representative*
Upland Surveys (Neighborhood Source Assessments, Hotspot Assessments, Pervious Area Assessments, and Institutional Site Assessments)	Nathan Forand, Angela Johnson, Megan Brosh – DEPRM
	Paul Sturm, Mike Novotney, Julie Tasillo, Tiffany Wright, Lisa Fraley-McNeal, Hye Yeong Kwon – Center for Watershed Protection
	Darin Crew – Herring Run Watershed Association
Stream Corridor Stability Assessment	Parsons, Brinkerhoff, Inc. in association with Coastal Resources, and EBA Engineering
Stormwater Facility Assessment	Steve Stewart, Hee Song (intern) – DEPRM
Watershed Characterization	Steve Stewart, Nathan Forand, Chris Barnes DEPRM

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CHAPTER 1

INTRODUCTION

1.1 Overview

The purpose of this report is to provide guidance on the restoration of the Upper Back River Watershed. This report outlines a series of recommendations for watershed restoration, describes management strategies for each of the 14 subwatersheds and identifies priority projects for implementation. Planning level cost estimates are provided where possible and a preliminary schedule for implementation over a 20-year horizon is outlined. Financial and technical partners for plan implementation are suggested for various recommendations and projects. The watershed plan is intended to assist the Herring Run Watershed Association, Baltimore City and Baltimore County in moving forward with restoration of the Upper Back River.

1.2 Background

A unique partnership was formed between Baltimore City, Baltimore County, The Herring Run and Jones Falls Watershed Associations, and the Center for Watershed Protection to develop Small Watershed Action Plans (SWAPs) for study areas within the Jones Falls and Back River Watersheds. This two-year effort involved working with all partners to conduct upland assessments and stream corridor assessments to identify pollution sources, environmental degradation, and restoration opportunities.

During this two-year effort the partners participated in the Steering Committee to provide technical guidance and direction on the collection of existing data and the field assessments and the development of the SWAPs. The Steering Committee partners also helped develop the materials for the three Stakeholder meetings that were held to solicit input from citizens on goals, locations of problems, and acceptable restoration practices.

This document follows in the footsteps of prior and continuing efforts to address adverse environmental conditions that exist within the Back River Watershed. These efforts include:

- Baltimore County - Back River Water Quality Management Plan (1996)
- Baltimore County - Redhouse Run Watershed Study (1997)
- Baltimore City – Moores Run Feasibility Study
- Baltimore City – Biddison Run Feasibility Study
- Baltimore City – Open Channel Drainage Facility Study for Herring Run (2004)
- Center for Watershed Protection (CWP) – Redhouse Run Study (2006)

The past restoration planning efforts by the County and City mainly detailed Capital Restoration projects, while the CWP effort documents both Capital Restoration and citizen based restoration options. None of these planning efforts provided detailed pollution removal estimates, met the

EPA A through I watershed planning criteria, nor provided planning based on developed Total Maximum Daily Loads (TMDLs); all of which are addressed in this report.

1.3 Environmental Requirements

This Small Watershed Action Plan was developed to meet diverse environmental program requirements, including, National Pollutant Discharge Elimination System – MS4 permit assessment and planning requirements, Total Maximum Daily Load (TMDL) reductions for nutrients and bacteria, and anticipated Chesapeake Bay Program development of a TMDL for nutrient and sediment reductions to meet water quality standards for the Chesapeake Bay. This is in addition to citizen needs for a healthy environment, clean water, and an aesthetically pleasing landscape to enhance community livability.

1.3.1 NPDES – MS4 Permits

Both Baltimore County (99-DP-3317, MD0068314) and Baltimore City (99-DP-3315, MD0068292) NPDES permits have a number of requirements that will be addressed by this plan.

One requirement is a systematic assessment of water quality within all of their watersheds and the development of restoration plans. This assessment must include:

- Source identification information based on GIS information
- A determination of current water quality conditions
- Identification and ranking of water quality problems
- Results of visual watershed inspections
- Identify all structural and non-structural water quality improvements opportunities, and
- Specify overall watershed restoration goals.

A second requirement requires each jurisdiction to address 10% of the impervious cover during each 5-year term of the permit, with jurisdictions seeking to address 20% of the impervious cover within their respective jurisdictions by 2010 when their current permit is up for renewal. It is anticipated that future permits will have the same requirement.

This plan meets the systematic assessment and planning requirements of the NPDES Permits and provides the mechanism for how each jurisdiction will meet the goals for addressing impervious cover.

1.3.2 TMDLs

Three TMDLs have been developed by Maryland Department of the Environment (MDE) for addressing water quality impairments within the planning area. A TMDL was developed for nutrients (Appendix H) to improve water quality in tidal Back River sufficiently to meet water quality standards for dissolved oxygen and chlorophyll a, using a Hydrologic Simulation Program Fortran model. The TMDL identified urban stormwater runoff as a contributor to the water quality degradation and based on the model determined that a 15% reduction in nitrogen and phosphorus in urban runoff was required to meet the water quality standards. Upgrades to the Back River Waste Water Treatment Plant will account for the majority of the nitrogen and phosphorus reduction with the upgrades that are anticipated to be completed by 2013.

A second TMDL for bacteria (Appendix I) was developed by MDE to address the high bacteria concentrations in the streams in Herring Run, a subwatershed of Back River. Using a Bacteria

Source Tracking (BST) methodology the sources of bacteria are partitioned between human, domestic pet, livestock, and wildlife. Herring Run bacteria TMDL requires reductions of bacteria in the range of 91%-95%. To achieve water quality standards, reductions for human and domestic pet sources would have to be 98%, while wildlife sources would have to be reduced 33-74%. The TMDL indicated that due to the large reduction requirements, the reductions would be implemented in an iterative fashion, with additional monitoring to measure progress. This document provides the first iteration on management measures to be implemented to address the Herring Run bacteria impairment.

The TMDL for chlordane in fish tissue (Appendix J) developed by MDE in 1999 recognized that there are no known current sources of chlordane and that the chlordane in fish tissue is the result of legacy concentrations in the sediment of tidal Back River. Chlordane was withdrawn from the market in 1988 and suspended for agricultural usage, other than to control termites in 1975. Given the urban nature of the Back River watershed, the most likely source of chlordane was it's use in the control of termites around residential dwellings. With the product unavailable on the market for twenty years now, the sources of chlordane have been reduced. Hazardous Waste Collection Days held by both Baltimore County and Baltimore City provide a means for homeowners to dispose of any chlordane products safely. MDE will continue to monitor chlordane in fish tissue with the expectation of decline over time. Chlordane will not be further addressed in this SWAP.

1.3.3 Chesapeake Bay Nutrient and Sediment Impairment

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

1.4 Partner Capabilities

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

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

1.4.1 Baltimore County

Baltimore County has a history of implementing restoration projects, including stream restoration, stormwater conversions and retrofits, reforestation, and shoreline enhancement projects. In the Back River watershed a total of two miles of streams have been restored, 598 acres of urban land has been either retrofit with stormwater management or existing stormwater management has been enhanced to provide additional water quality improvements. Approximately 7 million dollars have been spent to date on restoration activities within the entire Back River watershed. An additional 1.4 million dollars has been allocated for restoration in Back River. Many of the projects have additional funding provided through grant programs.

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

Baltimore County is under a consent decree to address Sanitary Sewer Overflows. The consent decree has specific requirements for improvements to pumping stations, remediation of sanitary sewer lines, maintenance and inspection. Implementation of the consent decree requirements will help reduce bacteria contamination, as well as, reduce nitrogen and phosphorus in the streams.

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

Through the installation of stormwater management facilities that address runoff from new development and redevelopment, implementation of Capital Restoration projects, and operation of street sweeping and inlet cleaning programs, Baltimore County estimates that 6% of the nitrogen and 7% of the phosphorus loads in the county portion of the watershed have been reduced.

1.4.2 Baltimore City

Baltimore City has a history of implementing restoration projects, including stream restoration, stormwater retrofits, and various trash collection devices. Within the Back River watershed the city has allocated $2.6 million for restoration work that includes stream restoration, wetland creation, and monitoring.

The city has an extensive monitoring network that includes chemical and biological monitoring that allows both a determination of current water quality status, as well as trends over time. In order to assist in measuring biological community improvements as a result of restoration the city has developed an urban index to better detect improvement. The city Illicit Connection Detection and Elimination Program uses two monitoring programs to detect the presence of illicit connections; stream impact sampling (SIS) and ammonia screening (AS). When either of these two monitoring programs indicates the possible presence of an illicit connection, a Pollution Source Tracking (PST) investigation is begun to locate and eliminate the source.

Baltimore City is under a consent decree to address Sanitary Sewer Overflows. The consent decree has specific requirements for improvements to pumping stations, remediation of sanitary sewer lines, maintenance and inspection. Implementation of the consent decree requirements will help reduce bacteria contamination, as well as, reduce nitrogen and phosphorus in the streams.

The city operates street sweeping and inlet cleaning programs throughout the city. These programs result in the removal of sediment, nitrogen, and phosphorus before they reach the waterways. The city and county recently participated in a study by the Center for Watershed Protection to determine the pollutant removal efficiency of street sweeping and inlet cleaning. The results of the study will be used to determine how much sediment, nitrogen, and phosphorus are removed as a result of these activities.

1.4.3 Herring Run Watershed Association

Herring Run Watershed Association (HRWA) is a grassroots, volunteer-based watershed organization. The HRWA mobilizes volunteers for environmental stewardship through outreach, public education, and advocacy. Their main focus has been on reducing sewage in streams and changing homeowner behaviors to improve streams. They have also been active in restoration through hands-on projects that take people to the stream, show them its problems, and take actions to solve those problems. These actions include; planting trees to reduce runoff, taking action to reduce stormwater runoff from homes, monitoring streams, and creating a green urban watershed center.

1.4.4 Summary

As can be seen from the above descriptions, the partners are well placed in terms of programs and experience to implement the actions proposed in this SWAP. Additional efficiencies can be realized through continued cooperation and implementation of the Baltimore Watershed Agreement Action Strategies across the broader region.

1.5 Upper Back River Watershed Overview

The Upper Back River watershed was selected for this study based on similarity of land use, and environmental issues. The Upper Back River represents 78% of the watershed. The Tidal Back River, with additional issues related to tidal waters, will be address through a separate SWAP to be developed in 2009.

The Upper Back River was further divided into 14 subwatersheds displayed in Figure 1-1. Table 1-1 provides a summary of key characteristics of the Upper Back River watershed.

Table 1-1: Basic Profile of the Upper Back River Watershed

Drainage Area	• 27, 716.7 acres (43.3 mi^2)	
Stream length	• 139.0 miles	
Land Use	• Low-Density residential (8.5%) • Med-Density Residential (26.5%) • High-Density Residential (20.4%) • Commercial (9.9%)	• Industrial (6.5%) • Institutional (8.0%) • Open Urban (6.2%) • Forest (11.5%)
Current Impervious Cover	• 30.7% of watershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (44.5%) • Baltimore County (55.5%)	
Soils	• A Soils – 0.0% • B Soils – 17.9%	• C Soils – 33.2% • D Soils – 46.7%

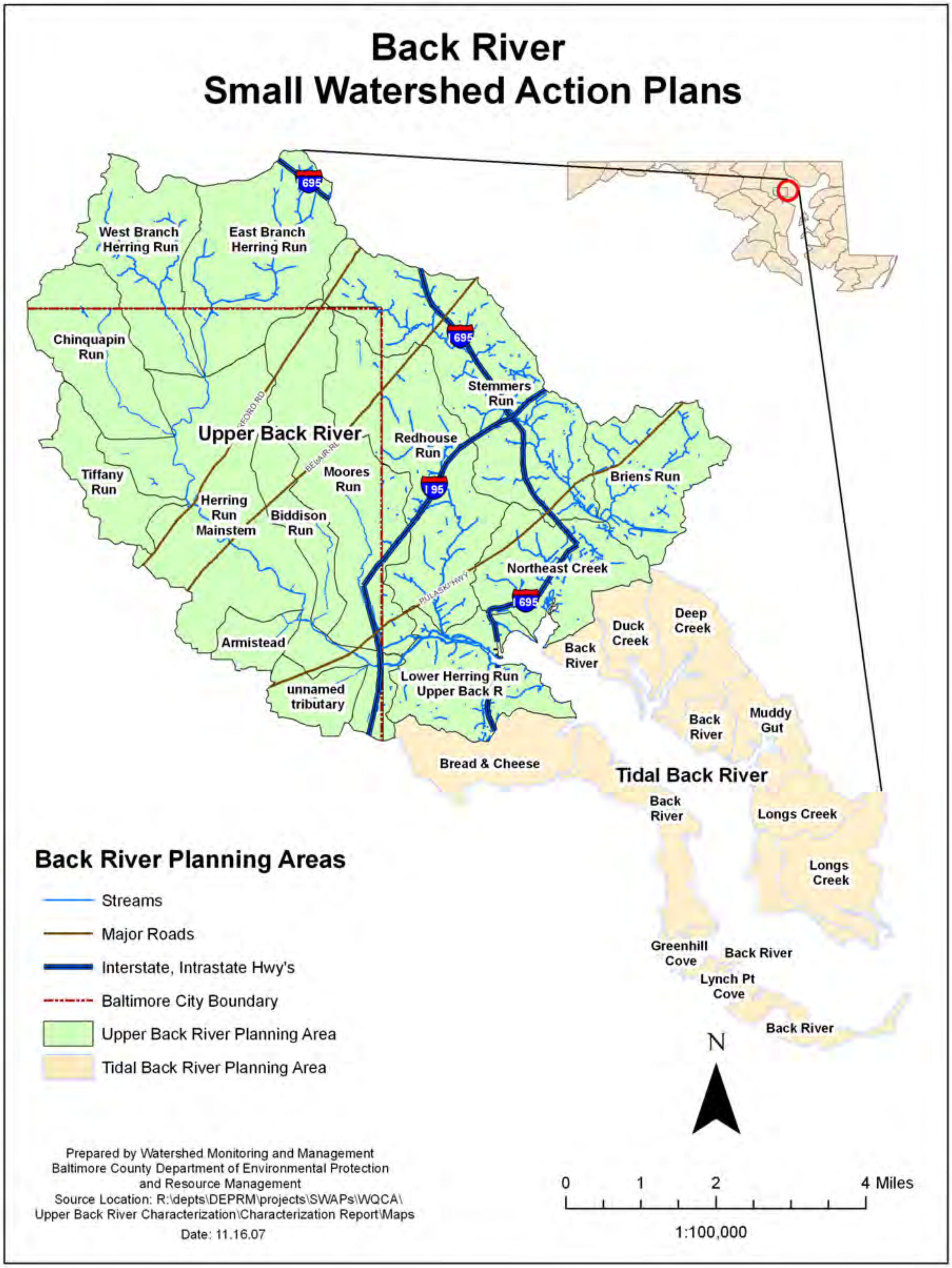


Figure 1-1: Upper Back River SWAP planning area and subwatersheds.

1.6 Report Organization

The remainder of the report is organized as follows:

Chapter 2 presents the eight watershed goals and the objectives associated with these goals.

Chapter 3 provides brief descriptions of the types of watershed restoration practices recommended for the Upper Back River Watershed in two categories – government strategies and citizen strategies.

Chapter 4 presents a prioritization of the 14 subwatersheds in the Upper Back River and summarizes their associated subwatershed-specific restoration strategies.

Chapter 5 presents the evaluation criteria and restoration monitoring framework.

A series of appendices provide additional detailed information used in the development and support for the Upper Back River SWAP. These appendices are outlined below:

- Appendix A – A table of specific restoration actions related to the goals and objectives presented in Chapter 2 are presented along with benefits, timeline, performance measure, estimated cost, and responsible party(s).
- Appendix B – A description of how the Upper Back River SWAP process meets the US Environmental Protection Agency's A through I Criteria for watershed planning.
- Appendix C – Cost analysis and a listing of potential funding sources.
- Appendix D – A copy of the Chesapeake Bay Program – Best Management Practice pollutant load reduction credits.

In addition, a second volume of appendices of supporting documentation on the condition of the Upper Back River watershed is provided. This second volume includes:

- Appendix E – Upper Back River Characterization Report (DEPRM 2008)
- Appendix F – List of stormwater retrofit and pond conversion opportunities. Detailed info on some Herring Run stormwater retrofit projects. (HRWA, CWP 2008)
- Appendix G – Stream Stability Assessment performed by Parsons Brinkerhoff in Stemmer's Run, Herring Run and Brien's Run subwatersheds. (Parsons 2008)
- Appendix H – Nutrient TMDL (MDE 2005)
- Appendix I – Bacteria TMDL-Herring Run (MDE 2006)
- Appendix J – Chlordane TMDL (MDE 1999)
- Appendix K – WQA for Zinc (MDE 2004)

CHAPTER 2

VISION STATEMENT AND GOALS

2.1 Vision Statement

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

> *Our vision for the Upper Back River watershed in 2028 is a healthy watershed with streams that achieve water quality standards and communities that are actively engaged in their role as stewards of the streams.*

2.2 Upper Back River SWAP Goals

The goals for the Upper Back River watershed grew out of the vision statement and input from both the Steering Committee and the wider Stakeholder Group. A total of 8 goals were identified. These goals were developed through discussions with the Upper Back River SWAP Steering Committee and from watershed residents at the stakeholder meetings. The actions associated with the goals and objectives are presented in Appendix A. Many of the actions address multiple goals and objectives, therefore the Action Table laid out in Appendix A indicates the goals and objectives with which it is associated. The actions, while in many cases are expressed in a quantifiable mode (i.e. linear feet of forest buffer planted), are meant to serve as a guide and not as an absolute in achieving the goals. The Steering Committee has determined that an Adaptive Management Strategy will be emphasized as implementation goes forward. This strategy will assess the success of implementation over time and will change the implementation actions based on the acceptance of the community and availability of funding.

2.3 Goal 1: Improve and Maintain Healthy Streams

The Back River watershed is identified as being impaired by nutrients and bacteria as indicated in the Maryland 303(d) list of impaired waters. To rectify this impairment a Total Maximum Daily Load (TMDL) analysis has been completed for nitrogen, phosphorous and bacteria. The objectives below are designed to meet the nitrogen and phosphorus TMDL reduction requirements in the Upper Back River watershed and address the TMDL for bacteria. The goals of the Chesapeake Bay 2000 Agreement have been developed through Maryland's Tributary Strategy Process. These goals will also be addressed through the objectives outlined below.

<u>Objectives</u>

1. Reduce annual average Total Nitrogen and Total Phosphorus loadings to the Upper Back River watershed by 15%, compared to loading estimated for the baseline period to meet the requirements developed by the Back River watershed TMDL analysis.
2. Reduce annual average Total Phosphorous loadings to the Upper Back River watershed and Total Nitrogen loadings to meet Maryland’s Tributary Strategy requirements and meet the goals of the Chesapeake Bay 2000 Agreement when developed as a Bay wide TMDL.
3. Complete sewer projects as identified and scheduled by the Federal Consent Decree to address the Back River TMDL analysis for bacteria.
4. Reduce other sources of bacteria.
5. Use the Baltimore Watershed Agreement (BWA) to identify ways to increase funding for urban stormwater projects.

2.4 Goal 2: Restore and Maintain Aquatic Biology and Habitat

The physical condition of the stream’s substrate and banks are important to support aquatic life. The relationship of the stream channel with urban infrastructure such as; bridge culverts, stormdrain outfalls and sewer manhole stacks and crossings can negatively affect the stability of the stream and its ability to support aquatic life.

Objectives

1. Meet Maryland State Water Quality Standards for the in-stream biological community.
2. Develop in conjunction with the Maryland Biological Stream Survey (MBSS) a methodology to assess the biological improvements of urban streams.
3. Continue monitoring the aquatic biology in urban streams.
4. Increase stream restoration projects by providing more funding, staff and qualified contractors.

2.5 Goal 3: Improve Stream Corridors for Water Quality, Biological and Habitat Enhancement

There is an added value from forest that is adjacent to stream channels. There is an increased reduction of nutrients and sediment through the filtering of groundwater and absorption of flood flows. Wildlife use these areas as corridors for travel and the trees provide needed detritus for aquatic life. There is ultimately an improved aesthetic quality for local residents from riparian forest cover.

Objectives

1. Explore opportunities to remove concrete channels.
2. Increase forest adjacent to stream channels.
3. Raise awareness of the importance of riparian forest cover to owners of riparian property.

2.6 Goal 4: Increase Tree Cover

Trees process water to remove nutrients, provide food and habitat for wildlife and clean the air. Trees have an inherent quality of life benefit to the citizens that live in and share the watershed.

Objectives

1. Meet Baltimore City and County urban tree canopy goals by planting more trees on both public and private lands.
2. Improve management to ensure healthy trees.
3. Develop a monitoring program for tracking the quantity and health of trees.
4. Empower citizens to plant and maintain healthy trees on public and private land.
5. Continue incentive programs for trees planted by private landowners.
6. Deter the removal of healthy existing trees that are not causing any threat or substantial inconvenience to the general public.

2.7 Goal 5: Reduce Stormwater Impacts from Impervious Surfaces

The management of stormwater is one of the primary BMPs in the urban environment. Roads and buildings cover 31% of the Upper Back River watershed. These impervious surfaces are the conduits by which stormwater reaches streams. All the debris and associated pollutants covering impervious surfaces is carried by stormwater and, if left untreated, is deposited directly into streams.

Objectives

1. Disconnect impervious surfaces from the stormdrain system.
2. Remove impervious cover from unused areas.
3. Investigate removing stormdrains and “daylighting” buried streams as part of retrofit projects.
4. Conduct outreach, education and incentives for homeowners and other watershed landowners to raise awareness of water quality best management practices they can employ on their properties.
5. Use the NPDES MS4 permit to increase construction of stormwater retrofits and conversions of existing facilities to address existing impervious surfaces.

2.8 Goal 6: Increase the Use of Public Facilities and Properties as Models of Good Best Management Practices (BMPs)

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

Objectives

1. Use the Baltimore Watershed Agreement to engage County and City agencies to share resources to provide BMPs on public sites.
2. Use the NPDES general stormwater permit to engage County and City agencies into developing Pollution Prevention Plans and instituting “good housekeeping” practices at County managed facilities.

2.9 Goal 7: Improve Access to Streams

Citizens must have an awareness of local streams and the natural environment before a sense of stewardship can be expected. When citizens have an experience with a stream, they may make a personal connection and ultimately change their behavior. The Upper Back River watershed has 139 miles of open stream channels, many within community parks. It should be safe for children to play in these streams. Local parks are opportunities for neighborhoods to engage in local stream protection activities.

Objectives

1. Complete sewer projects as identified and scheduled by the Federal Consent Decree to reduce the number of water contact alerts in the Upper Back River streams.
2. Reduce the amount of trash in the streams by exploring structural controls, inlet messages, community clean-up projects and raising awareness of littering and its connection with streams.
3. Provide awareness of streams and our impact on them at local parks through information signage.
4. Connect people with streams through activities like clean-ups, invasive removal, tree planting, trail maintenance, bird watching, etc.

2.10 Goal 8: Enhance Unused Green Space

Numerous parcels and/or pieces of parcels have the potential for water quality and habitat enhancements. By examining these parcels for individual benefits, the collective result may provide significant improvements to water quality.

Objectives

1. Improve management of natural and turf areas on public, private and institutional properties.
2. Increase participation in Parks and People Foundation’s community gardens program.
3. Increase participation in Baltimore County’s “Neighbor Space” program.
4. Raise awareness of water quality best management practices that homeowners can employ on their own properties.

CHAPTER 3

RESTORATION STRATEGIES

3.1 Restoration Strategies Overview

The restoration strategies presented here are divided into two mutually supporting categories; government strategies (3.2) and citizen based strategies (3.3). The ultimate goal of these strategies is to find a mix of restoration activities that will, when implemented, result in achieving the goals set out in Chapter 2. In order to meet the TMDL for nutrients to improve water quality in Baltimore Harbor, a 15% reduction in nitrogen and phosphorus from urban non-point sources must be achieved. The analysis the pollutant loads is presented in the *Upper Back River Characterization Report* in Volume 2, Appendix E. Section 3.4 of this chapter summarizes the pollutant load calculations and presents the management scenario on how the reduction in phosphorus and nitrogen will be achieved.

3.2 Government Strategies

Baltimore City and County governments working together through the Baltimore Watershed Agreement play a key role in the SWAP implementation process by restoring local streams and improving water quality through capital improvement projects and government management activities (development review process, street sweeping and inlet cleaning, illicit connection programs, and sewer line rehabilitation and maintenance).

3.2.1 Stormwater Management for New Development and Redevelopment

The Maryland Stormwater Act of 2007 required Maryland Department of the Environment to develop new stormwater management requirements for new development and redevelopment using Environmental Site Design (ESD) techniques. The use of ESD best management practices (BMPs) will result in the distribution of flow throughout the development site resulting in a reduction of stormwater runoff leaving the site. This will effectively reduce pollutant loads and protect stream channels from erosion. The ESD requirements build on the design manual and regulation change in 2000 where channel protection and water quality were specifically required. However, ESD may not result in a zero pollutant load from new development. There should be water quality improvements that result from the application of ESD to redevelopment projects where water quality was not previously provided. For purposes of restoration in the Upper Back River, the water quality improvements that result from redevelopment will not be counted. Instead, redevelopment will be tracked along with new development to determine if the increase in loads from new development is balanced by redevelopment, and thereby maintain the cap that is implicit in the TMDLs (i.e. there will be no increase in either phosphorus or nitrogen as a result of development).

3.2.2 Existing Stormwater Management Facility Conversions

Stormwater facility conversions involve the re-design of existing stormwater management facilities that are currently providing limited water quality improvement, to one with more effective stormwater management capabilities. Only dry detention ponds, which are designed for water quantity control, were investigated for conversion potential. The results of assessment are presented in section 3.8 of the *Upper Back River Characterization Report* in Volume 2, Appendix E. Until further analysis is conducted to determine the extent of the conversion, it is unknown how much pollutant removal can be obtained. It was assumed that the dry pond could be converted to limited extended detention with a shallow marsh, which permits 50% removal of phosphorus and nitrogen. In addition to design limitations, there are limitations based on ownership and size. Privately owned facilities will require additional staff time to obtain easements and the owner may not be willing to grant an easement. The size of the drainage area to the facility can also be a limitation, since proportional cost of the design and construction will increase. To account for these limitations, it was assumed that only 75% of the acres available for conversion will actually be converted.

3.2.3 Stormwater Management Retrofits

Stormwater retrofits are new structural stormwater management practices that can be used to address existing stormwater management problems and water quality issues where there are currently no stormwater facilities.

The preliminary investigation by The Center for Watershed Protection of potential retrofit sites in the Upper Back River watershed will be used to determine retrofit projects to target based on priority rankings.

3.2.4 Stream Restoration

Stream corridor restoration practices are used to enhance the appearance, stability, and aquatic function of urban stream corridors. The practices range from routine stream clean-ups, simple stream repairs such as vegetative bank stabilization and localized grade control, to comprehensive repair applications such as full channel redesign and re-alignment. Primary practices for use in the Upper Back River watershed include stream repair, buffer reforestation, and stream cleanups.

Using the results of the *Upper Back River Stream Stability Assessment* (Appendix G), areas of primary concern can be targeted for restoration projects. Any restoration project will most likely have an effect on the residents or businesses whose properties border or contain the stream. Outreach to these individuals can be accomplished through community meetings, mailed questionnaires, and canvassing to determine if sufficient authorization will be granted to perform the restoration.

Areas outside of the Stream Stability Assessment area can be targeted based on citizen complaints about the streams and neighborhoods identified by the Neighborhood Source Assessment (Appendix F) to be encroaching on the stream buffer. Areas on public land, where a successful buffer planting effort or establishment of no-mow area may be more likely, should be given a priority when selecting a buffer reforestation project location.

Tables 3-4 and 3-5 identify the nutrient reductions associated with stream restoration opportunities in the Upper Back River. There were 63 reaches identified for stream restoration through the Stream Stability Assessments in Stemmer's, Herring and Brien's Run totaling 44,766 feet of restoration opportunity. This shows that 30% of the assessed reaches are recommended for restoration. Extrapolating this percentage to the entire watershed, 733,972.8 ft of stream it can be determined that 220,191.8 ft of stream possess opportunity for restoration.

The calculation of pollutant load reductions associated with stream restoration were based on the re-analysis of the Spring Branch data presented in the NPDES 2006 Annual Report, which resulted in the following pollutant load reduction estimates:

- Total Nitrogen – 0.202 pounds per linear foot of stream restoration
- Total Phosphorus – 0.0107 pounds per linear foot of stream restoration

Stream restoration can often be combined with sanitary sewer capital repair projects to leverage additional money and water quality benefits for less cost. Examples include the Stony Run stream restoration project in the Jones Falls watershed completed by Baltimore City and the Minebank Run stream restoration project in the Lower Gunpowder Falls watershed completed by Baltimore County.

3.2.5 Street Sweeping and Storm Drain Inlet Cleaning

Street sweeping removes trash, sediment and organic matter such as leaves and twigs from the curb and gutter system, preventing their entry into storm drains and nearby streams. This helps reduce sedimentation and pollutants, like oils and metals, in the stream. Excessive organic matter can clog the streams and storm drain system resulting in costly maintenance. In addition, the decay of a disproportionate amount of organic matter in the stream robs essential oxygen from the water.

Neighborhoods with street sweeping recommended through the Neighborhood Source Assessments will be referred to Baltimore City or Baltimore County Public Works offices to determine if street sweeping is conducted there and if so, at what frequency. Adding a targeted neighborhood to the sweeping route or increasing the frequency of the sweeping there would address the build up of excessive curb and gutter material in that location.

There were approximately 228 miles of street recommended throughout 67 neighborhoods in the Upper Back River for street sweeping. Based on numbers from the 2007 Street Sweeping Program from the Dept of Public Works (NPDES section 3), in the Back River watershed, there were 1.24 tons (2,480 lbs.) of material removed per mile of street sweeping. The concentrations used were 1825.92 mg/kg total nitrogen and 707.95 mg/kg total phosphorus, based on the recently completed Street Sweeping- Inlet Cleaning study (CWP 2008). Finally, the milligrams of pollutant were back calculated for pounds of pollutant removed.

The TMDL model for nutrients may not specifically include sanitary sewer overflows and may already account for street sweeping.

3.2.6 Illicit Connection Detection and Disconnection Program and Hotspot Remediation

Illicit Discharge Detection and Elimination programs have been developed by Baltimore County and Baltimore City. The objective of these programs is to find and remediate discharges into streams that are harmful to aquatic life and water quality, or that are causing erosion/ sedimentation problems.

Baltimore County and Baltimore City will continue with their Illicit Discharge Detection and Elimination programs, seeking to improve techniques and methodologies for more effective reductions of these discharges. The pollutant reduction realized from implementation of the illicit connection programs have not been incorporated into the nutrient reduction strategies due to the uncertainty in the contribution of illicit connections to the overall pollutant loading rates. These programs will provide a margin of safety in the overall nutrient reduction strategy.

3.2.7 Sanitary Sewer Consent Decrees

Two Consent Decrees have been issued by the Environmental Protection Agency (EPA) and Maryland Department of the Environment (MDE) against Baltimore County and Baltimore City. The Consent Decrees outline the agreed upon work (capital, equipment and operations improvements to be completed by 2016) with deadlines necessary for compliance with the Clean Water Act and the Maryland water pollution control laws with the goal of eliminating sanitary sewer overflows.

Over an 8 yr period (2000-2007), the documented Sanitary Sewer Overflows in the Upper Back River totaled 137,754,757.0 gallons. This is an average of 17,219,344.6 gallons/yr. Using a 30mg/L concentration for nitrogen and a 10mg/L concentration for phosphorus, pollutant load reduction estimates were calculated and are shown in Tables 3-4 and 3-5. The reduction of these sanitary sewer overflows will improve water quality by reducing the nutrients as well as the bacteria associated with these overflows.

3.3 Citizen Based Strategies

The participation of citizens in improving the health of a watershed 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 the water and waterways within the watershed that would not be possible otherwise.

3.3.1 Downspout Disconnection

Rain downspout disconnection decreases flow to nearby streams during storm events, helping to quell stream bank erosion and reduce pollutants entering the stream during rainstorms. Downspout disconnection can be achieved through downspout redirection, rain barrels and/or rain gardens (see Appendix E, chapter 4).

Using a mix of outreach/awareness techniques and financial incentives, a downspout disconnection program can be implemented in neighborhoods identified by the Neighborhood Source Assessment. Initially, one or two pilot disconnection programs will be conducted in order to determine successful techniques and strategies for future success. Herring Run Watershed Association (HRWA) and the Center for Watershed Protection (CWP) have begun a pilot disconnection program in the Mayfield community. CWP is monitoring runoff from a control location to compare and assess results.

Through GIS, 1,486 rooftop acres were calculated to be in neighborhoods recommended for downspout disconnection through the Neighborhood Source Assessment. Based on percentages of potential for downspout disconnection from the neighborhood source assessment field sheets in Redhouse Run, it was determined there is an average of 60% potential for downspout disconnection among the total rooftop acres there. Through extrapolation, this calculation deems 892 rooftop acres viable for disconnection in the Upper Back River. Chesapeake Bay Program efficiencies for infiltration (50% Nitrogen, 70% Phosphorus) are used to calculate the potential nutrient reductions associated with disconnection in the Upper Back River. These reductions are shown in Tables 3-4 and 3-5.

3.3.2 Citizen Awareness

Raising awareness among citizens about some of the common activities around their homes and how those activities can negatively affect water quality is a primary citizen based strategy.

3.3.2.1 Lawn Fertilizer Application Awareness

A well-manicured and responsibly maintained lawn can be an asset to a watershed. Too often however, over-fertilization and irresponsible chemical applications result in pollutant charged runoff from lawns to local streams.

Areas identified by the Neighborhood Source Assessment as having high lawn maintenance should be targeted for awareness programs emphasizing responsible fertilizing techniques such as proper application amounts, proper time of year for fertilizing, soil testing for the nutrient requirements of the lawn and keeping fertilizers away from impervious surfaces. This education could be achieved through door-to-door canvassing, informational doorknob hangers or mailings, blurbs in community newsletters, or demonstrations at community meetings. Information on organic alternatives to chemical lawn treatments should also be included in these outreach efforts.

3.3.2.2 Pet Waste Awareness

Pet waste left on yards, sidewalks and common areas can be washed away by rain into the stormdrain and therefore into the stream. Once in the stream, this waste contributes bacteria such as E.coli and fecal coliforms that can cause health problems for people who come in contact with the contaminated stream. This waste can also contribute nutrients and its decay robs the stream of oxygen needed by fish and aquatic plants for survival.

Awareness programs emphasizing the importance of picking up after pets can include ‘pick up after your pet’ signs in common areas, informational doorknob hangers or mailings, blurbs in community newsletters, or demonstrations at community meetings.

3.3.3 Reforestation and Street Tree Planting

Trees help improve water quality by processing nitrogen and phosphorus in the groundwater which prevents these nutrients from reaching streams. Tree leaves and stems intercept precipitation, which helps to reduce the energy of raindrops and prevent any erosion that could be caused by their impact on the ground. In addition, trees strategically planted around the home can form windbreaks to reduce heating costs in the winter and when planted closer to the home, can reduce cooling costs in the summer.

Using incentive programs like Tree-Mendous Maryland and NeighborSpace of Baltimore County for planting on public property, and The Growing Home Campaign for private property plantings could increase the success of planting efforts. In addition, HRWA has obtained funding for a ½ off yard tree incentive program for canopy trees which has been successfully implemented throughout the watershed. HRWA also has piloted a successful street tree planting program in Baltimore County. Both HRWA programs were funded by the Chesapeake Bay Trust.

3.3.3.1 Riparian Buffer Reforestation

The riparian buffer is the last line of defense for the stream against nutrients in the groundwater. Buffer tree roots also help stabilize stream banks, reducing erosion and sedimentation in the stream.

The Stream Stability Assessment indicates areas within the assessed subwaterhseds that are recommended for buffer enhancement projects. The Neighborhood Source Assessment indicates 57 neighborhoods where buffer encroachment is evident. Combining this data, areas within the watershed can be targeted for buffer reforestation.

Areas on private land can be targeted for buffer awareness initiatives to encourage landowners to plant trees and/or create a no-mow area adjacent to the stream.

1,948 acres of buffer were determined to be open pervious or plantable through GIS land data. Further rough analysis in Redhouse Run showed that approximately 10% of the buffer area is feasible for establishing a forested buffer. Extrapolating this percent throughout the watershed gives a total of 194.8 acres of buffer possible for planting. The Chesapeake Bay Program removal efficiency for buffers allows for a land use change and a reduction efficiency of 25% for Nitrogen and 50% for phosphorus. In addition, ratios of 1:4 for nitrogen and 1:2 for phosphorus are used for calculating these efficiencies. In other words, 1 acre of forest buffer is theorized to treat 4 upland acres for nitrogen and 2 upland acres for phosphorus. Tables 3-4 and 3-5 show the potential nutrient reductions associated with forest buffers in the Upper Back River.

3.3.3.2 Upland Reforestation

Converting open areas in the upland portion of the watershed to forested areas by planting trees can decrease nutrients in nearby streams and reduce erosion.

Areas identified by the Pervious Area Assessment should be further investigated for potential for successful tree-planting efforts, focusing these investigations on the publicly owned parcels. A total of 123 acres were assessed, of these, 77 acres were on public property requiring minimal site preparation (Appendix E). These areas should be investigated first as the likelihood of a successful planting effort is greater here.

Many of the institutional areas assessed through the Institutional Site Assessment showed tree-planting opportunities. Using appendix 4-3 from Chapter 4 of Appendix E, institutions can be identified where tree-plantings are recommended restoration options.

3.3.3.3 Street Tree Planting

Aside from obvious aesthetic values, street trees shade concrete and can help cool an entire neighborhood while absorbing nutrients through their root systems, improving air quality and providing habitat for wildlife.

Neighborhoods recommended for street trees by the Neighborhood Source Assessment should be targeted for street tree plantings. Canvassing residents and/or contacting neighborhood associations can be effective techniques for beginning to implement a street tree planting program within a neighborhood.

3.4 Pollutant Load Reduction Analysis to Meet the Nutrient TMDL

3.4.1 TMDL Pollutant Load Reduction Requirements

In order to assess the nutrient pollutant loads in the Upper Back River planning area, a spreadsheet analysis was conducted. Using data supplied by Maryland Department of the Environment on per acre land use nitrogen and phosphorus loads and the Chesapeake Bay Program Watershed Model (Phase 4.3, segment 860-edge of stream loadings) per acre loadings for urban impervious and urban pervious loadings the nitrogen and phosphorus loads were calculated. Chapter 3 of the Upper Back River Characterization Report (Appendix E) presents the results for each subwatershed. This methodology was applied to derive the pollutant loads for nitrogen and phosphorus in anticipation of development of a Chesapeake Bay TMDL for these pollutants in 2010. The Chesapeake Bay TMDL will be based on the Phase 5 Chesapeake Bay Watershed Model linked to the Estuary Model. The Phase 5 land use loading rates are not currently available. At this time it is uncertain what the reduction requirements for urban stormwater sources of nitrogen and phosphorus will be for the Chesapeake Bay TMDL.

The land use was derived from the Maryland Department of Planning 2002 land use data layer. This information is presented in Chapter 2 of the Upper Back River Characterization Report (Appendix E).

The Maryland land use loadings assume full implementation of the tributary strategies for pollutant load reduction to the Chesapeake Bay. For this reason the urban land uses from the Chesapeake Bay program were used to determine the before restoration loadings. This will provide a before restoration loading rate and will allow a better assessment of progress made to date and further progress needed to meet the TMDL goals for urban non-point source reduction. Table 3-1 presents the per-acre loadings for nitrogen and phosphorus used in this analysis. These loading rates were also used for the reduction analysis discussed below.

Table 3-1: Land Use per Acre Nitrogen and Phosphorus Loadings (pounds/acre/year)

Land Use	Nitrogen Load per Acre	Phosphorus Load per Acre
Urban Pervious	15.77	2.28
Urban Impervious	8.06	0.51
Cropland	13.54	0.69
Pasture	5.64	0.66
Forest	1.29	0.02

The results of this analysis are presented in Table 3-2 with the annual loads of nitrogen and phosphorus split between urban, agriculture, and forest sources. A nutrient TMDL has been developed by Maryland Department of the Environment determine the load reductions needed for tidal Back River to meet water quality standards (Appendix H). The results from TMDL analysis indicated that the majority of the nitrogen and phosphorus reduction would be achieved through upgrades to the Back River Waste Water Treatment Plant. The upgrade to Enhanced Nutrient Removal (ENR) is due to be completed in 2013. In order to fully achieve water quality standards in tidal Back River the TMDL determined that an additional removal of nitrogen and phosphorus was required from urban sources with the percent reduction being set at 15% for both nitrogen and phosphorus. Table 3-2 presents the pounds removal needed to achieve this additional 15% reduction.

Table 3-2: Upper Back River Nitrogen and Phosphorus Loads

Source	# Nitrogen	# Phosphorus	15 % Nitrogen Reduction	15% Phosphorus Reduction
Urban	314,619	40,182	**48,189.6**	**6,055.8**
Agriculture	1,467	75		
Forest	5,245	116		
Total	**321,331**	**40,373**		

For purposes of this Small Watershed Action Plan the 15% reduction was applied to the total load to address the uncertainty in Best Management Practice performance and to provide a margin of safety in meeting the water quality standards in tidal Back River.

3.4.2 Pollutant Load Reduction Calculations

Most pollutant removal calculations are based on Chesapeake Bay Program models that credit nutrient reductions specific to individual scenarios as efficiencies or land use conversions. Stream restorations are credited using specific reduction amounts per stream mile restored and other practices are credited simply as a direct removal. Table 3-3 shows the Chesapeake Bay Program removal efficiencies of some stormwater management practices and Appendix D presents the full suite of best management practices and the associated efficiencies.

Table 3-3: Percent Removal Efficiency of BMPs

BMP	Pollutants		
	TSS	TP	TN
Detention Facilities	10	10	5
Extended Detention Facilities	60	20	30
Wet Ponds	80	50	50
Infiltration Practices	90	70	50
Filtration Practices	85	60	40

Detention Facilities = Detention Pond and Hydrodynamic Devices (DP, OGS, and UGS)
Extended Detention Facilities = Extended Detention Ponds (EDSD, EDSW, ED)
Wet Ponds and Wetlands = Wet Pond and Shallow Marsh (WP and SM)
Infiltration Practices = Infiltration Trench and Infiltration Basins (IB, IT and ITWQC), Porous Paving (PP), and Dry Wells (DW)
Filtration Practices = Sand filters and Bioretention Facilities (SF, BIO)

Listed in below are the specifics on best management practices and explanations about how the reduction numbers from Tables 3-4 and 3-5 are derived.

Stormwater Management Existing-based on numbers from Table 3-25 of Appendix E, The Upper Back River Characterization Report. The nitrogen and phosphorus pollutant loadings to each facility were based on the loading rates in Table 3-1. The pounds of removal were then calculated based on the facility type and the appropriate removal efficiency from Table 3-3.

Stormwater Management Conversions-based on numbers from Table 3-26 of Appendix E, The Upper Back River Characterization Report. Numbers for 'already implemented' column are from the three conversions listed in Table 7-13 of the 2008 Baltimore County NPDES Report. (Projects from the tidal Back River area not included in the calculations.)

Stormwater Management Retrofits-From Retrofit data from CWP. Numbers for 'already implemented' column are from the three retrofits listed in Table 7-13 of the 2008 Baltimore County NPDES Report. (Projects from the tidal Back River area not included in the calculations.)

Forest Buffers-Reduction numbers achieved through the Chesapeake Bay Program removal efficiency are based on a land use conversion plus a reduction efficiency. There are 1,948 acres considered open pervious in the stream buffer areas of Upper Back River. Rough GIS analysis shows approximately 10% or 194.8 acres feasible for planting. A reduction efficiency of 25% for nitrogen applied to four times the area and 50% for phosphorus applied to twice the area, yields the reduction efficiency estimates. Pollutant loads for forest are subtracted from the current urban pervious loads to obtain reductions based on the land use change. The reduction efficiency and land use change numbers are then combined to achieve the total reduction estimate.

Reforestation- Nutrient reduction numbers are based on 123 acres of pervious areas assessed (see Appendix E) and a land use conversion from urban pervious to forested. The numbers from the 'already implemented' column are based on Herring Run Watershed Association's tree planting numbers; 3,267 trees planted since 2004.

Stream Restoration-Based on recommended restoration lengths from the Parsons report on Brien's Run and county portions of Herring Run and Stemmer's Run (Appendix G), an average of 30% of the assessed streams were recommended for stream restoration. Extrapolating this percentage to the entire watershed's stream miles yields 220,192 ft or 41.7 miles of stream restoration opportunity.

The calculation of pollutant load reductions due to stream restoration are based on the re-analysis of the Spring Branch data presented in the NPDES 2006 Annual Report, which resulted in the following pollutant load reduction estimates:

Total Nitrogen – 0.202 pounds per linear foot of stream restoration
Total Phosphorus – 0.0107 pounds per linear foot of stream restoration

Existing stream restoration numbers indicated in the 'already implemented' column are derived from Table 7-13 of the 2008 Baltimore County NPDES Report.

Downspout Disconnection – The 205 neighborhoods recommended for downspout disconnection contain 1,486 impervious building acres (Table 4-1 Appendix F). Based on a 60% potential for downspout disconnection (from Redhouse Run counts), 891.5 impervious building acres were deemed feasible to disconnect. Chesapeake Bay Program efficiencies for infiltration, 50% for nitrogen and 70% for phosphorus, were used to determine nutrient reduction estimates.

Street Trees – It was determined that a total of 4,028 street trees could be planted in neighborhoods throughout the Upper Back River (Table 4-5 Appendix F). Estimated nutrient reductions were determined using the estimate of 400 trees per acre, and a land use conversion from urban pervious to forest.

Urban Nutrient Management – 134 neighborhoods were noted to have 30% or more high maintenance lawns. A total of 5,734.1 acres of pervious area exists within these neighborhoods. Using Chesapeake Bay Program loading rates for urban pervious, a reduction efficiency is applied (17% for N and 22% for P) to calculate nutrient reduction possibility.

Street Sweeping/Inlet Cleaning – The 67 neighborhoods recommended for street sweeping contain approximately 228 miles of road. Based on numbers from the 2007 Street Sweeping Program from the Dept of Public Works (NPDES section 3), in the Back River watershed, there were 1.24 tons (2,480 lbs.) of material removed per mile of street sweeping. Using a concentration of 1825.92 mg N/kg and 707.95 mg P/kg, a conversion factor was determined and potential load reductions calculated.

Sanitary Sewer Overflows-Over an 8 yr period (2000-2007), the documented Sanitary Sewer Overflows in the Upper Back River totaled 137,754,757.0 gallons. This is an average of 17,219,344.6 gallons/yr. The consent decree issued in September 2002, by EPA and MDE to the city of Baltimore will help reduce these sanitary sewer overflows and their associated nutrient loads. Based on a 30mg/L nitrogen concentration for raw sewage and 10mg/L phosphorus concentration, potential load reductions were calculated based on the elimination of these overflows.

Pollutant Load Reduction Calculation: The descriptions above for the various restoration strategies and the pollutant load reductions associated with the strategy were used in the development of the overall strategy to meet the 15% nitrogen and phosphorus reduction needed to meet the Back River TMDL. Tables 3-4 (Phosphorus) and Table 3-5 (Nitrogen) provide information on:

- The BMP type,
- How the pollution reduction is credited,
- The units available for treatment,
- A projected participation (how much of the available units are expected to be addressed),
- The pounds removed by future BMP implementation
- Pounds already removed by implementation, and
- The remaining pounds to be removed to meet the TMDL load reduction.

Table 3-4: Current and Projected Phosphorus Reductions due to BMPs

BMP	How Credited	TP Efficiency	Units Available	Projected Participation	TP Removed (lbs)	TP Removal (lbs) Already Implemented	TP Remaining (lbs)
Restoration Options							
Phosphorus to be Removed to meet the TMDL 15% Reduction							6,055.8
Stormwater Management Existing	Efficiency	Varies by Type	1,520.6 acres	NA	NA	563.4	5,492.4
Stormwater Management Conversions	Efficiency	Varies by Type	206 acres	75%	89.7	107.4	5,325.2
Stormwater Management Retrofits	Efficiency	Varies by Type	1,352 acres	75%	1,126.7	139.3	4,059.2
Riparian Forest Buffers	Land use conversion +Efficiency	50% for 2 upland acres	1,948 acres	10%	722.7		3,336.5
Reforestation	Land use conversion	Land use conversion	123 acres	40%	76.9	18.5	3,241.1
Stream Restoration	Linear Foot	.0107 lbs/ft	220,192 ft	30%	2,356.1	108.5	776.5
Downspout Disconnect	Efficiency	70%	892 acres	20%	63.7		712.8
Street Trees	Land Use Conversion	Land use conversion	10 acres	100%	22.8		690
Urban Nutrient Management	Efficiency	22%	5,734 acres	50%	1,438.1		-742.6
Street Sweeping/Inlet Cleaning	Direct removal		228 miles	100%	400.5	403.5	-1,546.6
SSO Reduction/Elimination	Direct removal			100%	1,432.6		-2,979.2
Total Pounds Phosphorus Removed							**9035.0**

Table 3-5: Current and Projected Nitrogen Reductions due to BMPs

BMP	How Credited	TN Efficiency	Units Available	Projected Participation	TN Removed	Already Implemented	TN Remaining
Restoration Options							
Nitrogen to be Removed to meet the TMDL 15% Reduction							48,189.6
Stormwater Management Existing	Efficiency	Varies by Type	1,520.6 acres	NA	NA	4,736.5	43,453.1
Stormwater Management Conversions	Efficiency	Varies by Type	206 acres	75%	827.4	938.2	41,687.5
Stormwater Management Retrofits	Efficiency	Varies by Type	2,131.6 acres	75%	5,808.7	1174.4	34,704.4
Riparian Forest Buffers	Land use conversion +Efficiency	50% for 4 upland acres	1,948 acres	10%	5,078.4		29,626.0

BMP	How Credited	TN Efficiency	Units Available	Projected Participation	TN Removed	Already Implemented	TN Remaining
Restoration Options							
Reforestation	Land use conversion	Land use conversion	123 acres	40%	713.9	118.7	28,793.4
Stream Restoration	Linear Foot	0.202 lbs/ft.	220,192 ft	30%	13,343.6	1,652.6	13,797.2
Downspout Disconnect	Efficiency	70%	892 acres	50%	718.5		13,078.7
Street Trees	Land Use Conversion	Land use conversion	10 acres	100%	146.2		12,932.5
Urban Nutrient Management	Efficiency	22%	5,734 acres	50%	7,686		5,246.5
Street Sweeping/Inlet Cleaning	Direct removal		228 miles	100%	1,032.9	1040.6	3,173.0
SSO Reduction/Elimination	Direct removal			100%	4,304.8		-1,131.8
Total Pounds Nitrogen Removed							**49,321.4**

The restoration strategies above, once implemented, will result in meeting the 15% reduction of nitrogen and phosphorus needed to meet the water quality standards for tidal Back River as determined by the Back River TMDL (Appendix H). Once the Chesapeake Bay TMDL is developed and finalized in 2010 and the urban nutrient load determined for Back River, the nutrient reduction strategy presented above will have to be reassessed to determine if it is sufficient to meet the reductions required under the Chesapeake Bay TMDL. If the strategies do not meet the reductions requirements, then within one year of TMDL approval, the strategies will be modified to meet the further reduction requirements required under the Chesapeake Bay TMDL.

Due to the uncertainty of effectiveness of best management practices and the magnitude of the reductions required, this document does not specifically address all of the actions needed to reduce bacteria levels in order to be in conformance with water quality standards. Instead, the reductions in bacteria will be conducted in an iterative fashion as recommended by MDE in the development of the TMDL (Appendix I). A bacterial monitoring program will be developed (Chapter 5) to further refine bacterial contamination sources and the effectiveness of various best management practices. The bacteria TMDL and progress being made to meet water quality standards will be reassessed in conjunction with MDE within five years of the completion of this SWAP. Based on that evaluation, a series of additional best management practices to address the bacteria TMDL may be developed.

CHAPTER 4

RESTORATION STRATEGY

4.1 Restoration Strategy Overview

An evaluation of each subwatershed in relation to ranking criteria is presented in this Chapter. Criteria were determined and are explained for the ranking methodology. Each criterion was selected because of its relation to one or several of the SWAP Goals. A score is associated with each criterion and then used to evaluate and rank the individual subwatersheds. This is a tool for targeting restoration actions by location/waterbody. A higher score has a higher priority. Some of the criteria are aimed at restoration needs and other criteria are focused on restoration potential.

The 14 Upper Back River subwatersheds are also summarized individually in this section. A profile of the land characteristics is presented in table format along with a narrative description. These characteristics are only a select few from Appendix F titled Characterization Report. A Management Strategy particular to the subwatershed is discussed. This is divided into two categories: *Engaging Citizens & Watershed Groups* and *Municipal Actions and Responsibilities.* This is consistent with the format in the previous Chapter 3.

4.2 Evaluation Criteria

Phosphorous and Nitrogen Load – Phosphorous and nitrogen loads were calculated for each subwatershed. The loads were calculated using data supplied by the Maryland Department of the Environment on per acre land use nitrogen and phosphorous loadings and the Chesapeake Bay Program Watershed Model. The method and results are summarized in the Characterization Report. For purposes of this prioritization a higher phosphorous and nitrogen load was correlated with a higher priority for restoration in the subwatershed.

Impervious surfaces – The amount of impervious surface within a watershed has been correlated with degradation in water quality. Impervious surfaces prohibit stormwater from infiltrating through the soil and prohibit the natural filtration of pollutants. The Center for Watershed Protection (CWP) has created a model that predicts stream quality with the amount of impervious cover in the subwatershed. The model has four categories for sensitive, impacted, damaged and severely damaged stream systems. For purposes of this prioritization the impervious surfaces for each subwatershed were placed into the four categories outlined in the CWPs impervious cover model.

Restoration Opportunity/Pollution Source Index – The assessment for each neighborhood contains a scoring system that categorizes the neighborhood as high, medium or low for both restoration opportunities and pollutions sources. These scores were combined in the matrix format below and then used as evaluation criteria for the prioritization of the subwatersheds. The subwatersheds that had the most neighborhoods with high potential for both restoration opportunities and as pollution sources received the highest priority score. The subwatersheds with the most neighborhoods that resulted in high and medium, received the second highest priority. The mediums scores and the high/low scores ranked as a third priority and the combined medium, low and none scores received the lowest priority.

ROI / PSI	**High**	**Med**	**Low**
High	***High/High***	**High/Med**	*High/Low*
Med	**Med/High**	*Med/Med*	Med/Low
Low	*Low/High*	Med/Med	Low/Low-None

NSA-Lawn Fertilizer Reduction – This category was selected form the Neighborhood Source Assessment to use in this prioritization because it has a quantitative pollution reduction efficiency related to the nutrient goals. Each neighborhood was evaluated as a pollution source for nutrients originating from lawn fertilizer. If more than 20% of the homes showed that fertilizer reduction was warranted then it became a recommendation for the neighborhood. For this prioritization process the acres associated with the recommended neighborhoods were summed. Then the acreage was divided by the total pervious acreage within the subwatershed. This normalized the acreage across the 14 subwatersheds. A ranking was then made between the subwatersheds and each received a priority score.

NSA-Downspout Disconnection/Redirection – This category was selected from the Neighborhood Source Assessment to use in this prioritization because the acres of impervious treated can be quantified and then related to the nutrient goals. Each neighborhood was evaluated as a pollution source for nutrients originating from rooftop runoff. A neighborhood in which 25% or more of the downspouts are feasible for disconnection/redirection scored for downspout disconnection/redirection as a recommended action. Feasible for disconnection was defined as downspouts either directly connected to the system or discharging to an impervious surface that leads into a storm drain inlet AND with at least 15 feet of usable pervious area to redirect the flow. For this prioritization process the impervious acres associated with the neighborhoods with downspout disconnection as a recommended action was summed. Then the acreage was divided by the total acreage of impervious buildings within the subwatershed. This normalized the acreage across the 14 subwatersheds. A ranking was then made between the subwatersheds and each received a priority score.

NSA-Trash Management – The results of the NSA include an indication of neighborhoods that are a source for trash. It was decided to use this data as a ranking tool because of it’s potential of becoming a pollutant regulated by EPA through the TMDL process. Many of these neighborhoods could reduce their trash with a variety of techniques to raise awareness of the problem and ways to solve it. Some ways to raise the awareness of citizen’s perception of trash as a problem include: a plaquerd marking the stormdrain inlet, a clean-up day, a recycling presentation and/or a targeted trash can inspection throughout the neighborhood. Baltimore County has regulations on homeowner trash management responsibility with regards to trashcans and lids. For purposes of the prioritization the number the neighborhoods identified as needing trash management were divided by the total number of neighborhoods in the subwatershed. This normalized the impact across the planning area and allowed a ranking of the subwatersheds. The scores were then broken into four brackets.

Institutional Site Index – The Institutional Site assessment was not finished for all of the subwatersheds in the Upper Back River planning area. This is identified as one of the actions needed in the Action Strategy (Appendix A). Institutions offer a unique opportunity to complete restoration activities on large acres of land. Usually the institutions are located on campuses that include many naturally resources. They also offer the opportunity to engage citizens, often students, in the restoration activities. This has the added benefit of raising awareness at the same time. After all of the Institutions have been assessed this prioritization may be modified to reflect the opportunity for working with institutions within certain subwatersheds.

Hotspot Site Index – Stormwater "hot spots" are commercial or industrial operations that produce higher levels of storm water pollutants, and/or present a higher potential risk for spills, leaks or illicit discharges into the storm water system. Stormwater hotspots are classified into four types of operations: commercial, industrial, municipal and transport-related. The Hot Spot Investigation is used to evaluate the potential of these types of facilities to contribute contaminated runoff to the storm drain system or directly to receiving waters. Sites were classified into four initial hotspot status categories: Not a hotspot, potential hotspot, confirmed hotspot or severe hotspot. These facilities may need further investigation or possibly need compliance with Maryland's NPDES general discharge permit. A training program for these operations may be developed to reduce the likelihood that these operations become a source for water contamination. For this prioritization process the number of hotspots where the inspection resulted in potential, confirmed or severe were summed for each subwatershed. The scores were broken into four groups and the subwatersheds were then ranked. The most hotspots were identified in the Redhouse Run subwatershed.

Pervious Area Site Index (PAA) – The Pervious Area Assessment identified sites that were open space, not developed. The site assessment included parcel size, public vs. private ownership, existing forest or wetlands and the extent of invasive species if they were present. The sites that are not providing much habitat or water quality value are then targeted for planting. Almost all of the PAAs identified in this survey were open space needing only minimal site preparation. For purposes of this prioritization, sites that are in public ownership are given a greater score because of the greater likelihood that they can be converted to tree cover. Sites that are in private ownership and are open space frequently are being planned for future development or expansion of an existing facility. The acres of PAAs in public ownership were summed and then weighted by two to give them a higher score. The acres of PAAs in private ownership were then added to this number to give a total weighted acreage. The total weighted acreage was then divided by the total acres of the subwatershed to normalize the acreage across the 14 subwatersheds. The percent of land identified as PAA was very small for all the subwatersheds. The Table 4-1 below shows the actual acreages and score.

Table 4-1: PAA Prioritization Score

	Acres PAA Public	Weighted PAA Public (x2)	Acres PAA Private	Total weighted acres	% acres per subshed acres	Score >.018 >.012 >.006 >0
Armistead Run	0	0	6.5	6.5	.016	3
Biddison Run	0	0	2.0	2.0	.003	1
Brien's	5.5	11.0	3.0	14	.009	2
Chinquapin Run	8.75	17.5	1.5	19	.012	3

	Acres PAA Public	Weighted PAA Public (x2)	Acres PAA Private	Total weighted acres	% acres per subshed acres	Score >.018 >.012 >.006 >0
East Branch Herring Run	6.0	12.0	1.0	13	.005	1
Herring Run Mainstem	9.0	18.0	6.0	24	.005	1
Lower Herring Run	0	0	5.0	5.0	.003	1
Moore's Run	16.0	32.0	4.5	36.5	.013	3
Northeast Creek	3.0	6.0	4.5	10.5	.006	2
Redhouse Run	29.5	59.0	3.0	62.0	.021	4
Stemmers Run	1.5	3.0	0	3.0	.001	1
Tiffany Run	0	0	0	0	0	1
Unnamed Tributary	0	0	0	0	0	1
West Herring Run	7.0	14.0	0	14.0	.007	2

Municipal Practices: Street Sweeping – Both Baltimore County and Baltimore City continually provide street sweeping services throughout their jurisdictions. Street sweeping immediately removes sediment and trash from the stream system network. As a part of the Neighborhood Source Assessment, street sweeping is identified as a recommended action for neighborhoods exhibiting trash and organic matter within the curb and gutter. For purposes of this prioritization the miles of roads for neighborhoods with street sweeping identified were summed. The total miles were summed. The sum for each subwatershed was ranked and placed into four equal categories. The subwatersheds with more miles of road received a higher prioritization score. These subwatersheds would receive a higher benefit from increased municipal street sweeping.

Municipal Stormwater Retrofits and Conversions - An evaluation of potential stormwater projects was conducted. The evaluation included both conversions of existing ponds and the feasibility of building new retrofit facilities. Baltimore County has a database on all of its stormwater management facilities, which includes information on the types of facility as well as drainage area and other details. The existing stormwater facilities that were classified as dry detention ponds were field assessed for their suitability for conversion to a type of facility that provides greater water quality benefits. A review of sites that indicated an opportunity for stormwater retrofit projects was conducted throughout both the City and the County portions of the planning area. This review used the Center for Watershed Protection's RRA process. Each of these assessments concluded with a list of potential stormwater facility projects. Each project was ranked on its feasibility for implementation and pollution reduction benefits. The results of these assessments are in the Upper Back River Characterization Report. For purposes of this subwatershed prioritization each facility was weighted based on its feasibility ranking and the size of its contributing drainage area. The scores for each subwatershed were totaled, then the total scores were broken into four equal categories. The subwatersheds with the best opportunity for stormwater retrofits and/or conversions received a higher prioritization.

Illicit Discharge Connection Potential - Baltimore City and Baltimore County have separate storm sewer and stormdrain systems constructed. However, the potential exists in all municipal stormdrain systems for pipes to leak into one another or to have pipes incorrectly connected. There are also many situations where private property owners have connected into the public system without approval. Baltimore County conducts a screening of outfall pipes and Baltimore City conducts an instream detection program to identify these illicit connections. A summary of the outfall monitoring data is discussed in the Characterization report (Appendix E). The outfall data values fall into four categories: no data, low, moderate or high. For purposes of this prioritization the subwatersheds with a high value were given a higher priority for action.

Stream Corridor Improvements – Stream corridors are the interface between the land and the surface water system. Within urban areas these corridors are heavily impacted from the flashy nature of the urban hydrology and the disturbance from humans. Forested stream buffers are a very important component in watershed restoration. They provide filtering of runoff that improves water quality and they provide habitat for wildlife and aquatic life within the stream system. In the Characterization Report (Appendix F) a 100-foot area was delineated using GIS and the land use within that area was categorized as forested, open pervious or impervious. For purposes of this prioritization the percent of open pervious acreage was used to indicate subwatersheds that could benefit from more stream buffer planting.

The scoring criteria are summarized in Table 4-2. This table contains the criteria, how the criteria are related to the restoration priority, the ranking categories and the corresponding scores.

Table 4-2: Restoration Prioritization Criteria, Ranking Categories, and Score

Criteria	Criteria Related to Priority	Ranking Categories	Score
Phosphorous Load	Higher Load (lbs/acre/yr) = Higher Priority	.80 ≥. 90 .70 ≥. 80 .60 ≥ .70 .50 ≥ .60	=4 =3 =2 =1
Nitrogen Load	Higher Load (lbs/acre/yr) = Higher Priority	7.5 ≥ 8.0 7.0 ≥ 7.5 6.5 ≥ 7.0 6.0 ≥ 6.5	=4 =3 =2 =1
% Impervious	Higher % Impervious = Higher Priority	≥ 40% 25% ≥ 40% 10% ≥ 25% ≤ 10%	=4 =3 =2 =1
ROI/ PSI index	Higher PSI and ROI = Higher Priority	High/High High/Med mix all Med or Low/Med mix all Low	=4 =3 =2 =1
NSA - *Lawn Fertilizer Reduction*	Higher Acres Fertilizer Reduction Opportunity (normalized per subwatershed pervious acres) = Higher Priority	% of subwatershed ≥ 60% % of subwatershed 40 ≥ 60% % of subwatershed 20 ≥ 40% % of subwatershed ≤ 20%	=4 =3 =2 =1
NSA – *Downspout Disconnection*	Higher acres feasible (normalized per subwatershed acres) = Higher Priority	60 ≥ 80 40 ≥ 60 20 ≥ 40 30 ≥ 20	=4 =3 =2 =1
NSA – *Trash Management*	Higher % of Neighborhoods = Higher Priority	75 ≥ 100% 50 ≥ 75% 25 ≥ 50% 0 ≥ 25%	=4 =3 =2 =1
HSI Index	Higher Status (number of potential, confirmed or severe per subwatershed) = Higher Priority	15 ≥ 20 10 ≥ 15 5 ≥ 10 0 ≥ 5	=4 =3 =2 =1

Criteria	Criteria Related to Priority	Ranking Categories	Score
PAA Index	Higher acreage (% per subwatershed) and public ownership = Higher Priority	.018 ≥ .024 .012 ≥ .018 .006 ≥ .012 0 ≥ .006	=4 =3 =2 =1
Municipal Mgn. Practices – Street Sweeping	Higher miles of roads (for neighborhoods w/ street sweeping recommended) = Higher Priority	45 ≥ 60 30 ≥ 45 15 ≥ 30 0 ≥ 15	=4 =3 =2 =1
Municipal SWM conversions and retrofits	Higher feasibility and drainage area = Higher Priority	≥ 1,500 1,000 ≥ 1,500 500 ≥ 1,000 0 ≥ 500	=4 =3 =2 =1
Illicit Connection Detection Potential	Higher data value = Higher prioritization	High Moderate Low No data	=4 =3 =2 =1
Stream Corridor Improvements	Higher open pervious buffer = Higher Priority	75 ≥ 100% 50 ≥ 75% 25 ≥ 50% 0 ≥ 25%	=4 =3 =2 =1

The subwatershed restoration prioritization scoring and ranking results are displayed in Table 4-3.

Table 4-3: Subwatershed Restoration Prioritization Scoring and Ranking Results

	Phosphorous Load	Nitrogen Load	% Impervious	ROI/PSI Index	NSA – Lawn Fertilizer Reduction	NSA – Downspourt Disconnection	Trash Management	HSI Index	PAA Index	Municipal Practices	Stormwater Retrofits & Conversions	Illicit Connection Potential	Stream Corridor Improvements	Total Score	Subwatershed Rank
Armistead Run	3	4	3	3	1	1	4	1	3	1	1	1	3	29	6 tied
Biddison Run	3	4	3	3	3	3	2	1	1	1	3	1	2	30	5
Brien Run	2	2	3	2	1	1	2	1	2	1	1	2	3	23	12
Chinquapin Run	3	3	3	2	3	3	1	1	3	2	4	2	2	32	2
East Branch Herring Run	3	4	3	2	2	3	1	1	1	2	1	1	3	27	8 tied
Herring Run Mainstem	3	3	3	2	1	3	2	1	1	4	4	1	3	31	3 tied
Lower Herring Run	2	2	3	2	1	1	1	1	1	1	1	1	3	20	14
Moore's	3	3	3	2	1	2	2	1	3	2	1	1	3	27	8

	Phosphorous Load	Nitrogen Load	% Impervious	ROI/PSI Index	NSA – Lawn Fertilizer Reduction	NSA – Downspout Disconnection	Trash Management	HSI Index	PAA Index	Municipal Practices	Stormwater Retrofits & Conversions	Illicit Connection Potential	Stream Corridor Improvements	Total Score	Subwatershed Rank
Run															tied
Northeast Creek	1	1	3	2	1	3	1	1	2	1	1	2	3	22	13
Redhouse Run	3	3	3	2	1	4	1	4	4	3	3	2	3	36	1
Stemmers Run	2	3	3	2	2	2	1	1	1	2	1	2	3	25	11
Tiffany Run	4	4	4	3	1	4	3	1	1	2	1	2	1	31	3 tied
Unnamed Tributary	4	4	3	2	1	1	3	1	1	1	1	2	3	27	8 tied
West Herring Run	4	4	3	2	3	3	1	1	2	1	1	1	3	29	6 tied

The subwatersheds were placed in three priority categories: very high priority, high priority, and medium priority. The results are shown in Figure 4-1. While restoration activities will have to occur throughout the Upper Back River in order to meet the environmental goals, the subwatershed prioritization provides information on where the initial focus should be located. Two subwatershed were moved from the high priority to the very high priority category based on known problems.

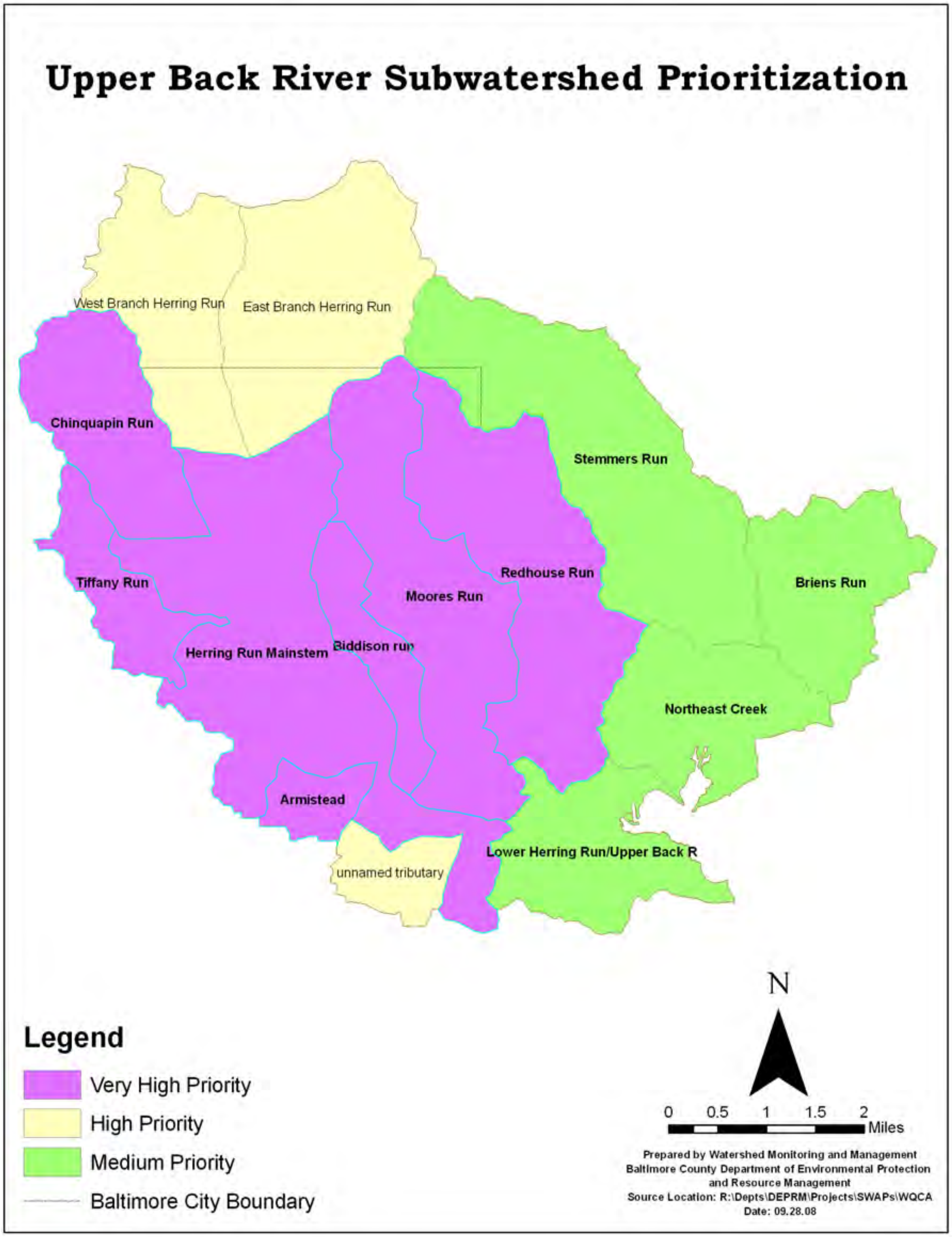


Figure 4-1: Subwatershed Prioritization Based on Scoring

4.3 Subwatershed Overviews

Subwatershed strategies are presented in this section with the subwatersheds arranged in alphabetical order. An initial table for each subwatershed presents basic profile information, including drainage area, stream length, land use, impervious cover, soils, stormwater management, and the percent distribution between Baltimore City and Baltimore County.

At the end of each subwatershed overview, the management strategy for that subwatershed is defined through a series of recommendations for citizen actions and municipal actions. A map showing the restoration opportunities locations follows the recommendations. Specific information on city streams was not included in this document, as the information was not available at the time the document was developed.

4.3.1 Armistead Run

Subwatershed Description

Armistead Run is a small industrialized subwatershed located entirely within the Baltimore City limits. The stream begins in the Orangeville Industrial Area off Edison Highway. From here, it flows east, intersects Erdman Ave. and turns northeast before flowing through the Armistead Gardens neighborhood and into Herring Run. Thirty-three percent of the stream buffer is forested. Table 4-4 presents the basic information on Armistead Run.

Table 4-4: Basic Profile of Armistead Run Subwatershed

Drainage Area	• 416.1 acres (0.7 mi^2)	
Stream length	• 1.45 miles	
Land Use	• Low-Density residential (0.0%) • Med-Density Residential (0.0%) • High-Density Residential (25.2%)	• Open Urban Land (30.4%) (includes forests) • Commercial (3.4%) • Industrial (57.5%)
Impervious Cover	• 37.3% of subwatershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (100%) • Baltimore County (0%)	
Soils	• A Soils – 0.0% • B Soils – 4.5%	• C Soils – 5.0% • D Soils – 90.6%
Stormwater management	• City - No existing stormwater facilities were identified • County - NA	

Neighborhood Assessments

Two (2) distinct neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance. NSA-L-63 has only 0.4 acres within the subwatershed boundary and is covered in the Herring Run Mainstem subwatershed section. Subwatershed boundaries were not used to designate neighborhood boundaries so some neighborhoods may exist in more than one subwatershed. Pollution prevention opportunities to address stormwater volume and pollutants include downspout disconnection, storm drain stenciling, street tree planting and buffer enhancement.

There are 1.98 impervious building acres in the neighborhood where downspout disconnection is recommended in Armistead Run. Based on an 85% potential for disconnection, 1.7 impervious building acres were deemed feasible for downspout disconnection. NSA-L-61 is a privately owned neighborhood so, similar to multi-family apartment neighborhoods; this would be a good area to target. Table 4-5 shows a summary of neighborhood recommendations.

Table 4-5. Summary of Neighborhood Assessment Recommendations in Armistead Run

Neighborhood Site ID	Median lot size (acres)	Recommended Actions									
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Pet Waste	Buffer Enhancement	Street Trees	Notes
NSA_L_186	1/4	85			X	X				10	
NSA_L_61	Multifam	50	X		X	X			X	0	Tree planting

Typical homes in NSA-L-61

Hot Spot Assessment

Table 4-6 shows the two sites assessed in Armistead Run for hot spot status. Both assessed as confirmed hot spots.

Table 4-6. Summary of Hotspot Sites Recommendations in Armistead Run

Status	Site ID	Description	Potential Sources of Pollution					
			Vehicle Operations	Outdoor Storage Materials	Waste Management	Physical Plant	Turf/Landscaping	Stormwater Management
Confirmed	HSI-L-201	Construction supply		X	X	X		X
Confirmed	HIS-L-202	Body shop/junkyard	X	X	X	X		X

Institutional Site Assessment

There were no institutional areas assessed in the Armistead Run subwatershed.

Stream Assessment

There were no stream assessments performed in Armistead Run.

Illicit Discharges

Baltimore City will continue with their Illicit Discharge Detection and Ellimination program, seeking to improve techniques and methodologies for more effective reductions of these discharges.

Stormwater Retrofits and Pond Conversions

There were no retrofit or pond conversion opportunities identified in Armistead Run.

Pervious Area Restoration

Table 4-7 shows the one possible pervious area restoration site identified during the assessment. It is a large parcel owned by AK Asset Management Company. Pervious area restoration has the potential to convert areas of turf, sometimes a relatively high nutrient input land use, to forest, which can absorb rather than shed nutrients.

Table 4-7. Summary of Pervious Area Recommendations in Armistead Run

Site	Location	Description	Size (acres)	Priority
PAA-L-201	Chase & Iris	Vacant lot	6.5	

Subwatershed Management Strategy

Implementation recommendations for the Armistead Run subwatershed are as follows:

Engaging Citizens & Watershed Groups

1. Conduct downspout disconnection in each of the two neighborhoods. Most of the lots in NSA-L-61 do not have room for downspout re-direction so rain barrels are recommended. NSA-L-186 has good potential for re-direction.
2. Address buffer encroachment in NSA-L-186 by increasing tree canopy and establishing no-mow areas where possible.
3. Investigate PAA-L-201 for tree-planting possibilities. Plant street trees in NSA-L-186 and encourage residential tree planting to expand lot canopies in NSA-L-61.
4. To address trash issues, engage citizens in a storm drain stenciling program and conduct stenciling activities in both neighborhoods. Educate citizens about trash.
5. Encourage residents to implement bayscaping on their properties.

Municipal Actions

1. Conduct follow-up investigations at the two hot spot sites as both were assessed as confirmed hot spots.
2. Implement or increase street sweeping in L-61.

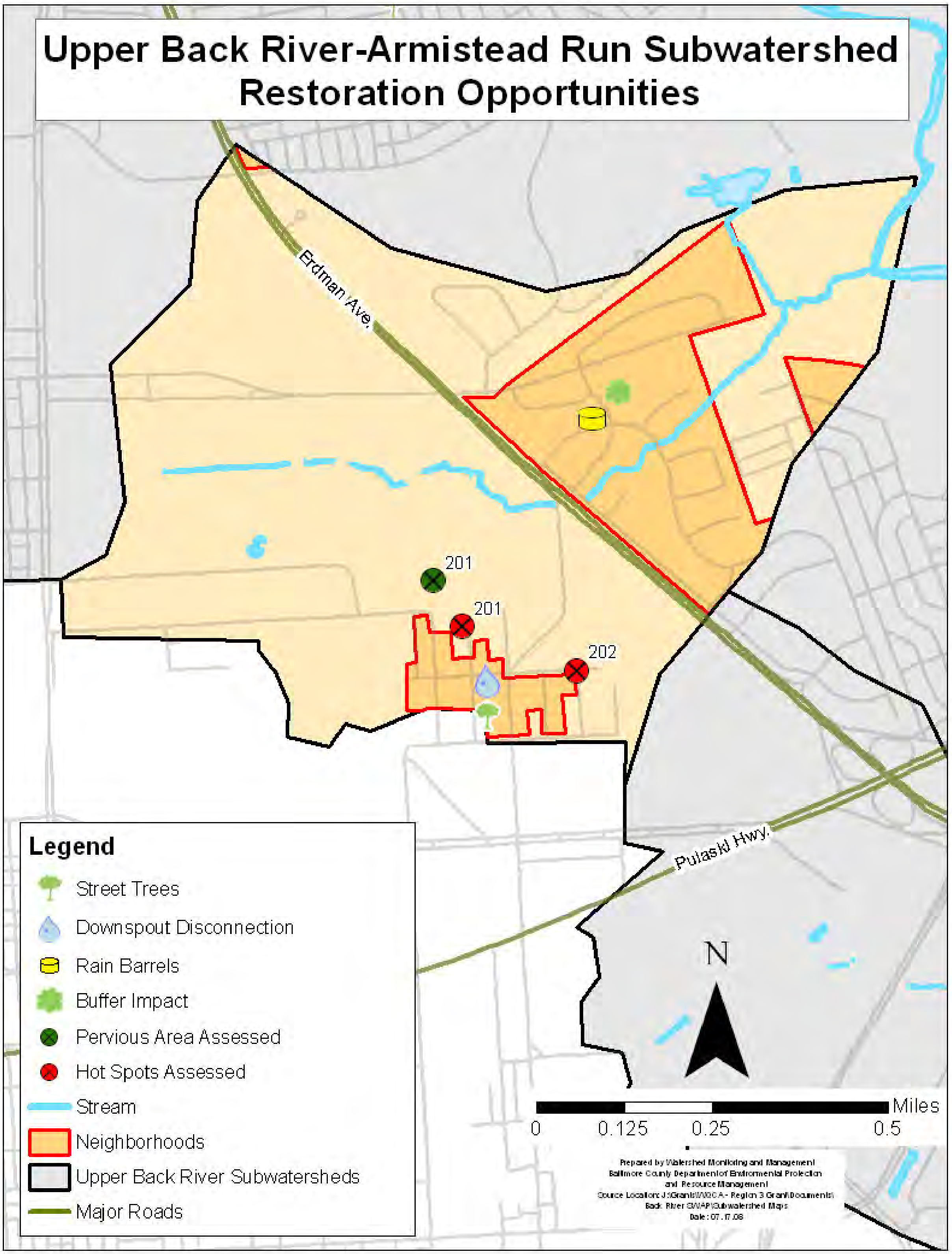


Figure 4-2 – Restoration Opportunities in Armistead Run

4.3.2 Biddison Run

Subwatershed Description

The Biddison Run stream is piped in the upper sections of the subwatershed. The stream is first daylighted in Gardenville off Sipple Ave. west of Frankford Ave. From here it passes behind the Holly Lane Apartments and follows a southerly flow passing beneath Sinclair La., past Franklin Elementary School and intersecting Moravia Rd. before joining Herring Run. 54% of the stream buffer is forested.

The northern half of Biddison where the stream is piped is almost all neighborhoods and as you travel south, the other land uses become evident. Table 4-8 displays the basic information on Biddison Run.

Table 4-8. Basic Profile of Biddison Run Subwatershed

Drainage Area	• 790.7 acres (1.2 mi^2)
Stream length	• 3.12 miles
Land Use	• Low-Density residential (0.0%) • Med-Density Residential (46.0%) • High-Density Residential (19.2%) • Open Urban Land (6%) (includes forests) • Commercial (16.1%) • Institutional (8.5%)
Current Impervious Cover	• 33.6% of subwatershed
Jurisdictions as Percent of Subwatershed	• Baltimore City (100%) • Baltimore County (0%)
Soils	• A Soils – 0.0% • B Soils – 6.7% • C Soils – 3.4% • D Soils – 89.9%
Stormwater management	• City - No existing stormwater facilities were identified • County - NA

Neighborhood Assessment

Nine (9) distinct neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance. Subwatershed boundaries were not used to designate neighborhoods so neighborhoods often exist in more than one subwatershed. Pollution prevention opportunities to address stormwater volume and pollutants include downspout disconnection, storm drain stenciling, tree planting and public education (i.e. nutrient management). There seems to be ample opportunity here for stenciling and downspout disconnection.

There are 44.8 impervious building acres in neighborhoods where downspout disconnection is recommended in Biddison Run. Based on an average of 69.5% potential for disconnection, 31 impervious building acres were deemed feasible for downspout disconnection. Disconnection efforts should first concentrate on the 2 multi-family neighborhoods due to the efficiencies achieved by coordinating with one landowner instead of individual homeowners. Table 4-9 shows a summary of neighborhood recommendations.

Table 4-9. Summary of Neighborhood Assessment Recommendations in Biddison Run

Site ID	Median lot size (acres)	Recommended Actions									
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Pet Waste	Buffer Enhancement	Trash Mgmt	Street Trees	Notes
NSA_L_150	1/3	60	X		X	X					0	Rust staining on streets & sidewalks
NSA_L_164	Multifam	95		X	X	X	X		X	X	0	Trash mgmt, stained lots
NSA_L_165	Multifam	100			X	X			X	X	0	Expand buffer, tree planting
NSA_L_78	<1/4	60		X	X	X					0	
NSA_L_79	<1/4	60			X						0	
NSA_L_82	<1/4	40	X		X		X				35	Alley retrofits
NSA_L_83	<1/8	75	X		X	X				X	0	Park/garden creation or trees, alley retrofits
NSA_L_85	<1/4	90	X		X	X	X			X	0	Gutter algae
NSA_L_86	<1/4	45			X	X			X		50	

Dry weather discharge and algae in NSA-L-85

alley retrofit opportunity in NSA-L-83

dumpsters over storm drain in NSA-L-164

Hot Spot Assessment

There were no sites assessed in Biddison Run for hot spot status.

Institutional Site Assessment

There were no institutional areas assessed in the Biddison Run subwatershed.

Stream Assessment

There were no stream assessments performed in the Biddison Run subwatershed.

Illicit Discharges

Baltimore City will continue with their Illicit Discharge Detection and Ellimination program, seeking to improve techniques and methodologies for more effective reductions of these discharges.

Stormwater Retrofits and Pond Conversions

There were two retrofit opportunities identified in Biddison Run and no pond conversions. Table 4-10 shows these retrofits.

Table 4-10. Summary of Retrofit Opportunities in Biddison Run

Site	Drainage Area (ac)	Description/Classification	Priority
R1	345	Wet Pond/Wetland	Medium
R3	1.5	Bioretention	Medium

Pervious Area Restoration

Table 4-11 shows the one possible pervious area restoration identified during the assessment. Pervious area restoration has the potential to convert areas of turf, sometimes a relatively high nutrient input land use, to forest which can absorb rather than shed nutrients.

Table 4-11. Summary of Pervious Area Recommendations

Site	Location	Description	Size (acres)	Priority
PAA-L-351	Off Sipple	Church open space	2	

PAA-L-351

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct downspout disconnection programs in each off the nine neighborhoods. Give priority to L-164 and L-165.
2. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs like The Growing Home Campaign and TreeBaltimore.
3. Engage citizens in a storm drain stenciling program and conduct stenciling activities in both neighborhoods.
4. Plant street trees in L-82 and L-86.
5. Investigate standing water/algae in L-85, Woodlea and Greenhill (see pic)
6. Reduce buffer encroachment by planting trees and establishing no-mow areas in neighborhoods listed in Table 4-9, especially L-165.
7. Address trash problems in neighborhoods indicated in Table 4-9.
8. Engage the 1st Church of God in potential tree plating on their property, PAA-L-351.
9. Investigate city trash truck depot off Moravia Rd for possible dumping/trash in stream and stream buffer area.

Municipal Actions

1. Conduct street sweeping in NSAs L-83, 85, 86 and 164.
2. Further investigate the possibility of implementing the two retrofits listed in Table 4-10.

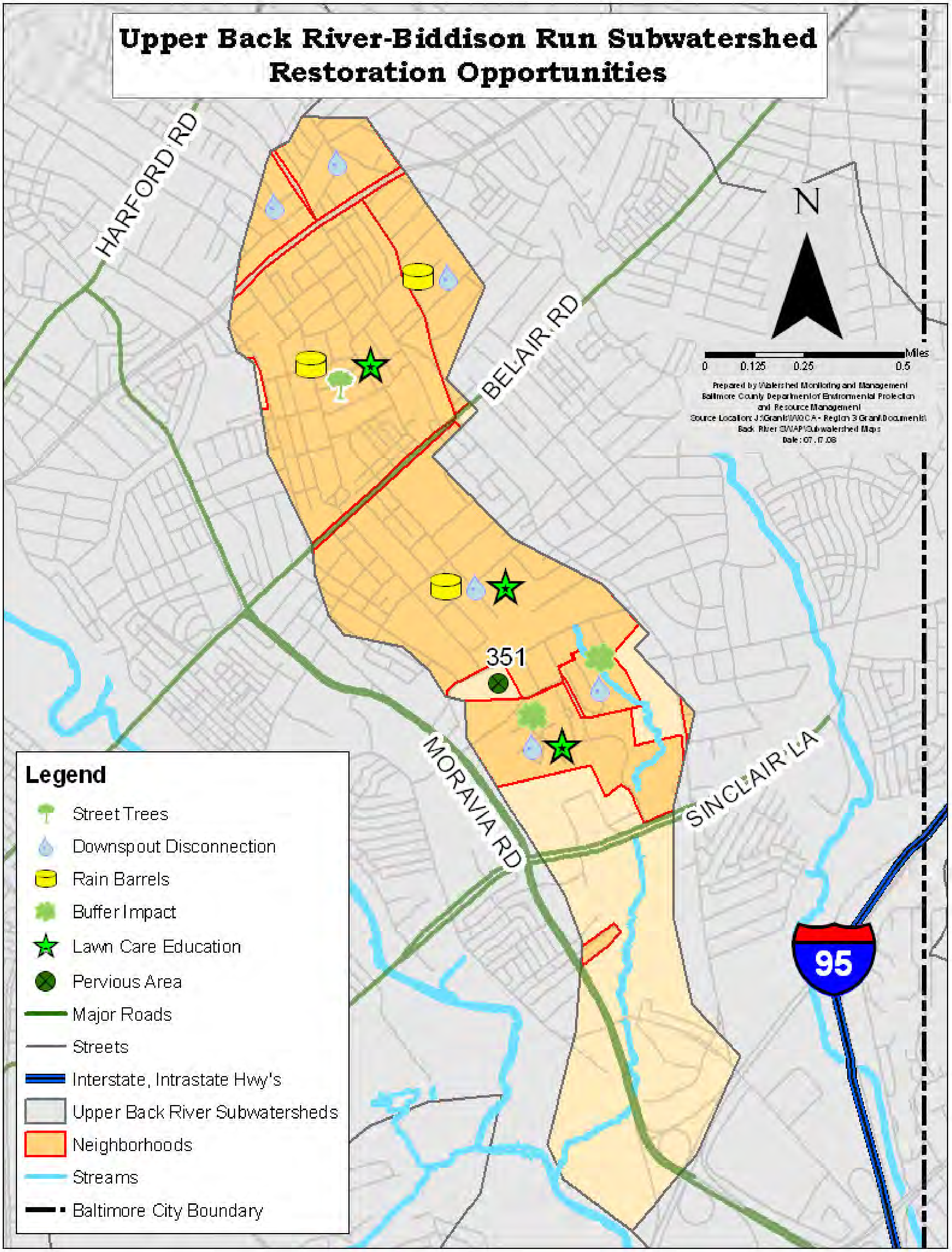


Figure 4-3 – Restoration Opportunities in Biddison Run

4.3.3 Briens Run

Subwatershed Description

Brien's Run begins below the intersection of Pulaski Highway and Middle River Road. From here, it flows southwest past Middle River Middle and Victory Villa Elementary Schools, past the Pulaski Industrial Park to the South and meets with Stemmers Run before entering Northeast Creek. 23% of the Brien's Run stream buffer is forested. 26% of the stream shows degrading vertical stability and 34% shows degrading lateral stability. Table 4-12 presents the basic information on Brien's Run.

Table 4-12. Basic Profile of Brien's Run Subwatershed

Drainage Area	• 1,636.1 acres (2.6 mi^2)	
Stream length	• 10.7 miles	
Land Use	• Low-Density residential (3.7%) • Med-Density Residential (2.5%) • High-Density Residential (36.4%)	• Open Urban Land (18.8%) (includes forests) • Commercial (11.2%) • Institutional (7.1%)
Current Impervious Cover	• 28.4% of subwatershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (0%) • Baltimore County (100%)	
Soils	• A Soils – 1.8% • B Soils – 27.8%	• C Soils – 53.7% • D Soils – 16.8%
Stormwater management	• County – 24.4% of the watershed is treated by stormwater facilities • City - NA	

Neighborhood Assessment

Eleven (11) distinct neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance. Subwatershed boundaries were not used to designate neighborhoods so some neighborhoods may exist in more than one subwatershed. Pollution prevention opportunities to address stormwater volume and pollutants include storm drain stenciling, rain barrels, street tree planting and public education (i.e. nutrient management).

Neighborhood NSA-L-39 has excellent opportunity to improve the buffer there. There is ample space for planting and the stream there looks unhealthy and cloudy. The tax parcel layer shows the area is zoned as unbuildable/environmentally constrained and no owner is indicated. Table 4-13 shows a summary of neighborhood recommendations.

Homes in NSA-L-44

Homes in NSA–L-208

Table 4-13. Summary of Neighborhood Assessment Recommendations

Recommended Actions												
Site ID	Median lot size (acres)	% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Pet Waste	Buffer Enhancement	Street Trees	Notes
NSA_L_129	Multifamily	0			X					10	Trash management
NSA_L_206	1/4	30		X	X		X			0	
NSA_L_207	1/2	50		X	X	X	X		X	0	
NSA_L_208	<1/4	80	X		X		X			0	New development, still building
NSA_L_39	<1/4	40	X			X	X		X	100	See PAA-L-701/ stream buffer
NSA_L_40	Multifamily	100	X							0	Trailer park
NSA_L_41	1/4	20			X	X	X			0	
NSA_L_42	<1/4	40	X		X	X				0	
NSA_L_43	1/4	65	X		X		X			15	New construction and SWM
NSA_L_44	<1/8	60	X		X					100	Alley retrofits
NSA_L_46	Multifamily	70	X		X		X			0	Dumping in wooded area/see PAA-L-702

Hot Spot Assessment

There were no hot spot investigations performed in Brien's Run.

Institutional Site Assessment

There were no institutional site assessments performed on Brien's Run.

Stream Assessment

A stream stability assessment was conducted by Parsons Brinkerhoff in the Brien's Run subwatershed. The subwatershed deficiencies as outlined in the report are as follows: 'Problems with the Brien's Run subwatershed include moderate stream bank erosion, various channel disturbances and fish blockages. Channel disturbances include invasive species and culverts causing fish blockages, as well as a large amount of waste and trash in some locations.'

Table 4-14. Summary of Stream Conditions in Brien's Run

Stream Opportunities	Number of Problems
Restoration/Stabilization	10
Buffer Enhancement	8
Bank Planting	2
Utility Conflicts	1
Wetland Enhancement	10
Yard Waste Education	23
Invasive Plant Removal	9
Trash Dumping	34

Illicit Discharges

Baltimore County uses a prioritization system for sampling outfalls for illicit discharges. Brien's Run contains five 'priority 2' outfalls and one 'priority 1' outfall. Priority 2 outfalls are sampled once per year and priority 1 outfalls are sampled four times per year.

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

Stormwater Retrofits and Pond Conversions

There were no retrofit opportunities identified in Brien's Run and 12 pond conversion opportunities. The conversion opportunities are displayed in Table 4-15.

Table 4-15. Summary of SWM Pond Conversion Opportunities in Brien's Run

Pond #	Drainage Area (ac)	Priority
803	1.7	High
793	3.6	High
792	3.7	High
686	1.9	High
685	2.9	High
553	9.0	High
456	1.5	Low
329	1.0	Low
554	2.9	Medium
974	2.1	Medium
692	3.7	Medium
544	2.9	Medium

Pervious Area Restoration

Table 4-16 shows the three possible pervious area restoration sites identified during the assessment. Pervious area restoration has the potential to convert areas of turf, sometimes a relatively high nutrient input land use, to forest, which can absorb rather than shed nutrients.

Table 4-16. Summary of Pervious Area Recommendations

Site	Location	Description	Size (acres)	Ownership
PAA_L_701	In NSA-L-39	Stream buffer	5.5	Public
PAA_L_702	In NSA-L-46	Forested area	1.5	Private
PAA_L_703	In NSA-L-207	Open area	1.5	Private

Subwatershed Management Strategy

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

1. Implement rain barrel education/supply initiative in neighborhoods indicated in Table 4-13 including instruction on proper usage of the barrel.
2. Increase tree canopies on private lots by educating citizens on how to plant and care for trees, the benefits of trees and about programs like The Growing Home Campaign.
3. Provide lawn care education to neighborhoods identified in Table 4-13 as needing nutrient management. Work with homeowners in these neighborhoods to reduce the amount of chemicals applied to their lawn and other pollution prevention measures.
4. Improve stream buffer by planting trees on public land in PAA-L-701.
5. Plant street trees in neighborhoods indicated in Table 4-13.

6. Engage citizens in a storm drain stenciling program and conduct stenciling activities in neighborhoods indicated in Table 4-13.
7. Address trash issues in NSAs L-129 and L-46.

Municipal Actions

1. Make contact with owner of PAA-L-702 and establish conservation easement on small forested area here.
2. Focus on high priority pond conversions for implementation.

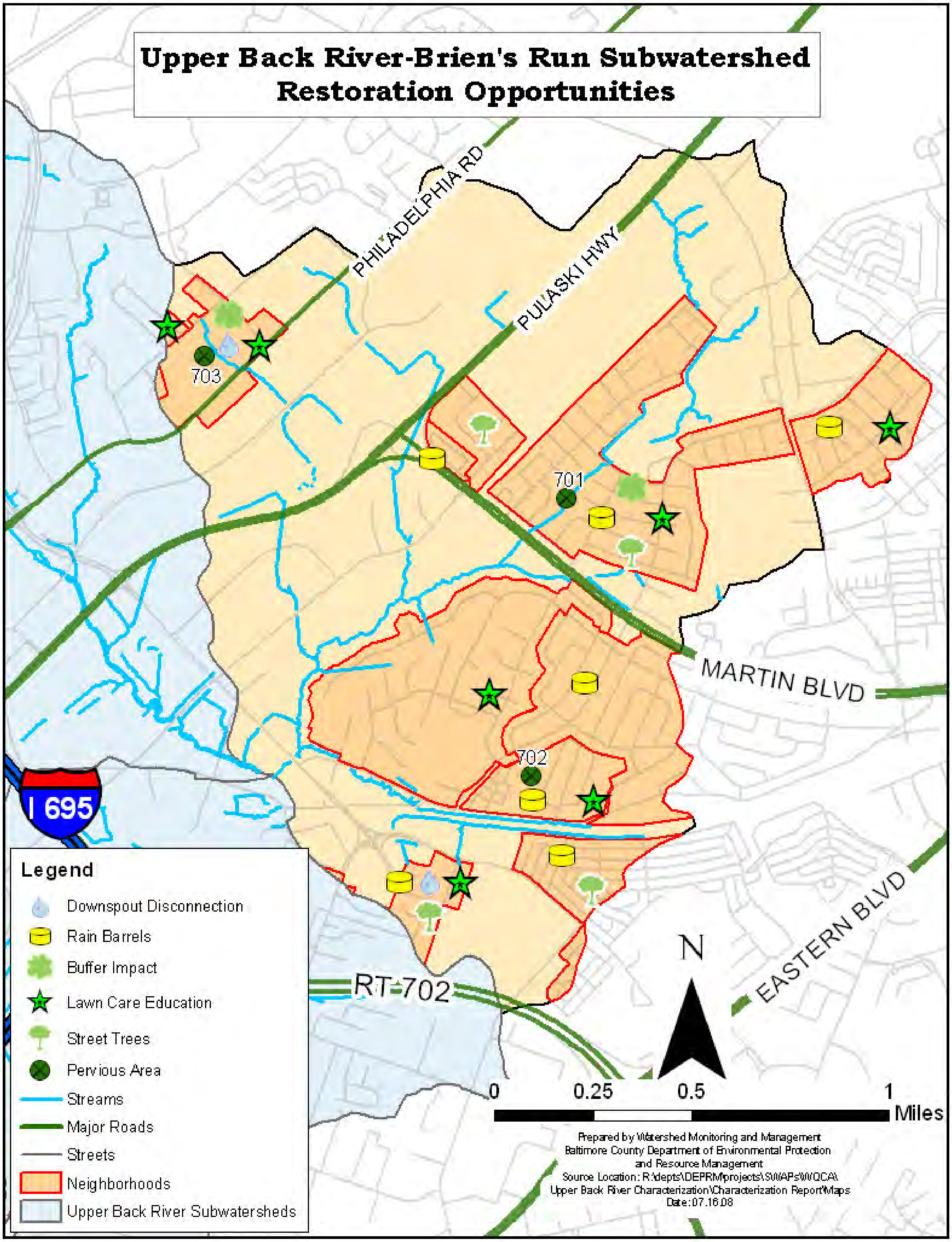


Figure 4-4 – Restoration Opportunities in Brien's Run

4.3.4 Chinquapin Run

Subwatershed Description

Chinquapin Run begins just north of the Baltimore City/ Baltimore County boundary near Regester Avenue. There are no open channels within the headwaters in Baltimore County, but the stream daylights just south of Walker Avenue at the City/ County line. The stream is bordered by City owned Chinquapin Park until it meets Hillen Road. At this point it is piped under Morgan State University until it meets the mainstem of Herring Run at the back end of the campus. (see pic)

This is primarily a residential watershed with several opportunities for downspout disconnection and storm drain stenciling within the neighborhoods. There are also numerous schools and churches with opportunities for tree planting and other onsite best management practices. Table 4-17 presents the basic information on Chinquapin Run.

Table 4-17. Basic Profile of Chinquapin Run Subwatershed

Drainage Area	• 1650 acres (2.5 mi^2)	
Stream length	• 4.94 miles	
Land Use	• Low-Density residential (0.0%) • Med-Density Residential (34.6%) • High-Density Residential (43.9%)	• Open Urban Land (7.6%) (includes forests) • Commercial (4.9%) • Institutional (8.1%)
Population	• 25,986 (2000 census)	
Current Impervious Cover	• 35.2% of subwatershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (78%) • Baltimore County (22%)	
Soils: Hydrologic Soil Group	• A Soils – 1.6% • B Soils – 19.3 %	• C Soils – 8.4% • D Soils – 70.7%
Stormwater management	• County - No existing stormwater facilities were identified • City - No existing stormwater facilities were identified	

Neighborhood Assessment

Thirty-two (32) distinct neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance. Subwatershed boundaries were not used to designate neighborhoods so some neighborhoods may exist in more than one subwatershed. Pollution prevention opportunities to address stormwater volume and pollutants include downspout disconnection, storm drain stenciling, tree planting and public education (i.e. nutrient management).

trash management problems in NSA-L-110A

Morgan State construction project in Chinquapin Run buffer area where it joins Herring Run

There are 116.8 impervious building acres in Chinquapin Run. Many of the neighborhoods in Chinquapin Run were assessed using the NSA jr form, which does not require a percent downspout disconnection number hence the 'nd' or no data entries in this associated column. Therefore the average percentage for potential for disconnection is not included here. However, disconnection efforts should first concentrate on the 14 multi-family neighborhoods due to the efficiencies achieved by coordinating with one landowner instead of individual homeowners. NSA-L-110A, the Kensington Gate Apartments, shows great potential for multiple restoration opportunities. Table 4-18 shows a summary of neighborhood recommendations.

Table 4-18. Summary of Neighborhood Assessment Recommendations

Site ID	Median lot size (acres)	Recommended Actions									Notes
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Parking Lot Retrofits	Alley Retrofits	Street Trees	
NSA_L_109	Multifamily	X			X	X		X		10	Downspout disconn
NSA_L_110A	Multifamily	X						X		0	Trash mgmt/SW
NSA_L_110B	Multifamily	nd							X	0	Impervious removal/alley
NSA_L_112	<1/4	30		X	X	X				0	Concrete buffer in park/
NSA_L_116	Multifamily	X				X		X		0	Tree planting/downspout
NSA_L_117	Multifamily	X			X			X		0	Downspout
NSA_L_130	<1/8	nd			X				X	0	Alley retrofit
NSA_L_136	1/3	80		X			X			0	
NSA_L_137	1/3	80			X		X			0	
NSA_L_149A	Multifamily	nd	X					X		0	SW retrofit
NSA_L_149B	<1/4	X			X	X				0	
NSA_L_22	<1/8	nd	X							0	Downspout disconn
NSA_L_23	<1/8	75			X	X				0	Tree planting
NSA_L_28	1/4	75			X		X			0	
NSA_L_29	Multifamily	50	X		X		X	X		0	Lot retrofit/tree planting
NSA_L_30	Multifamily	50	X		X		X		X	0	Street sweeping/alley
NSA_L_31	1/8	45			X				X	0	Alley retrofits
NSA_L_32	1/4	85	X	X		X				50	
NSA_L_33	1/8	nd	X			X				0	
NSA_L_34	<1/8	nd	X		X				X	0	
NSA_L_35	1/8	50			X	X			X	0	
NSA_L_36	<1/8	nd	X		X				X	0	Alley retrofit
NSA_L_38	<1/8	nd	X		X				X	50	
NSA_L_49	<1/4	X		X	X					0	Trash mgmt
NSA_L_50A	Multifamily	X						X		0	Downspout disconn
NSA_L_50B	<1/4	70			X	X				0	
NSA_L_51	1/4	X			X					nd	Street sweeping/street trees
NSA_L_93	Multifamily	X			X			X		25	Sediment control
NSA_L_94	Multifamily	nd	X		X					75	
NSA_L_95	Multifamily	X	X				X			0	Tree planting
NSA_L_96	Multifamily	nd					X			20	Tree planting
NSA_L_97	Multifamily	X						X		0	Downspout disconn

Hot Spot Assessment

No sites were assessed in Chinquapin Run for hot spot status. Less than 5% of the watershed is in commercial land use with the remaining area in residential or institutional land cover.

Institutional Site Assessment

Table 4-19 shows the nine institutional areas assessed in the Chinquapin Run subwatershed. Several properties offer opportunities to plant upwards of one hundred trees. The Maryland Youth Residence Center offers several opportunities that include infrastructure maintenance. Perhaps an incentive to become a registered Green School could be used to improve the campus.

Table 4-19. Summary of Recommendations for Schools and Places of Worship

Site ID	Name of Site	Public/ Private	Greening Opportunities						
			Nutrient Management	Tree Planting (#)	Stormwater Retrofit	Downspout Disconnection	Impervious Cover Removal	Trash Management	Notes
ISI_L_103	St. Pius Church	Private	Y	145	Y	N	Y	N	SWM needed for parking lot
ISI_L_104	Nothside Baptist Church	Private	N	170	N	N	N	Y	Dumping and Invasive removal
ISI_L_105	Leith Walk Rec Center	Public	N	245	N	N	Y	Y	Trash and debris in gutters
ISI_L_106	Govans Elementary	Public	N	15	N	N	N	N	Reseed small field
ISI_L_107	MD Youth Residence Center	?	N	105	N	Y	N	Y	Debris in gutters, sediment, trash,
ISI_L_108	Messiah Evangelical	Private	N	105	N	N	N	N	Tree planting
ISI_L_109	Lois T. Murphy Special Ed. School	Public	N	62	N	N	N	N	Tree Planting
ISI_L_110	St. Mathews Church & School	Private	N	N	N	Y	N	Y	Dumpster near inlet
ISI_L_111	Faith Presbyterian	Private	N	25	N	Y	?	N	Debris in gutters

Tree planting opportunity at ISI-L-103

Impervious removal and good housekeeping at ISI-L-105

Stream Assessment

A stream stability assessment was not conducted for the Chinquapin Run watershed. The subwatershed consists of one open channel and the remaining drainage system is piped. The open channel lies entirely within Baltimore City. It has been evaluated from previous field inspections and determined to not have bank erosion problems. Therefore there are no stream opportunities identified for the Chinquapin Run in this report.

Illicit Discharges

Baltimore County uses a prioritization system for sampling outfalls for illicit discharges. Priority one describes an outfall with major problems including the presence of chemicals in the water. Priority two describes outfalls with moderate problems including erosion and trash but no chemical problems detected. Priority 1 outfalls are sampled four times per year and priority 2 outfalls are sampled once per year. There are no priority 1 or priority 2 outfalls in the county portion of Chinquapin Run.

Baltimore County and Baltimore City will continue with their Illicit Discharge Detection and Elimination programs, seeking to improve techniques and methodologies for more effective reductions of these discharges.

Stormwater Retrofits and Pond Conversions

There were nine retrofit opportunities identified in Chinquapin Run and no pond conversions. Table 4-20 shows these retrofits.

Table 4-20. Summary of Retrofit Opportunities in Chinquapin Run

Site	Drainage Area (ac)	Description/Classification	Priority
R3B	45	Wet Pond/Wetland	High
R6A	84	Wet Pond/Wetland	Medium
R2B	53	Wet Pond/Wetland	Medium
R6B	300	Wet Pond/Wetland	Low
R6C	68	Wet Pond/Wetland	Low
R8	82.8	Wet Pond/Wetland	Low
R2A	3.8	Bioretention	Low
R5	44	Wet Pond/Wetland	Low
R9	1.0	Enhancement	Medium

Pervious Area Restoration

Table 4-21 shows the five possible pervious area restorations identified during the assessment. Pervious area restoration has the potential to convert areas of turf, sometimes a relatively high nutrient input land use, to forest, which can absorb rather than shed nutrients.

Table 4-21. Summary of Pervious Area Recommendations

Site	Location	Description	Size (acres)	Ownership
PAA_L_101	Kitmore Rd.	Buffer area of stream	0.75	Public
PAA_L_102	Northwood & Woodbourne	Open space behind townhomes	0.50	Unknown
PAA_L_103	Bradhurst Rd.	Walter De Wees Park	2.00	Public
PAA_L_104	Northwood ES	Open space by school	6.00	Public
PAA_L_105	Behind Alameda Shopng Cntr	Impervious area removal necessary	1.00	Private

PAA-L-101

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures according to Table 4-18, focusing efforts on the multi-family neighborhoods.
2. Engage citizens in a storm drain stenciling program and conduct stenciling activities in the neighborhoods indicated in Table 4-18.
3. Plant street trees in the neighborhoods indicated in Table 4-18. There is an estimated potential for 320 street trees in this subwatershed.
4. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs like The Growing Home Campaign and TreeBaltimore.
5. Examine parking lot and alley retrofit opportunities outlined in Table 4-18. Baltimore City's Alley Gating and Greening Program could be of assistance here.
6. Further investigate 5 pervious areas in Table 4-21 for tree plating opportunities. Give priority to those on public land.
7. Table 4-19 identifies schools and churches assessed through the ISI. Leith Walk Rec Center and the Maryland Youth Resident Center each show multiple opportunities for watershed restoration activities.

Municipal Actions

1. Conduct street sweeping in NSAs L-28-30, 49 and 51.
2. Further investigate retrofit opportunities listed in Table 4-20 for implementation.

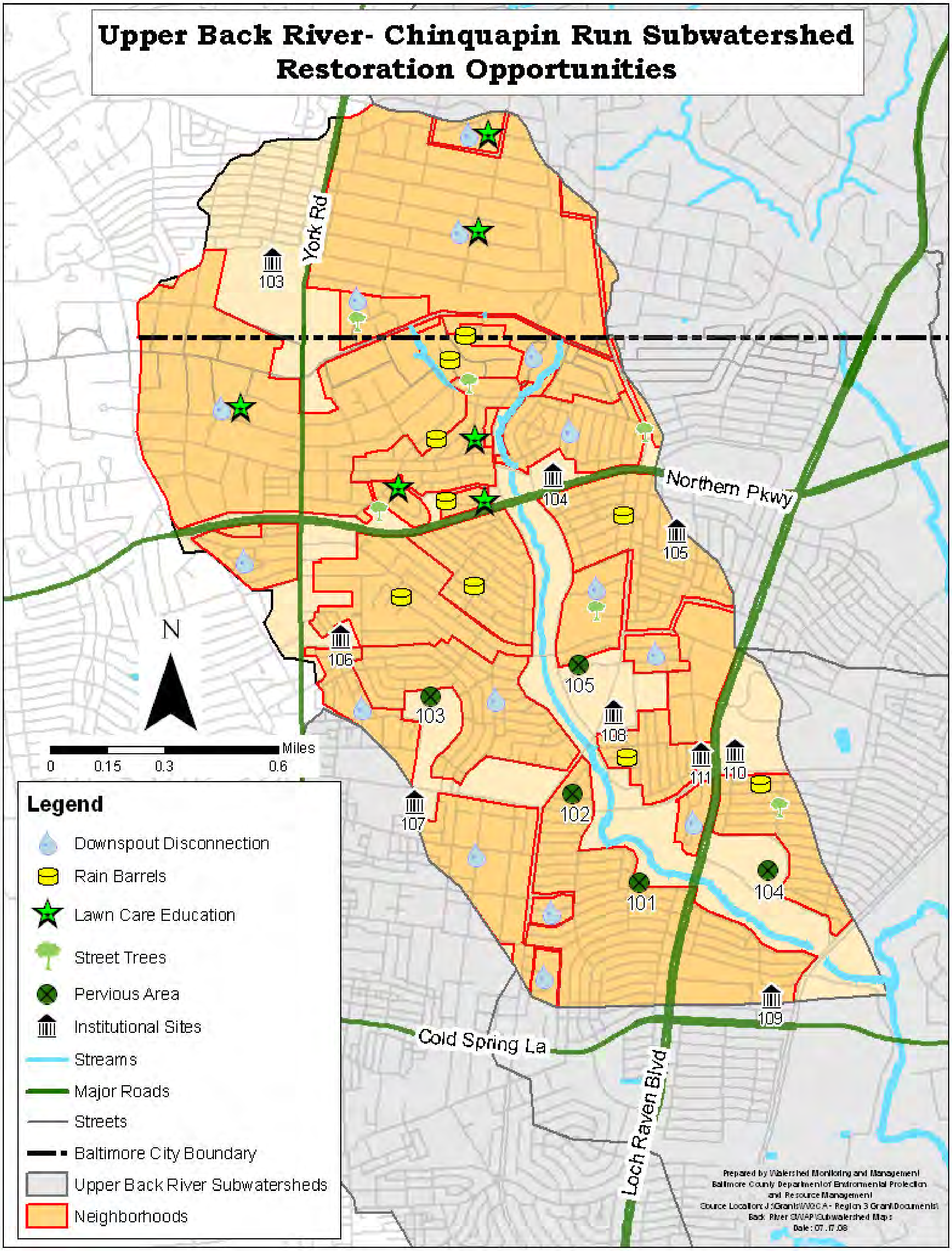


Figure 4-5 – Restoration Opportunities in Chinquapin Run

4.3.5 East Herring Run

Subwatershed Description

The Herring Run East stream begins in the proximity of the Perring Parkway/I695 interchange. From here it flows south along Perring Parkway and down behind the Perring Racquet club. The flow path turns to the west here and joins a smaller tributary of East Herring Run. This smaller tributary begins at the Baltimore County Public Library on Taylor Avenue and flows south. From the confluence of these two tributaries, East Herring Run flows south along the eastern side of Mount Pleasant Golf Course. Only 20% of the stream buffer is forested. This is tied for the lowest percentage in the entire Upper Back River. Table 4-22 presents the basic information on East Herring Run.

Table 4-22. Basic Profile of Herring Run East Subwatershed

Drainage Area	• 2690.4 acres (4.2 mi^2)	
Stream length	• 11.6 miles	
Land Use	• Low-Density residential (0.0%) • Med-Density Residential (38.7%) • High-Density Residential (29.0%)	• Open Urban Land (14.8%) (includes forests) • Commercial (8.2%) • Institutional (8.3%)
Current Impervious Cover	• 32.1% of subwatershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (81%) • Baltimore County (19%)	
Soils	• A Soils – 9.6% • B Soils – 21.4%	• C Soils – 41.4% • D Soils – 27.2%
Stormwater management	• City - No existing stormwater facilities were identified • County - Only 0.9% of the county portion of the watershed is treated by stormwater facilities	

Neighborhood Assessment

Thirty-three (33) distinct neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance. Subwatershed boundaries were not used to designate neighborhood boundaries so some neighborhoods may exist in more than one subwatershed. Pollution prevention opportunities to address stormwater volume and pollutants include downspout disconnection, storm drain stenciling, tree planting and public education (i.e. nutrient management). Buffer improvement and lot retrofits along with downspout disconnection seem to be the best opportunities here.

There are 164.6 impervious building acres in neighborhoods where downspout disconnection is recommended in Herring Run East. Based on an average of 51.7% potential for disconnection, 85 impervious building acres were deemed feasible for downspout disconnection. Disconnection efforts should first concentrate on the multi-family neighborhoods with high opportunities for disconnection due to the efficiencies achieved by coordinating with one landowner instead of individual homeowners. NSA-L-121, although 100% disconnected, shows many opportunities including lot retrofits, tree plantings and buffer improvement. Table 4-23 shows a summary of neighborhood recommendations.

Table 4-23. Summary of Neighborhood Assessment Recommendations

Site ID	Median lot size (acres)	Recommended Actions									Notes
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Pet Waste	Buffer Enhancement	Street Trees	
NSA_L_100	Multifam	30		X	X	X			X	0	Dumpsters and mulch piles drain to stream
NSA_L_101	Multifam	10		X		X				0	Trees & bayscaping
NSA_L_102A	Multifam	40		X	X	X	X		X	0	Trees/buffer
NSA_L_102B	Multifam	10		X	X	X			X	0	Plant stream buffer
NSA_L_103	Multifam	80	X		X	X				0	Trash mgmt/bioretention
NSA_L_104A	Multifam	90			X	X				0	Trash mgmt
NSA_L_104B	Multifam	90			X	X				0	Trash mgmt
NSA_L_105	Multifam	100		X		X				0	trees
NSA_L_106A	Multifam	100			X	X				10	bioretention
NSA_L_106B	Multifam	100				X				0	
NSA_L_121	Multifam	0			X		X		X	0	Lot retrofits/increase buffer, no-mow/tree plantings
NSA_L_140	1/8	50			X	X	X			50	
NSA_L_141	1/4	60			X					50	
NSA_L_142	<1/8	25			X		X			75	Alley retrofits
NSA_L_143	<1/8	10			X		X			75	Alley retrofits
NSA_L_144	1/4	20		X	X		X		X	0	Buffer enhancement
NSA_L_145	1/2	15		X					X	50	Stream naturalization/buffer planting,no-mow
NSA_L_146	<1/8	25	X		X		X	X		100	Alley retrofits/street trees
NSA_L_147	1/2	95		X		X			X	0	Community garden
NSA_L_148	1/3	30		X		X				0	
NSA_L_19	1/8	40	X	X		X		X	X	75	Street and yard trees/buffer improvement
NSA_L_198	1/4	45			X		X			25	
NSA_L_25	1/3	85		X	X	X	X		X	0	Tree planting/stream
NSA_L_26	<1/8	85	X						X	50	
NSA_L_27	1/2	20		X	X	X	X	X	X	20	
NSA_L_69	Multifam	100		X	X	X				0	Stormwater planters
NSA_L_70	1/8	20			X	X				100	Tree plantings
NSA_L_71	Multifam	50		X	X	X			X	0	
NSA_L_72	<1/4	55		X	X	X				150	
NSA_L_73	1/4	60			X	X	X		X	50	Buffer education, no-mow, buffer plantings
NSA_L_74	1/8	40			X	X			X	100	
NSA_L_75	<1/4	60				X				50	

Site ID	Median lot size (acres)	Recommended Actions									
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Pet Waste	Buffer Enhancement	Street Trees	Notes
NSA_L_99	Multifam	65		X	X	X	X			50	

Hot Spot Assessment

Table 4-24 shows the one site assessed in Herring Run East for hot spot status, a car repair shop on Old Harford Rd. The assessment determined the site to be a confirmed hot spot due to the numerous potential sources of pollution.

Table 4-24. Summary of Hotspot Sites Recommendations

Status	Site ID	Description	Potential Sources of Pollution					
			Vehicle Operations	Outdoor Storage Materials	Waste Management	Physical Plant	Turf/Landscaping	Stormwater Management
Confirmed	HSI_L_504	car repair	X	X	X	X		X

community garden or tree plating opportunity NSA-L-26

concrete channel in NSA-L-145

Institutional Site Assessment

Table 4-25 shows the ten institutional areas assessed in the Herring Run East subwatershed.

Table 4-25. Summary of Recommendations for Schools and Places of Worship

Site ID	Name of Site	Public/ Private	Greening Opportunities						
			Nutrient Management	Tree Planting (#)	Stormwater Retrofit	Downspout Disconnection	Impervious Cover Removal	Trash Management	Notes
ISI_L_505	Pleasant Plains ES	Public	Y	200	X				
ISI_L_506	Halstead Academy	Public	N	100	X				
ISI_L_511	Villa Cresta ES	Public	Y	200	X				naturalize drainage channel
ISI_L_512	Former Loch Raven ES	Private	Y	100					
ISI_L_523	St. Andrews Lutheran	Private	N	117		X			
ISI_L_524	Moreland Memorial Cemetary	Private	Y	75					sediment control, buffer planting
ISI_L_525	Oakleigh ES	Public	Y	180					gutter cleaning
ISI_L_526	White Oak	Public	Y	425					storm drain stenciling
ISI_L_531	Babcock Presb.	Private	N	150		X			
ISI_L_532	Immaculate Heart of Mary	Private	N	150				X	storm drain stenciling

Stream Assessment

A stream stability assessment was conducted by Parsons Brinkerhoff in the county portion of the Herring Run subwatershed. The stream assessment performed did not discern between the Eastern and Western Branches, so the data is presented here as a combination of those two subwatersheds.

The subwatershed deficiencies as outlined in the PB report are as follows:
Problems with the Herring Run subwatershed include moderate bank erosion potential, various channel disturbances, fish blockages and only 67% of in stream habitat rated fair. Channel disturbances include culverts causing fish blockages and invasive plants. Table 4-26 shows the number of opportunities identified through the stream assessment.

Table 4-26. Summary of Stream Conditions in Herring Run

Stream Opportunities	Number of Problems (reach length ft)
Restoration/Stabilization	24
Buffer Enhancement	5
Bank Planting	54
Utility Conflicts	0
Wetland Enhancement	5
Yard Waste Education	13
Invasive Plant Removal	17
Trash Dumping	25

Illicit Discharges

Baltimore County uses a prioritization system for sampling outfalls for illicit discharges. Priority one describes an outfall with major problems including the presence of chemicals in the water. Priority two describes outfalls with moderate problems including erosion and trash but no chemical problems detected. Priority 1 outfalls are sampled four times per year and priority 2 outfalls are sampled once per year. There are four priority 2 outfalls in the county portion of Herring Run East and no priority 1 outfalls.

Baltimore County and Baltimore City will continue with their Illicit Discharge Detection and Elimination programs, seeking to improve techniques and methodologies for more effective reductions of these discharges.

Stormwater Retrofits and Pond Conversions

There were nine retrofit opportunities identified in Chinquapin Run and no pond conversions. Table 4-27 shows these retrofits.

Table 4-27 Summary of Retrofit Opportunities in Chinquapin Run

Site	Drainage Area (ac)	Description/Classification	Priority
R28A	100	Wetpond/Wetland	Low
R29B	1.8	Permeable Pavement	Medium
R29D	0.1	Permeable Pavement	Medium
R29C	0.25	Bioretention	Medium
R28B	37	Wetpond/Wetland	Medium
R3	1.0	Bioretention	Medium
R29A	1.1	Bioretention	Medium
R37	0.8	Bioretention	Medium
R2B	1.0	Dry Swale	Medium

Pervious Area Restoration

Table 4-28 shows the three possible pervious area restoration sites identified during the assessment. Site 507 is a forested area owned by St. Margaret's Episcopal Church worthy of preservation. Pervious area restoration has the potential to convert areas of turf, sometimes a relatively high nutrient input land use, to forest, which can absorb rather than shed nutrients.

Table 4-28. Summary of Pervious Area Recommendations

Site	Location	Description	Size (acres)	Ownership
PAA-L-507	Off Joppa near 695	Church forested area	2	Private
PAA-L-508	End of Clearwood	Park area	4	Public
PAA-L-509	Putty Hill & Kendale	Lg median between 2 roads	2	Public

Subwatershed Management Strategy

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

1. Reduce the unforested buffer area. Investigate neighborhoods shown in Table 4-23 to be encroaching on the buffer and extend/plant the buffer wherever possible.
2. Conduct appropriate downspout disconnection measures according to Table 4-23, focusing efforts on the multi-family neighborhoods. There are many opportunities for rain gardens in this subwatershed.
3. Engage citizens in a storm drain stenciling program and conduct stenciling activities in the neighborhoods indicated in Table 4-23.
4. Plant street trees. Table 4-23 shows a potential for over 1000 street trees plantings.

5. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs like The Growing Home Campaign and TreeBaltimore.
6. Educate citizens on the benefits of bayscaping and implement a program to encourage the establishment of bayscaping on resident's private lots.
7. Engage Institutions sited in Table 4-25 in respective restoration efforts, especially tree plantings.
8. Investigate three pervious areas listed in Table 4-28 for potential tree plantings; giving primary consideration to the two areas listed as public property.

Municipal Actions

1. Conduct stream restorations at opportunity sites listed in Table 4-26 and in further detail in Appendix G.
2. Investigate medium priority retrofits listed in Table 4-27 for implementation possibilities.

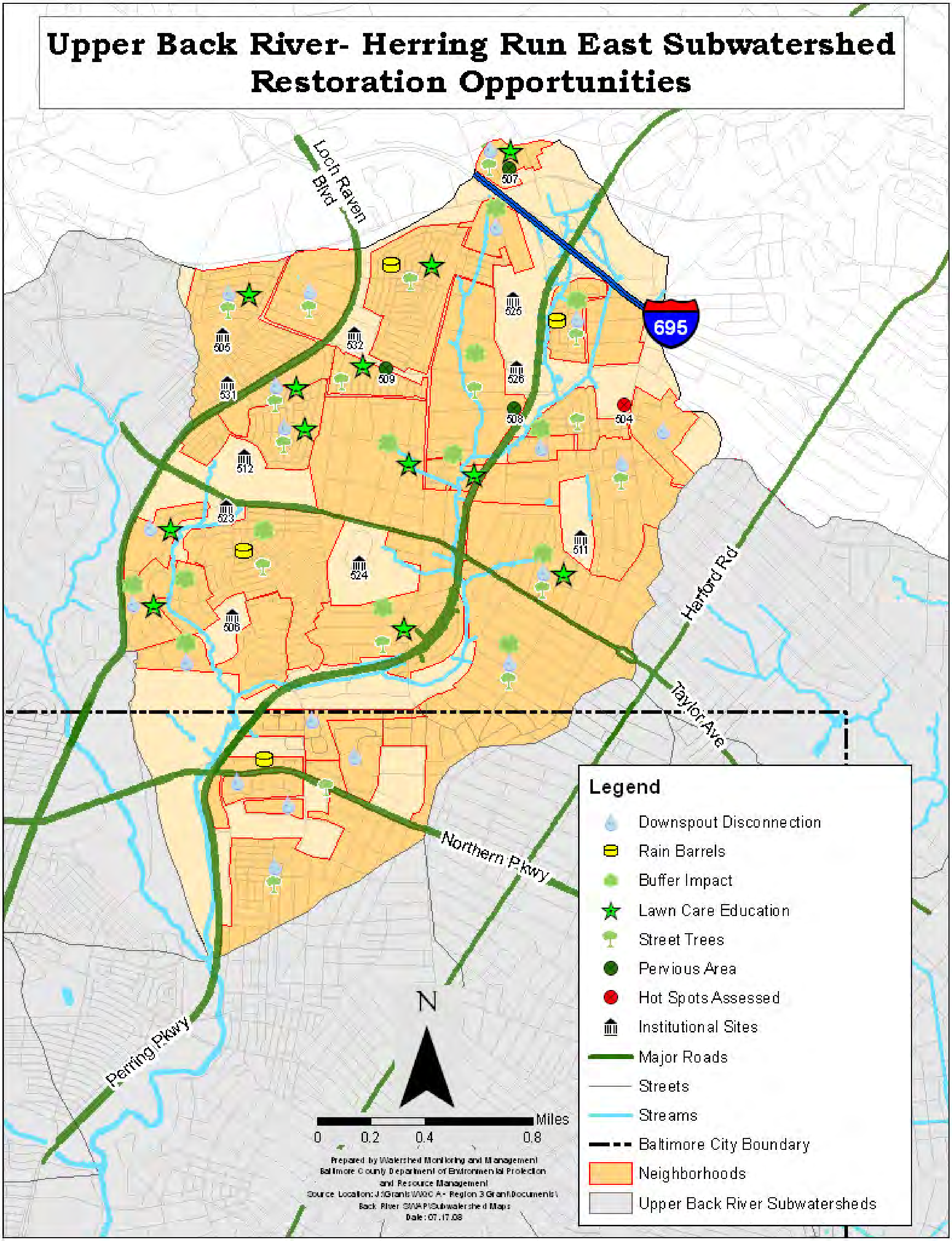


Figure 4-6 – Restoration Opportunities in the East Herring Run Subwatershed

4.3.6 Herring Run Mainstem

Subwatershed Description

The Herring Run mainstem is the largest of the subwatersheds in this SWAP. Beginning at the confluence of the Herring Run East and Herring Run West streams, which is at the southern end of Mt. Pleasant golf course, the Herring Run mainstem flows past the Morgan State University campus and through Herring Run Park crossing Harford Rd, Belair Rd and Sinclair La. Before entering the tidal Back River area, the Herring Run mainstem passes beneath 895, Rt. 40, and I 95.

This is a highly urbanized and impacted subwatershed with over 25% of the land use designated as high density residential. Table 4-29 presents the basic information the Herring Run mainstem.

Table 4-29 Basic Profile of Herring Run Mainstem Subwatershed

Drainage Area	• 4431.2 acres (6.9 mi^2)	
Stream length	• 17.1 miles	
Land Use	• Low-Density residential (0.0%) • Med-Density Residential (25.0%) • High-Density Residential (25.4%)	• Open Urban Land (21.7%) (includes forests) • Commercial (10.4%) • Institutional (11.4%)
Current Impervious Cover	• 35.0% of subwatershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (97%) • Baltimore County (3%)	
Soils	• A Soils – 0.6% • B Soils – 10.9%	• C Soils – 5.9% • D Soils – 80.9%
Stormwater management	• City - No existing stormwater facilities were identified • County - Only 9% of the county portion of the watershed is treated by stormwater facilities	

Neighborhood Assessment

Thirty-nine (39) distinct neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance. Subwatershed boundaries were not used to designate neighborhood boundaries so some neighborhoods may exist in more than one subwatershed. Pollution prevention opportunities to address stormwater volume and pollutants include downspout disconnection, storm drain stenciling, tree planting and public education (i.e. nutrient management).

There are 285.4 impervious building acres in neighborhoods where downspout disconnection is recommended in Herring Run Mainstem. Based on an average of 68.4% potential for disconnection, 195 impervious building acres were deemed feasible for downspout disconnection. Disconnection efforts should first concentrate on the multi-family neighborhoods with high opportunities for disconnection due to the efficiencies achieved by coordinating with one landowner instead of individual homeowners. NSA-L-61 is a privately owned neighborhood so, similar to multi-family apartment neighborhoods, this would be a good area to target. Table 4-30 shows a summary of neighborhood recommendations for the Herring Run Mainstem.

Table 4-30. Summary of Neighborhood Assessment Recommendations

Site ID	Median lot size (acres)	Recommended Actions									
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Street Sweeping	Buffer Enhancement	Street Trees	Notes
NSA_L_110B	Multifam	nd								0	Impervious removal/alley retrofit
NSA_L_111	Multifam	100		X		X				0	
NSA_L_117	Multifam	nd			X					0	Downspout disconn/bioretention/tree
NSA_L_118	Multifam	nd		X	X				X	0	Tree planting/curb cut opportunity
NSA_L_130	<1/8	nd			X					0	Alley retrofit
NSA_L_164	Multifam	95		X	X	X	X	X	X	0	Trash Mgmt, stained lots
NSA_L_168	<1/4	90	X							5	Alley retrofit
NSA_L_172	1/8	nd			X			X		0	Cnvert open space & condemned homes to parks
NSA_L_175	<1/8	75			X	X				0	Plant empty parcels
NSA_L_176	<1/8	100			X					0	Trees in common areas
NSA_L_20	<1/4	40		X	X		X	X		0	
NSA_L_21	<1/8	80			X	X	X	X		80	
NSA_L_37	1/8	80	X	X		X				20	
NSA_L_38	<1/8	nd	X		X					50	Downspout disconn
NSA_L_51	1/4	nd			X			X		nd	Street trees
NSA_L_54	<1/8	50	X		X			X		0	Street sweeping
NSA_L_55	<1/8	75	X		X			X		0	Trash
NSA_L_56	1/4	95		X	X		X			50	
NSA_L_57	<1/4	50	X		X			X		50	
NSA_L_58	<1/8	50	X		X					50	Trash/dumping in wooded area
NSA_L_59	<1/8	50	X		X					50	
NSA_L_60	<1/8	70	X		X					50	
NSA_L_61	Multifam	50	X		X	X		X	X	0	Tree planting
NSA_L_63	<1/8	85	X		X			X		60	Park creation 2 diff open
NSA_L_64	<1/8	50	X		X					50	
NSA_L_65	<1/8	100	X		X	X				0	Alley retrofit, imp cover
NSA_L_66A	<1/8	50	X		X					0	Heavy oil stains, trash, alley
NSA_L_66B	1/4	65			X	X				25	
NSA_L_67	<1/4	45	X			X		X		40	
NSA_L_68	<1/8	60	X		X		X			10	
NSA_L_75	<1/4	60				X		X		50	
NSA_L_76	1/4	50		X		X				40	
NSA_L_77	1/4	50		X	X	X	X	X		25	
NSA_L_78	<1/4	60		X	X	X				0	

Site ID	Median lot size (acres)	Recommended Actions									
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Street Sweeping	Buffer Enhancement	Street Trees	Notes
NSA_L_79	<1/4	60			X					0	
NSA_L_82	<1/4	40	X		X		X			35	Alley retrofits
NSA_L_83	<1/8	75	X		X	X		X		0	Open space for planting
NSA_L_84	Multifam	100		X		X				0	Park/garden creation, open space trees
NSA_L_85	<1/4	90	X		X	X	X	X		0	Gutter algae water

impervious cover removal potential in NSA-L-65

Hot Spot Assessment

Table 4-31 shows the three sites assessed in Herring Run Mainstem for hot spot status. All three assessed as confirmed hot spots.

Table 4-31. Summary of Hotspot Sites Recommendations

Status	Site ID	Description	Potential Sources of Pollution					
			Vehicle Operations	Outdoor Storage Materials	Waste Management	Physical Plant	Turf/ Landscaping	Stormwater Management
Confirmed	HSI-L-503	junkyard	X	X	X	X		X
Confirmed	HSI-L-505	Vehicle storage	X	X	X	X		X
Confirmed	HIS-L-506	junkyard	X	X	X	X		X

Institutional Site Assessment

Table 4-32 shows the five institutional areas assessed in the Herring Run West subwatershed.

Table 4-32. Summary of Recommendations for Schools and Places of Worship

Site ID	Name of Site	Public/ Private	Greening Opportunities						
			Nutrient Management	Tree Planting (#)	Stormwater Retrofit	Downspout Disconnection	Impervious Cover Removal	Trash Management	Notes
ISI_L_507	Fort Worthington ES	Public	N	0			X		
ISI_L_508	Lakewood ES	Public	N	0			X		
ISI_L_509	St. Teresa	Public	N	20		X	X		
ISI_L_510	Armistead Gardens ES	Public	N	200					Street sweeping / sediment control
ISI_L_533	Montebello Hospital Center	Private	Y	200	X	X			

PAA-L-503, an old ball field adjacent to Herring Run buffer

Stream Assessment

There were no stream assessments performed in the Herring Run mainstem.

Illicit Discharges

Baltimore City will continue with their Illicit Discharge Detection and Elimination programs, seeking to improve techniques and methodologies for more effective reductions of these discharges.

Stormwater Retrofits and Pond Conversions

There were 21 retrofit opportunities identified in Herring Run Mainstem and one pond conversion. Table 4-33 shows the retrofits and Table 4-34 shows the conversion.

Table 4-33. Summary of Retrofit Opportunities in Herring Run Mainstem

Site	Drainage Area (ac)	Description/Classification	Priority
R15A	130	Wetpond/Wetland	High
R15C	40	Wetpond/Wetland	High
R12B	60	Wetpond/Wetland	Low
R12D	9041	Wetpond/Wetland	Low
R15B	100	Wetpond/Wetland	Low
R38A	2.0	Bioretention	Medium
R14	1.0	Bioretention	Medium
R18	5.0	Bioretention	Medium
R19	2.0	Bioretention	Low
R21	0.75	Dry Swale	High
R22	12	Dry Swale	Medium
R23	0.6	Bioretention	Medium
R41B	0.15	Impervious Cover Removal	High
R12A	80	Wetpond/Wetland	Medium
R20	25	Wetpond/Wetland	Medium
R15C	40	Wetpond/Wetland	Medium
R38B	4.5	Bioretention	Medium
R41A	0.7	Bioretention	Medium
R10	1.5	Bioretention	Medium
R39	40	Wetpond/Wetland	Medium
R42A	305	Wetpond/Wetland	Low

Table 4-34 Summary of SWM Pond Conversion Opportunities in Herring Run Mainstem

Pond #	Drainage Area (ac)	Priority
305	6.5	High

Pervious Area Restoration

Table 4-35 shows the four possible pervious area restoration sites identified during the assessment. All of the sites are close to or part of the Herring Run buffer area. Pervious area restoration has the potential to convert areas of turf, sometimes a relatively high nutrient input land use, to forest, which can absorb rather than shed nutrients.

Table 4-35 Summary of Pervious Area Recommendations

Site	Location	Description	Size (acres)	Ownership
PAA-L-503	Off Armistead Way	Old baseball field	6	Private
PAA-L-504	Parkside & Sinclair	Herring Run buffer	5	Public
PAA-L-505	Parkside & Belair	Herring Run buffer	3	Public
PAA-L-506	Herring Run Rd.	Herring Run Buffer	1	Public

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures according to Table 4-30, focusing efforts on the multi-family neighborhoods. Many of the neighborhoods in Herring Run Mainstem have smaller lots where rain barrels are recommended.
2. Plant street trees in the neighborhoods indicated in Table 4-30. There is an estimated potential for 830 street trees in this subwatershed.
3. Engage citizens in a storm drain stenciling program and conduct stenciling activities in the neighborhoods indicated in Table 4-30.
4. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs like The Growing Home Campaign and TreeBaltimore.

5. All three hot spots in this subwatershed were assessed as confirmed, so further investigation into reducing stormwater pollutants at these three locations is recommended.
6. Engage Institutions sited in Table 4-32 in restoration efforts, especially tree plantings.
7. Further investigate four pervious areas listed in Table 4-35 for potential tree plantings, giving primary consideration to the three areas listed as public property.

Municipal Actions

1. Conduct street sweeping in neighborhoods identified in Table 4-30. This will also help with the trash issues in the neighborhoods indicated in Appendix 4-1b of the Characterization Report.
2. Examine high priority storm water retrofits and pond conversion for possibilities of implementation from Table 4-33 and 4-34.

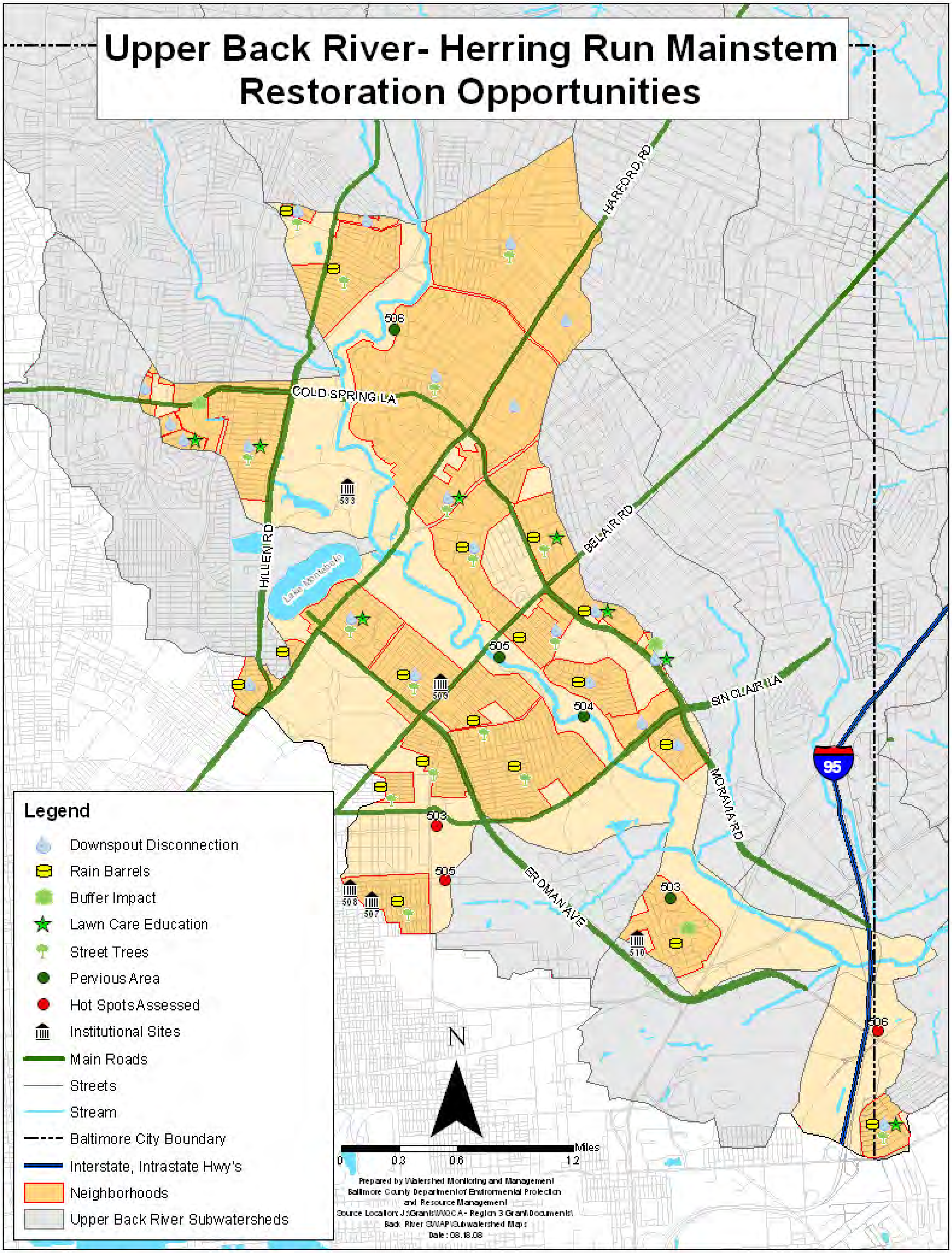


Figure 4-7- Restoration Opportunities in the Herring Run Mainstem

4.3.7 Lower Herring Run

Subwatershed Description

The Lower Herring Run /Upper Back River subwatershed actually contains the confluence of Herring Run, Moores Run and Redhouse Run where they empty to the tidal Back River area. Lower Herring Run also has a few streams and tidal creeks of its own. The most significant of which runs due north from the intersection of Merritt Blvd. and North Point Blvd. and joins this confluence about 500 feet east of I-695. The other streams are small and drain either directly to the Back River tidal area or to the confluence already mentioned. 24% of the stream buffer is unforested. Table 4-36 presents the basic information on Lower Herring Run/Upper Back River.

Table 4-36 Basic Profile of Lower Herring Run/Upper Back River Subwatershed

Drainage Area	• 1596.1 acres (2.5 mi^2)	
Stream length	• 13.48 miles	
Land Use	• Low-Density residential (0.0%) • Med-Density Residential (11.8%) • High-Density Residential (8.6%)	• Open Urban Land (23.3%) (includes forests) • Commercial (18.9%) • Industrial (22.6%)
Current Impervious Cover	• 33.0% of subwatershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (0%) • Baltimore County (100%)	
Soils	• A Soils – 1.4% • B Soils – 47.4%	• C Soils – 34.3% • D Soils – 16.9%
Stormwater management	• City - NA • County – 3.9% of the county portion of the subwatershed is treated by storm water facilities	

Neighborhood Assessment

Seven (7) distinct neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance. Subwatershed boundaries were not used to designate neighborhood boundaries so some neighborhoods may exist in more than one subwatershed. Pollution prevention opportunities to address stormwater volume and pollutants include rain barrels, storm drain stenciling, tree planting and stream buffer education.

There are 20.4 impervious building acres in the neighborhood where downspout disconnection is recommended in Lower Herring Run/Upper Back River. Based on a 60% average potential for disconnection, 12.24 impervious building acres were deemed feasible for downspout disconnection. Table 4-37 shows a summary of neighborhood recommendations for the Herring Run Mainstem.

Table 4-37. Summary of Neighborhood Assessment Recommendations

Recommended Actions											
Site ID	**Median lot size (acres)**	**% Opportunity for Downspout Disconnection**	**Rain Barrels**	**Rain Gardens**	**Stormdrain Stencils**	**Bayscape**	**Nutrient Management**	**Pet Waste**	**Buffer Enhancement**	**Street Trees**	**Notes**
NSA_L_01	1/2	80		X		X			X	0	
NSA_L_169	<1/8	30	X		X					100	Park/garden creation

		Recommended Actions									
Site ID	**Median lot size (acres)**	**% Opportunity for Downspout Disconnection**	**Rain Barrels**	**Rain Gardens**	**Stormdrain Stencils**	**Bayscape**	**Nutrient Management**	**Pet Waste**	**Buffer Enhancement**	**Street Trees**	**Notes**
NSA_L_212	1/4	20			X	X	X		X	0	
NSA_L_213	1/2	65		X	X	X			X	0	
NSA_L_214	Multifam	100	X							0	Tree planting
NSA_L_216	1/4	65		X					X	0	
NSA_L_68	<1/8	60	X		X		X			100	

Hot Spot Assessment

There were no sites assessed in Lower Herring Run/Upper Back River for hot spot status.

Institutional Site Assessment

There were no institutional areas assessed in the Lower Herring Run/UBR subwatershed.

Stream Assessment

There were no stream assessments performed in Lower Herring Run/UBR.

Illicit Discharges

Baltimore County uses a prioritization system for sampling outfalls for illicit discharges. Priority one describes an outfall with major problems including the presence of chemicals in the water. Priority two describes outfalls with moderate problems including erosion and trash but no chemical problems detected. Priority 1 outfalls are sampled four times per year and priority 2 outfalls are sampled once per year. Lower Herring Run/UBR has two priority 2 outfalls and no priority 1 outfalls.

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

Stormwater Retrofits and Pond Conversions

There were no retrofit opportunities identified in Lower Herring Run and one pond conversion. Table 4-38 shows the conversion.

Table 4-38. Summary of SWM Pond Conversion Opportunities in Lower Herring Run

Pond #	Drainage Area (ac)	Priority
969	5.2	High

Pervious Area Restoration

Table 4-39 shows the one pervious area restoration site assessed in the Lower Herring Run/UBR. Pervious area restoration has the potential to convert areas of turf, sometimes a relatively high nutrient input land use, to forest, which can absorb rather than shed nutrients.

Table 4-39. Summary of Pervious Area Recommendations

Site	Location	Description	Size (acres)	Ownership
PAA-L-301	Diamond Point Rd.	Open Space	5	Private

typical homes in NSA-L-212

section of PAA-L-301

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs like The Growing Home Campaign and TreeBaltimore. All neighborhoods here were recommended for tree canopy improvement on private lots.
2. Conduct appropriate downspout disconnection measures according to Table 4-37, focusing efforts on the multi-family neighborhoods.
3. Plant street trees in neighborhoods L-68 and 169.
4. Engage citizens in a storm drain stenciling program and conduct stenciling activities in the neighborhoods indicated in Table 4-37.
5. The single pervious area identified here is in the Chesapeake Bay critical area where building can be constrained so despite the private ownership, a tree planting here could be successful.

Municipal Actions

1. Complete pond conversion from Table 4-38.

Figure 4-8- Restoration Opportunities in the Lower Herring Run/Upper Back River Subwatershed

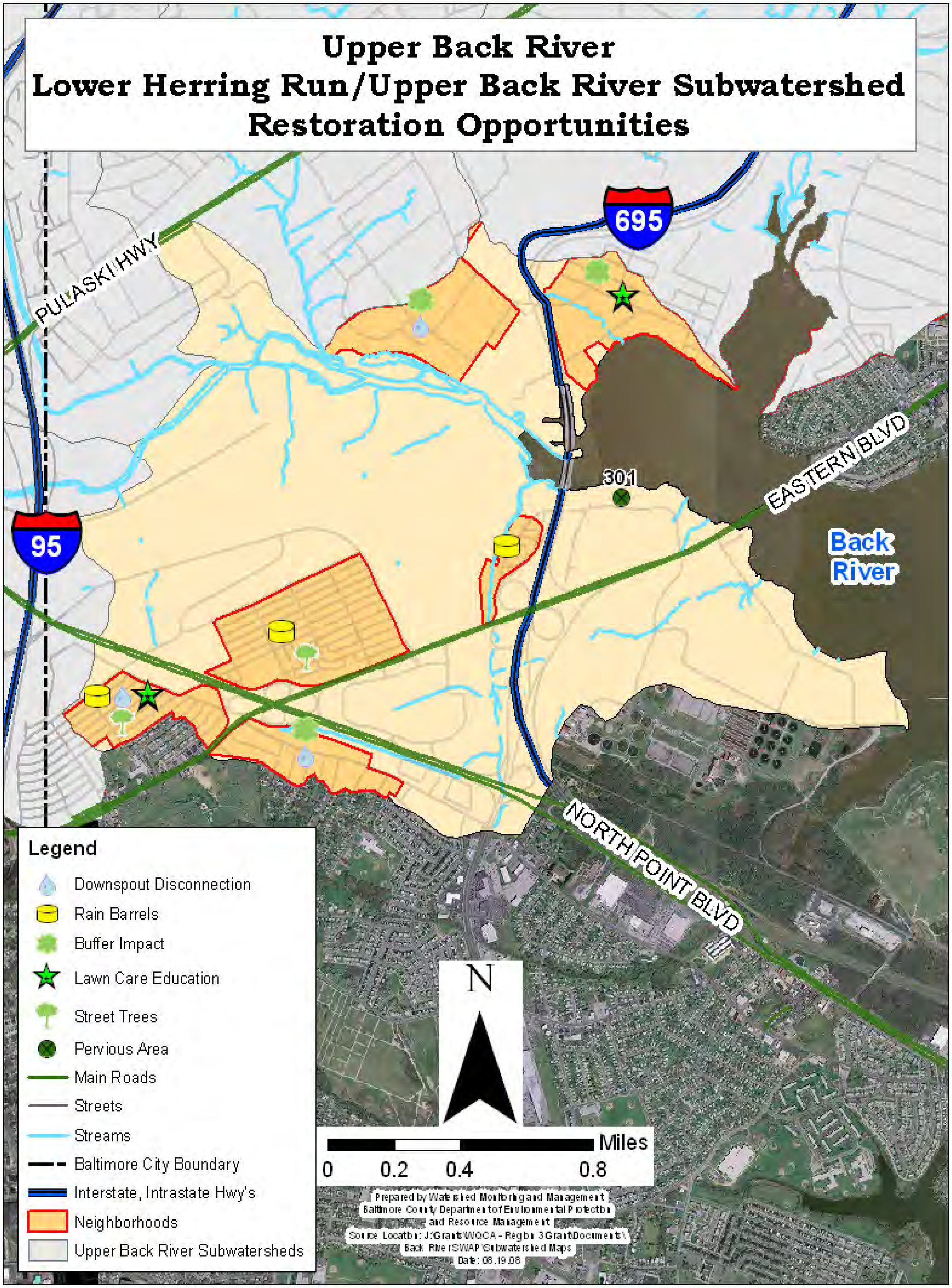


Figure 4-8- Restoration Opportunities in the Lower Herring Run Upper Back River

4.3.8 Moore's Run

Subwatershed Description

The Moore's Run stream is piped in the upper sections of the subwatershed. The stream first sees daylight traveling in a concrete channel in Gardenville near the Hazelwood Elementary/Middle School south of Hamilton Ave. From here it follows a southerly flow passing beneath 895 and 95 and follows 95 South before its confluence with Herring Run just east of the Baltimore City border.

Recent highway construction along I-95 is in close proximity to Moore's Run and is likely having an effect on water quality there. Baltimore City Public Works is also in the process of making storm drain and sanitary sewer improvements in Moore's Run north of where it intersects 895. The sewer improvements are mandated as part of Baltimore City's consent decree with the Environmental Protection Agency and the State of Maryland. Table 4-40 presents basic information about Moore's Run.

Table 4-40. Basic Profile of Moore's Run Subwatershed

Drainage Area	• 2797.7 acres (4.4 mi^2)	
Stream length	• 7.39 miles	
Land Use	• Low-Density residential (16.6%) • Med-Density Residential (19.4%) • High-Density Residential (9.1%)	• Open Urban Land (30.5%) (includes forests) • Commercial (10.9%) • Institutional (4.7%)
Current Impervious Cover	• 25.1% of subwatershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (83%) • Baltimore County (17%)	
Soils	• A Soils – 0.0% • B Soils – 16.8%	• C Soils – 18.1% • D Soils – 75.1%
Stormwater management	• County - Only 5.5% of the watershed is treated by a stormwater facilities • City - No existing stormwater facilities were identified	

Neighborhood Assessment

Twenty-nine (29) distinct neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance. Subwatershed boundaries were not used to designate neighborhoods so neighborhoods often exist in more than one subwatershed. Pollution prevention opportunities to address stormwater volume and pollutants include downspout disconnection, storm drain stenciling, tree planting and public education (i.e. nutrient management). There seems to be ample opportunity here for buffer expansions/ improvements.

There are 215.8 impervious building acres in neighborhoods where downspout disconnection is recommended in Moore's Run. Based on an average of 68.6% potential for disconnection, 148 impervious building acres were deemed feasible for downspout disconnection. Disconnection efforts should first concentrate on the 6 multi-family neighborhoods due to the efficiencies achieved by coordinating with one landowner instead of individual homeowners. NSAs L-218 & 219 especially have plenty of open space for disconnections. Table 4-41 shows a summary of neighborhood recommendations for the Herring Run Mainstem.

park or garden opportunity in NSA-L-163

downspout disconnection opp. in NSA-L-21

Table 4-41. Summary of Neighborhood Assessment Recommendations

Site ID	Median lot size (acres)	Recommended Actions									
		% Opportunity for Downspout Disconnection	Rain Barrels	Street Sweeping	Stormdrain Stencils	Bayscape	Nutrient Management	Trash Mgmt	Buffer Enhancement	Street Trees	Notes
NSA_L_04	<1/4	10	X			X				0	
NSA_L_05	1/4	40			X	X			X	50	
NSA_L_06	1/4	60	X							0	
NSA_L_09	1/4	50				X			X	0	
NSA_L_150	1/3	60	X		X	X				0	Rust staining on streets/sidewalks
NSA_L_151A	1/4	70	X		X			X		0	Dumping in forested
NSA_L_151B	<1/8	70	X		X					0	Alley retrofits/rain barrels
NSA_L_160	Multifamily	100			X	X				20	Nice tree canopy here
NSA_L_161	<1/8	100	X		X	X				100	
NSA_L_162	Multifamily	100			X	X		X	X	25	Dumping off
NSA_L_163A	<1/8	75	X		X			X		0	Park/garden
NSA_L_163B	Multifamily	65	X		X	X	X			0	
NSA_L_164	Multifamily	95		X	X	X	X	X	X	0	Most of neighborhood
NSA_L_183A	<1/8	100	X	X	X			X		100	See PAA-L-403/alley retrofits/st. sweeping
NSA_L_183B	1/2	60	X			X	X			100	
NSA_L_184	1/4	75		X	X	X		X	X	100	Some dumping in
NSA_L_187	<1/4	90			X	X			X	50	Tree panting opp in buffer area
NSA_L_189	1/4	20			X	X		X		0	
NSA_L_190	<1/4	40			X	X	X			40	
NSA_L_218	Multifamily	100			X	X	X	X		0	Pkg lot retrofits/trash mgmt/tree plantings
NSA_L_219	Multifamily	100		X		X	X	X		0	Trash mgmt
NSA_L_74	1/8	40		X	X	X			X	100	
NSA_L_75	<1/4	60		X		X		X		50	

Site ID	Median lot size (acres)	Recommended Actions: % Opportunity for Downspout Disconnection	Rain Barrels	Street Sweeping	Stormdrain Stencils	Bayscape	Nutrient Management	Trash Mgmt	Buffer Enhancement	Street Trees	Notes
NSA_L_79	<1/4	60			X					0	
NSA_L_80	<1/4	80			X	X	X			0	Residential tree
NSA_L_85	<1/4	90	X	X	X	X	X	X		0	Woodlea & greenhill,
NSA_L_86	<1/4	45		X	X	X			X	50	
NSA_L_87	<1/4	60	X		X	X				25	Moores Run City
NSA_L_88	<1/8	75	X		X			X		0	Buffer planting opp/yard waste

Hot Spot Assessment

Table 4-42 shows the 2 sites assessed in Stemmers Run for hot spot status.

Table 4-42. Summary of Hotspot Sites Recommendations

Status	Site ID	Description	Potential Sources of Pollution: Vehicle Operations	Outdoor Storage Materials	Waste Management	Physical Plant	Turf/Landscaping	Stormwater Management
Confirmed	HSI_L_401	Small engine repair		X				X
Potential	HSI_L_402	Auto Repair Shop	X		X	X		

Institutional Site Assessment

There were no institutional areas assessed in the Moore's Run subwatershed.

Stream Assessment

There were no stream assessments performed in the Herring Run mainstem.

Illicit Discharges

Baltimore County uses a prioritization system for sampling outfalls for illicit discharges. Priority one describes an outfall with major problems including the presence of chemicals in the water. Priority two describes outfalls with moderate problems including erosion and trash but no chemical problems detected. Priority 1 outfalls are sampled four times per year and priority 2 outfalls are sampled once per year. The county portion of Moore's Run contains one 'priority 2' outfall.

Baltimore County and Baltimore City will continue with their Illicit Discharge Detection and Elimination programs, seeking to improve techniques and methodologies for more effective reductions of these discharges.

Stormwater Retrofits and Pond Conversions

One retrofit opportunity was identified in Moore's Run and no pond conversions. Table 4-43 shows the retrofit.

Table 4-43. Summary of Retrofit Opportunities in Moore's Run

Site	Drainage Area (ac)	Description/Classification	Priority
R4	32	Wet Pond/Wetland	High

Pervious Area Restoration

Table 4-44 shows the four possible pervious area restorations identified during the assessment. Three of the four are in the buffer of Moore's Run and have substantial acreages so these would be priorities for restoration efforts. Pervious area restoration has the potential to convert areas of turf, sometimes a relatively high nutrient input land use, to forest which can absorb rather than shed nutrients. Along with Herring Run Watershed Association, programs like Tree-Mendous Maryland and NeighborSpace of Baltimore County could be valuable resources for planting those areas on public land or community open space.

Table 4-44. Summary of Pervious Area Recommendations

Site	Location	Description	Size (acres)	Ownership
PAA-L-401	Off Denview	Moores Run buffer	7	Public
PAA-L-402	Sinclair & Denview	Moores Run buffer	6	Public
PAA-L-403	End of Radecke	Park area	3	Public
PAA-L-404	Along Denview	Moores Run buffer	4.5	Private

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures according to Table 4-41, focusing efforts on the multi-family neighborhoods.
2. There is approximately 3,500 ft of buffer that could be expanded along Moore's Run Rd., Sinclair La and Cedgate Rd.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs like The Growing Home Campaign and TreeBaltimore. Most neighborhoods here were recommended for tree canopy improvement on private lots.
4. Plant street trees in the neighborhoods indicated in Table 4-41. There is an estimated potential for 810 street trees in this subwatershed.
5. Engage citizens in a storm drain stenciling program and conduct stenciling activities in the neighborhoods indicated in Table 4-41.
6. Conduct focused business education and outreach efforts to hot spot locations identified in Table 4-42.
7. Further investigate four pervious areas listed in Table 4-44 for potential tree plantings, giving primary consideration to the three areas listed as public property.

Municipal Actions

1. Conduct street sweeping in neighborhoods identified in Table 4-41. This will also help with the trash issues in the neighborhoods indicated in Table 4-41
2. Complete high priority retrofit from Table 4-43.

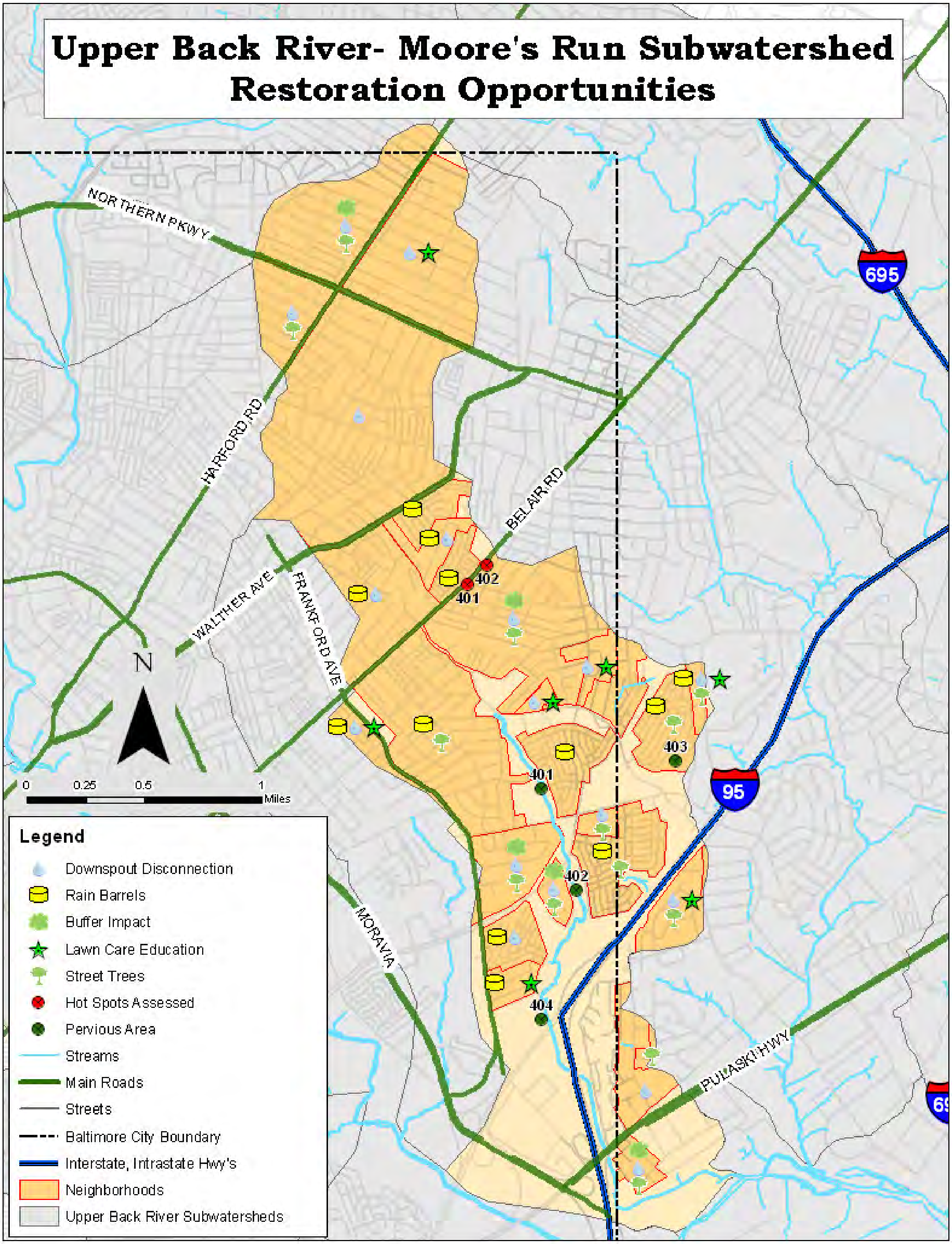


Figure 4-9- Restoration Opportunities in the Moore's Run Subwatershed

4.3.9 Northeast Creek

Subwatershed Description

Northeast Creek begins at the confluence of Stemmers Run and Brien's Run and flows beneath the 695/702 interchange. The subwatershed is characterized by small tidal creeks and a tidal area at the mouth where it empties to Back River. The stream is met by a few smaller tributaries before emptying into Back River. 25% of the stream buffer is forested.

Neighborhoods within Northeast Creek could benefit the watershed most through a downspout disconnection program and an incentive program encouraging residents to plant trees on their properties. Table 4-45 presents some basic information about Northeast Creek

Table 4-45. Basic Profile of Northeast Creek Subwatershed

Drainage Area	• 1,643.9 acres (5.8 mi^2)	
Stream length	• 17.5 miles	
Land Use	• Low-Density residential (5.1%) • Med-Density Residential (26.7%) • High-Density Residential (1.9%)	• Open Urban Land (32.9%) (includes forests) • Commercial (7.5%) • Institutional (3.2%)
Current Impervious Cover	• 21.8% of subwatershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (0%) • Baltimore County (100%)	
Soils	• A Soils – 2.3% • B Soils – 31.7%	• C Soils –49.5% • D Soils – 16.4%
Stormwater management	• 10.5 % of the watershed is treated by stormwater facilities	

Neighborhood Assessment

Eleven (11) distinct neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance. Subwatershed boundaries were not used to designate neighborhoods so some neighborhoods may exist in more than one subwatershed. Pollution prevention opportunities to address stormwater volume and pollutants include downspout disconnection, storm drain stenciling, tree planting and public education (i.e. nutrient management).

There are 57.4 impervious building acres in neighborhoods where downspout disconnection is recommended in Northeast Creek. Based on an average of 56.4% potential for disconnection, 32.4 impervious building acres are estimated feasible for downspout disconnection.

NSA-L-209 & 210 are the only neighborhoods fully contained by the subwatershed, so this would be the best place to start if implementing restoration actions within Northeast Creek. Table 4-46 shows a summary of neighborhood recommendations for Northeast Creek.

Table 4-46. Summary of Neighborhood Assessment Recommendations

Site ID	Median lot size (acres)	Recommended Actions									
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Pet Waste	Buffer Enhancement	Street Trees	Notes
NSA_L_01	1/2	80		X		X			X	0	
NSA_L_02	1/4	50	X	X	X	X				0	
NSA_L_191	1/4	70			X	X			X	0	
NSA_L_192	1/4	50				X			X	0	See PAA-L-653
NSA_L_193	<1/4	40					X		X	50	
NSA_L_209	<1/8	70			X	X	X			10	Duplexes and SFHs
NSA_L_210	1/2	70		X	X	X	X			40	PAA-L-651 & 652
NSA_L_211	1/4	45			X				X	0	
NSA_L_212	1/4	20			X	X	X		X	0	Needs more trees
NSA_L_43	1/4	65	X		X		X			15	
NSA_L_48	<1/8	60	X							25	Street sweeping

Hot Spot Assessment
There were no sites were assessed in Northeast Creek for hot spot status.

Institutional Site Assessment
There were no institutional sites assessed in Northeast Creek.

Stream Assessment
There were no stream assessments performed in Northeast Creek

Illicit Discharges
Baltimore County uses a prioritization system for sampling outfalls for illicit discharges. Northeast Creek contains three ‘priority 2’ outfalls. Priority 2 outfalls are sampled once per year.

Baltimore County will continue with their Illicit Discharge Detection and Elimination programs, seeking to improve techniques and methodologies for more effective reductions of these discharges.

Stormwater Retrofits and Pond Conversions

No retrofits or pond conversions were identified in the Northeast Creek Subwatershed.

Pervious Area Restoration

Table 4-47 shows the three possible pervious area restorations identified during the assessment.

Table 4-47. Summary of Pervious Area Recommendations

Site	Location	Description	Size (acres)	Ownership
PAA-L-651	Off Cedar Rd.	Open space between houses	3	Public
PAA-L-652	Off Essex Rd.	Open space, mowed	2.5	Private
PAA-L-653	Near Pulaski & Berk	Abandoned Lot	2	Private

PAA-L-651 - Note Northeast Creek in the background

Subwatershed Management Strategy

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

1. Conduct appropriate downspout disconnection measures according to Table 4-46.
2. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs like The Growing Home Campaign and TreeBaltimore. All of the neighborhoods here were recommended for tree canopy improvement on private lots.
3. Engage citizens in a storm drain stenciling program and conduct stenciling activities in the neighborhoods indicated in Table 4-46.
4. Provide lawn care education to neighborhoods identified with high turf management in Table 4-46. Work with homeowners in these neighborhoods to reduce the amount of nutrients applied to their lawn and other pollution prevention measures.
5. Further investigate three pervious areas listed in Table 4-47 for potential tree plantings, giving primary consideration to the one area listed as public property.

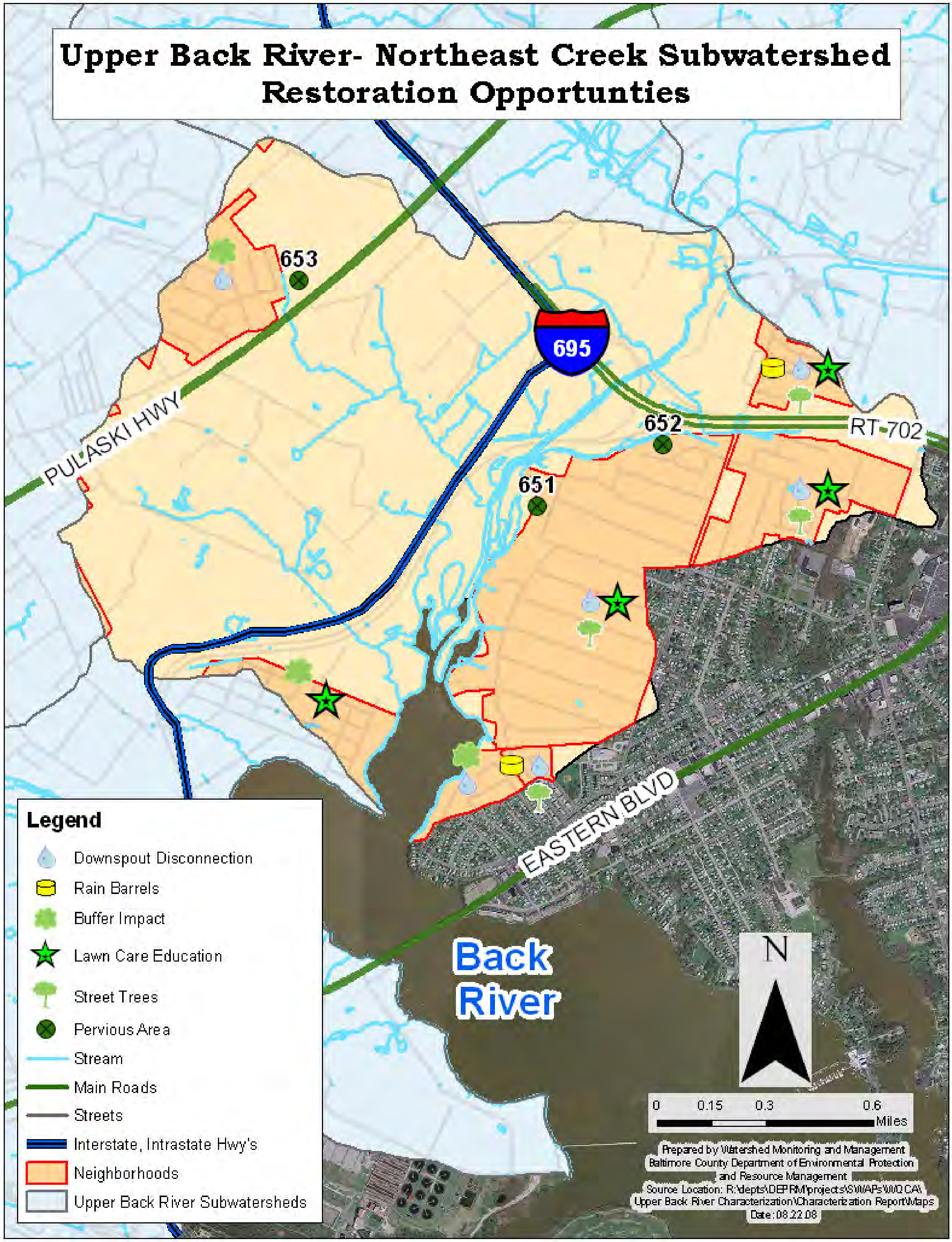


Figure 4-10- Restoration Opportunities in the Northeast Creek Subwatershed

4.3.10 Redhouse Run

Subwatershed Description

Redhouse Run begins in the northeast corner of Baltimore City between Harford and Belair roads. From here, it flows southeast into the county through Overlea then south under interstate 95 through Rosedale and enters Herring Run just south of Pulaski Highway. The land use in the subwatershed is over 70% residential and there is 25 % impervious cover. 20% of the stream buffer is forested; this is the lowest percentage in the SWAP area. Table 4-48 shows some basic information about Redhouse Run.

Table 4-48. Basic Profile of Redhouse Run Subwatershed

Drainage Area	• 3020.4 acres (5.4 mi^2)	
Stream length	• 14.7 miles	
Land Use	• Low-Density residential (47.1%) • Med-Density Residential (21.1%) • High-Density Residential (2.8%)	• Open Urban Land (12.1%) (includes forests) • Commercial (7.7%) • Institutional (7.8%)
Current Impervious Cover	• 25.1% of subwatershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (22%) • Baltimore County (78%)	
Soils	• A Soils – 0.1% • B Soils – 7.4%	• C Soils – 61.2% • D Soils – 31.3%
Stormwater management	• County - Only 4.6% of the county portion of the subwatershed is treated by stormwater facilities • City - No existing stormwater facilities were identified	

Neighborhood Assessment

Forty-seven (47) distinct neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance. Subwatershed boundaries were not used to designate neighborhoods so some neighborhoods may exist in more than one subwatershed. Pollution prevention opportunities to address stormwater volume and pollutants include downspout disconnection, storm drain stenciling, tree planting and public education (i.e. nutrient management). 157 impervious building acres were deemed feasible for downspout disconnection. Disconnection efforts should be certain to include the 4 multi-family neighborhoods due to efficiencies achieved by coordinating with one landowner instead of individual homeowners. Table 4-49 shows a summary of neighborhood recommendations for Redhouse Run.

concrete stream channel in NSA-L-81

sediment laden stream in NSA-L-18

Table 4-49. Summary of Neighborhood Assessment Recommendations

Site ID	Median lot size (acres)	Recommended Actions									
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Street Sweeping	Buffer Enhancement	Street Trees	Notes
NSA_L_01	1/2	80		X		X			X	0	some trash near stream
NSA_L_02	1/4	50	X	X	X	X				0	front yard tree planting
NSA_L_03	1/4	50	X	X	X	X				0	front yard tree planting
NSA_L_04	<1/4	10	X			X				0	
NSA_L_05	1/4	50			X	X			X	50	
NSA_L_06	1/4	60	X							0	
NSA_L_07	1/2	40		X	X	X			X	0	
NSA_L_08	1/8	35	X							0	
NSA_L_09	1/4	50		X		X			X	0	
NSA_L_10	1/2	70			X	X				0	
NSA_L_11	<1/4	15	X		X	X				50	
NSA_L_12	1/4	nd	X			X				100	
NSA_L_13	1/8	10	X							20	

Site ID	Median lot size (acres)	Recommended Actions									
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Street Sweeping	Buffer Enhancement	Street Trees	Notes
NSA_L_14	<1/8	30	X					X		0	lots of organic debris in streets & driveways
NSA_L_15	1/2	35		X	X				X	0	outreach to residents on stream
NSA_L_151A	1/4	70	X		X					0	Eliminate dumping in forested
NSA_L_151B	<1/8	70	X		X					0	Alley retrofits
NSA_L_152	<1/4	55			X	X				10	
NSA_L_153	<1/4	80			X	X				0	
NSA_L_154	1/4	70			X	X		X	X	75	
NSA_L_155A	1/4	100			X	X				0	All downspouts directly
NSA_L_156	1/4	90			X	X		X		0	Alley retrofit
NSA_L_157A	<1/4	75			X				X	0	
NSA_L_157B	Multifa	100			X	X	X			0	
NSA_L_158	Multifa	100				X				0	Existing curb cut
NSA_L_159	Multifa	100				X		X		0	Existing curb cut
NSA_L_16	<1/8	60	X		X					0	private property plantings
NSA_L_17	<1/4	50		X	X	X			X	100	Street trees
NSA_L_178	<1/4	75	X		X		X		X	30	Enhance buffer
NSA_L_18	<1/8	30		X	X	X				0	
NSA_L_180	1/4	80						X	X	100	
NSA_L_181	1/4	55			X	X			X	100	Extend buffer/no mow
NSA_L_182	1/2	50		X	X			X	X	0	Stream restoration-heavy sediment/buffer enhancement
NSA_L_183A	<1/8	100	X		X			X		100	See PAA-L-403. most of nsa in moores run
NSA_L_183B	1/2	60	X			X	X			100	
NSA_L_184	1/4	75			X	X		X	X	100	Some dumping in wooded area
NSA_L_189	1/4	20		X	X	X				0	
NSA_L_190	<1/4	40			X	X	X			40	
NSA_L_191	1/4	70			X	X			X	0	
NSA_L_192	1/4	50				X			X	0	See PAA-L-653
NSA_L_193	<1/4	40					X		X	50	Most of nsa is in stemmers
NSA_L_196	1/2	85		X		X	X			0	
NSA_L_213	1/2	65		X	X	X			X	0	
NSA_L_218	Multifa	100			X	X	X			0	Lot retrofits, trash mgmt.
NSA_L_79	<1/4	60			X					0	
NSA_L_80	<1/4	80			X	X	X			0	Plating in duplex area
NSA_L_81	<1/4	90	X		X	X			X	30	Stream restoration-concrete removal and daylighting

Hot Spot Assessment

Table 4-50 shows the 21 sites assessed for hot spot status in Redhouse Run, representing the majority of the hot spots assessed in the Upper Back River watershed. Priority should be given to the nine confirmed hot spots shown in the table below.

Table 4-50. Summary of Hotspot Sites Recommendations

Status	Site ID	Description	Potential Sources of Pollution					
			Vehicle Operations	Outdoor Storage Materials	Waste Management	Physical Plant	Turf/Landscaping	Stormwater Management
Potential	HSI_L_451	Citgo Gas Station	X			X		X
Confirmed	HSI_L_452	Rosedale Plaza			X	X		
Confirmed	HSI_L_453	none provided	X	X	X	X		
Confirmed	HSI_L_454	Electrical Supply	X	X	X	X		
Confirmed	HSI_L_455	Car Repair/Truck Storage	X	X	X	X		
Potential	HSI_L_456	Truck Maintenance	X	X				
Potential	HSI_L_457	Refrigeration		X	X	X	X	X
Potential	HSI_L_458	Integrity Recycling		X	X	X		
Potential	HSI_L_459	Auto Repair/Junkyard	X	X	X	X		
Confirmed	HSI_L_460	Trucking Co.	X	X	X	X		
Potential	HSI_L_461	Truck Rental/Repair	X	X	X	X		
Potential	HSI_L_462	Marty's Auto Paint		X	X			
Potential	HSI_L_469	Rosedale Village		X	X	X	X	X
Not a hotspot	HSI_L_470	Rosedale Center School				X	X	X
Confirmed	HSI_L_471	Rosedale Fire Co.	X	X	X	X	X	X
Potential	HSI_L_472	School Bus Depot	X	X				X
Potential	HSI_L_473	McNew Excavating	X	X	X	X		X
Confirmed	HSI_L_474	Tire & Service Center	X	X	X	X		
Not a hotspot	HSI_L_475	Used Car Lot	X		X			X
Confirmed	HSI_L_476	Overlea Plaza			X	X		
Confirmed	HSI_L_477	Glenmore Service/Gas Station	X	X	X	X		X

Due to the large number of hot spots, a separate map was created to show their locations. See Figure 4-11.

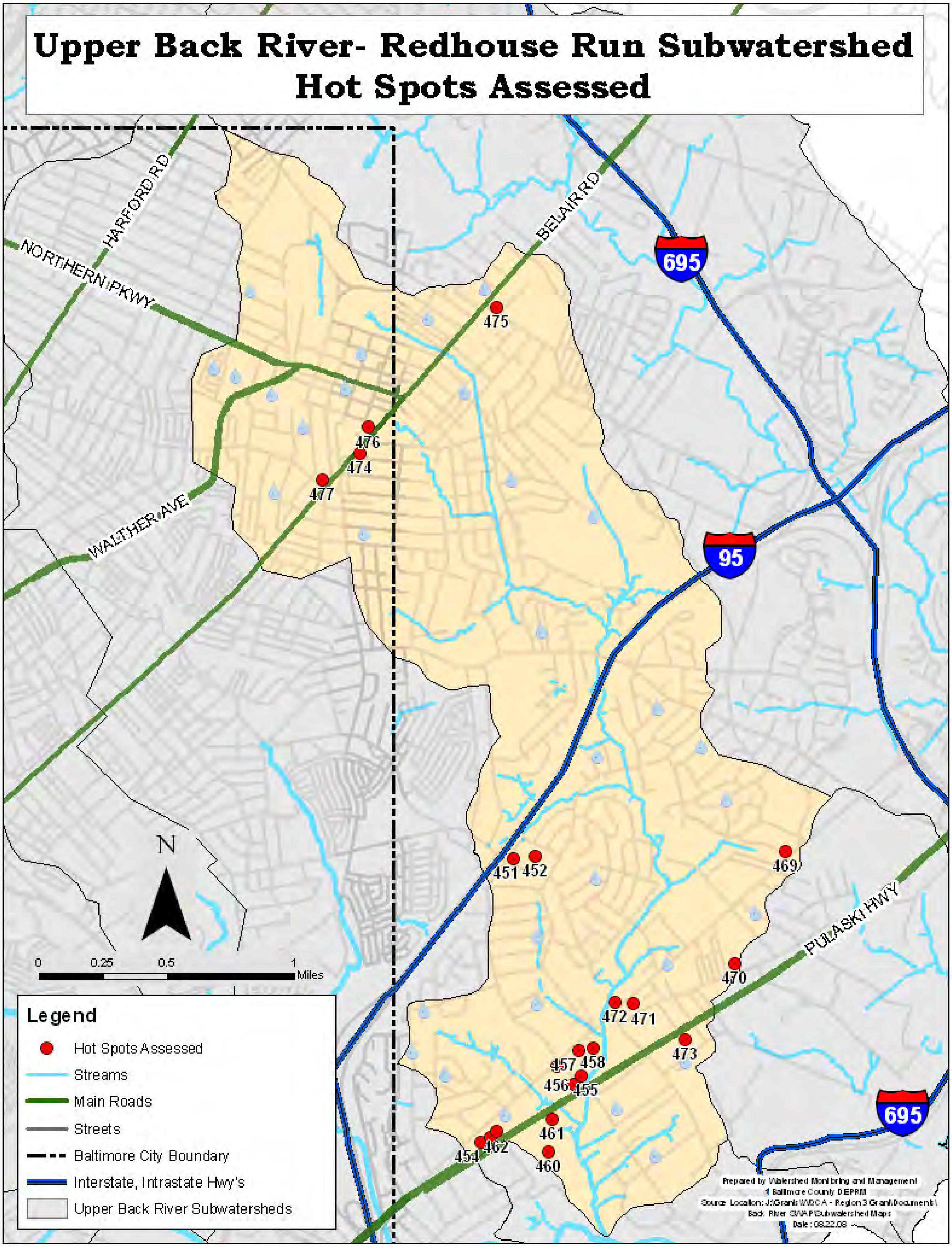


Figure 4-11- Hot Spots Assessed in the Redhouse Run Subwatershed

Institutional Site Assessment

Table 4-51 shows the six institutional areas assessed in the Redhouse Run subwatershed. Trash management and tree planting appear to be the best opportunities along with education about washwater dumping in storm drains.

Table 4-51. Summary of Recommendations for Schools and Places of Worship

Site ID	Name of Site	Public/ Private	Greening Opportunities						
			Nutrient Management	Tree Planting (#)	Stormwater Retrofit	Downspout Disconnection	Impervious Cover Removal	Trash Management	Notes
ISI_L_451	Redhouse Run ES	Public	N	250	X			X	washwater dumping
ISI_L_452	Golden Ring MS	Public	N	50	X			X	washwater dumping
ISI_L_453	Fullerton ES / Senior Center	Public	Y	400				X	washwater dumping
ISI_L_454	McCormick ES	Public	Y	200				X	
ISI_L_455	Overlea HS	Public	Y	100	X			X	
ISI_L_456	Elmwood ES	Public	N	130				X	washwater dumping

Stream Assessment

CWP, HRWA, and other SWAP project partners, including JFWA, conducted a physical stream corridor assessment along 8 linear stream miles in the Redhouse Run subwatershed June 10th and 12th, 2006. There is a stream restoration project to be conducted by Baltimore County along the St. Patricks Rd. area of Redhouse Run.

Observations along the stream corridor by field crews included the following:

- Limited areas for streams to access floodplain. Currently the 1.5-year storm and above are confined within the stream channel.
- Habitat is severely limited by the lack of water in the channel –especially in the summer.
- Few obvious illicit discharges were noted and trash problems were limited to a number of locations.
- Limited areas for stream buffer improvements except in streamside parks and at individual homes. In both cases there may be conflicting community interests – damage to riparian planting projects were noted in these areas.
- County park maintenance staff may be persuaded to allow a larger buffer on some of the park areas as they are maintaining turf areas sometimes within 5-10ft of the streambank.

Recommended Actions:

- In tandem with stormwater retrofits, stream restoration could benefit highly eroding areas and provide relief and reduce erosive flows in park areas, such as St. Patrick Street, by lowering the floodplain as part of restoration efforts*.
- Resurvey potential illicit discharge locations throughout the watershed.

- Pursue limited trash cleanup and riparian reforestation projects.
- Work with County Park maintenance staff to allow larger buffers on park areas in the Redhouse Run.

*There is a planned stream restoration project to be conducted by Baltimore County along the St. Patrick Rd. area of Redhouse Run.

Illicit Discharges

Baltimore County uses a prioritization system for sampling outfalls for illicit discharges. Priority one describes an outfall with major problems including the presence of chemicals in the water. Priority two describes outfalls with moderate problems including erosion and trash but no chemical problems detected. Priority 1 outfalls are sampled four times per year and priority 2 outfalls are sampled once per year. Redhouse Run contains four priority 2 outfalls and one priority 1 outfall.

Baltimore County and Baltimore City will continue with their Illicit Discharge Detection and Elimination programs, seeking to improve techniques and methodologies for more effective reductions of these discharges.

Stormwater Retrofits and Pond Conversions

Table 4-52 shows the 33 retrofits identified in Redhouse Run. In addition, there were three pond conversion opportunities identified and they are shown in Table 4-53.

Table 4-52. Summary of Retrofit Opportunities in Redhouse Run

Site	Drainage Area (ac)	Description/Classification	Priority
R15C	3.2	Level Spreader	Medium
R29	16.0	Bioretention	Medium
R30	8.0	Bioretention	Medium
R32	0.5	Enhance Sand Filter	High
R1A	0.25	Dry Swale	Medium
R5A	1.0	Filter Strip	Medium
R8A	1.5	Bioretention	Medium
R11	5.0	Bioretention	Medium
R14	1.0	Bioretention	Medium
R15A	2.0	Bioretention	Medium
R18A	1.8	Bioretention	Medium
R19	2.0	Sand Filter	Low
R27	1.5	Vegetated Filter Strip	Medium
R28	1.0	Bioretention	Low
R1C	0.35	Enhance Rain Garden	High
R6	0.35	Reforestation	High
R18B	336	Floodplain Restoration	Medium
R31	3.5	Enhance Dry Swale & Sand Filter	High
R1B	0.5	Permeable Pavement	Medium
R15B	4.25	Level Spreaders/Filter Strips	Medium
R20A	1.0	Downspout Disconnection	High
R4	3.5	Bioretention	High
R7	3.0	Bioretention	Medium
R8B	7.5	Bioretention	Medium
R12	4.0	Sand Filter	Low
R13	1.5	Dry Swale/Bioretention	High

R19	2.0	Bioretention	Low
R20B	2.0	Bioretention	Medium
R22	2.0	Sand Filter	Low
R23	2.0	Bioretention	Medium
R26	4.0	Bioretention	Medium
R24	2.0	Catch Basin Inlets	High

Table 4-53. Summary of SWM Pond Conversion Opportunities in Redhouse Run

Pond #	Drainage Area (ac)	Priority
1211	61.7	High
1409	2.4	Medium
560	2.4	Medium

Pervious Area Restoration

Table 4-54 shows the eight possible pervious area restorations identified during the assessment.

Table 4-54. Summary of Pervious Area Recommendations

Site	Location	Description	Size (acres)	Ownership
PAA_L_451	Southern tip of RR	Shell Gas Station	1	Private
PAA_L_452	South Redhouse Run	Church	1	Private
PAA_L_453	North Redhouse Run	Fullerton Rec Center	6	Public
PAA_L_454	NW Redhouse Run	Lillian Holt Center for Arts	5	Public
PAA_L_455	Golden Ring Middle	Golden Ring Middle	7.5	Public
PAA_L_456	End of Elm	Redhouse Run Elementary	4	Public
PAA_L_457	MD School Blind	MD School for the Blind	1	Private
PAA_L_458	End of Kolb	Park	7	Public

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Reduce the unforested buffer area. Investigate neighborhoods shown in Table 4-49 to be encroaching on the buffer and extend/plant the buffer wherever possible. Also investigate buffer areas that exist as common spaces for planting opportunities and potential for using the Tree-Mendous Maryland program.
2. Conduct appropriate downspout disconnection measures according to Table 4-49, focusing efforts on the multi-family neighborhoods. There are many opportunities for rain gardens in this subwatershed.
3. Engage citizens in a storm drain stenciling program and conduct stenciling activities in the neighborhoods indicated in Table 4-49.
4. Educate citizens on the benefits of bayscaping and implement a program to encourage the establishment of bayscaping on resident's private lots.
5. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs like The Growing Home Campaign and TreeBaltimore.
6. Plant street trees. Table 4-49 shows a potential for over 1000 street trees plantings.
7. Conduct focused business education and outreach efforts to nine confirmed hot spot locations identified in Table 4-50.
8. Engage Institutions sited in Table 4-51 in respective restoration efforts, especially tree plantings.
9. Investigate eight pervious areas listed in Table 4-54 for potential tree plantings; giving primary consideration to the five areas listed as public property.

Municipal Actions*

1. County park maintenance staff may be persuaded to allow a larger buffer on some of the park areas as they are maintaining turf areas sometimes within 5-10ft of the streambank.
2. Conduct street sweeping in neighborhoods identified in Table 4-49.
3. Implement high priority storm water retrofits and pond conversions shown in Tables 4-52 and 4-53 respectively.

*NOTE: Baltimore County is in the planning stages of a stream restoration that will occur around the summer of 2009 near the St. Patricks Rd area of Redhouse Run.   See Figure 4-12 below for exact location.

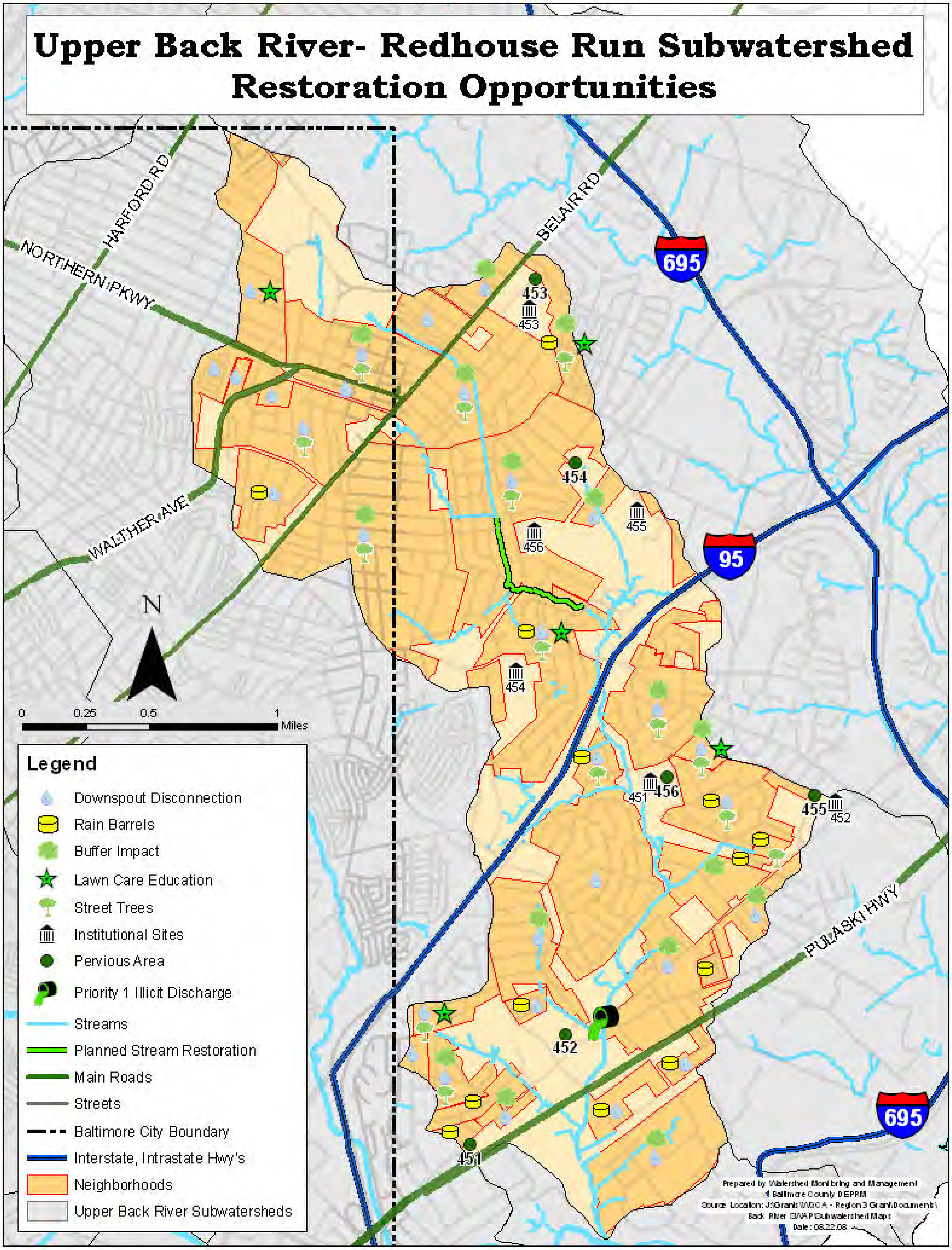


Figure 4-12- Restoration Opportunities in the Redhouse Run Subwatershed

4.3.11 Stemmer's Run

Subwatershed Description

Stemmers Run begins just northeast of Baltimore City between Harford and Belair roads at the Parkville Middle School and at the Parkwood Cemetary flowing through Double Rock Park. From here, it flows southeast along 695 through Linover Park and Gardens of Faith Cemetery and under the 695/95 interchange. Stemmers Run continues its southeasterly flow through the Golden Ring area and joins Brien's Run before entering the Northeast Creek watershed.

Stemmer's Run appears to be under some duress due to the heavy construction activity here. New neighborhood developments and the substantial construction project at the 695/95 interchange make Stemmers Run appear to be the subwatershed most impacted by construction in the Upper Back River.

The neighborhoods within Stemmers Run showed substantial opportunity for downspout disconnection, bayscaping, stormdrain stenciling and street trees. Table 4-55 shows some basic information about Stemmer's Run.

Table 4-55. Basic Profile of Stemmers Run Subwatershed

Drainage Area	• 3690.6 acres (5.8 mi^2)	
Stream length	• 26.8 miles	
Land Use	• Low-Density residential (16.6%) • Med-Density Residential (19.4%) • High-Density Residential (9.1%)	• Open Urban Land (30.5%) (includes forests) • Commercial (10.9%) • Institutional (4.7%)
Current Impervious Cover	• 25.1% of subwatershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (3%) • Baltimore County (97%)	
Soils	• A Soils – 3.1% • B Soils – 13.1%	• C Soils – 66.0% • D Soils – 17.6%
Stormwater management	• County - Only 19% of the watershed is treated by a stormwater facilities • City - No existing stormwater facilities were identified	

Neighborhood Assessment

Forty-two (42) distinct neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance. Subwatershed boundaries were not used to designate neighborhoods so some neighborhoods may exist in more than one subwatershed. Pollution prevention opportunities to address stormwater volume and pollutants include downspout disconnection, storm drain stenciling, tree planting and public education (i.e. nutrient management).

There are 239 impervious building acres in neighborhoods where downspout disconnection is recommended in Stemmers Run. Based on an average of 58.7% potential for disconnection, 140 impervious building acres were deemed feasible for downspout disconnection. Disconnection efforts should first concentrate on the 15 multi-family neighborhoods due to the efficiencies achieved by coordinating with one landowner instead of individual homeowners. Table 4-56 shows a summary of neighborhood recommendations for Stemmer's Run.

poor sediment control in NSA-L-177

car wash where runoff goes to stormdrain in NSA-L-19

Table 4-56. Summary of Neighborhood Assessment Recommendations

Site ID	Median lot size (acres)	Recommended Actions									
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Street Sweeping	Buffer Enhancement	Street Trees	Notes
NSA_L_113	1/4	55					X			0	
NSA_L_114	<1/8	75	X		X		X		X	0	Stream buffer improvement
NSA_L_115	Multifami	100	X							0	
NSA_L_12	1/4	nd	X			X				100	
NSA_L_122	Multifami ly	100	X		X		X				Dumping in pkg lot by SWM
NSA_L_123	Multifami	70	X		X					0	
NSA_L_124	Multifami	50			X		X			0	
NSA_L_126	1/3	90		X			X		X	0	Buffer
NSA_L_127	1/2	65				X				0	
NSA_L_128	Multifami	100			X			X		0	
NSA_L_155A	1/4	100			X	X					
NSA_L_155B	Multifami	100		X	X		X	X		20	Possible lot retrofits
NSA_L_156	1/4	90			X	X		X			Alley retrofit
NSA_L_157A	<1/4	75			X				X	0	
NSA_L_157B	Multifami	100			X	X	X			0	
NSA_L_17	<1/4	50		X	X	X			X	100	
NSA_L_177	1/4	60	X				X	X	X	30	Poor sediment control/plant buffer,
NSA_L_178	<1/4	75	X		X		X		X	30	Buffer enhancement
NSA_L_179	1/2	80		X		X			X		
NSA_L_181	1/4	55			X	X			X	100	Extend buffer in field

Site ID	Median lot size (acres)	Recommended Actions									
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Street Sweeping	Buffer Enhancement	Street Trees	Notes
NSA_L_182	1/2	50		X	X			X	X	0	Stream restoration-heavy sediment/ buffer enhancement
NSA_L_185	<1/4	5			X	X	X		X	0	New
NSA_L_193	<1/4	40					X		X	50	
NSA_L_194	Multifami ly	50				X	X			0	Many tree planting opps.
NSA_L_195	Multifami ly	50				X	X			0	Car wash drains to storm drain
NSA_L_196	1/2	85		X		X	X			0	
NSA_L_197	1/4	55	X		X	X	X			0	Rust staining in driveways
NSA_L_199	1/2	20		X		X	X		X	0	Educate resident on buffer expansion
NSA_L_200	Multifami	50			X	X	X			0	
NSA_L_201	Multifami ly	45			X	X	X			0	Consider open space tree planting
NSA_L_202	Multifami	0			X	X	X			0	
NSA_L_203	Multifami	15			X	X	X			0	
NSA_L_204	Multifami	5			X	X	X		X	0	Extend buffer
NSA_L_205	1/2	0			X	X	X		X	0	Dying street trees
NSA_L_206	1/4	30		X	X		X			0	
NSA_L_207	1/2	50		X	X	X	X		X	0	
NSA_L_69	Multifami ly	100		X	X	X				0	Recommend Stormwater planters
NSA_L_72	<1/4	55		X	X	X				150	
NSA_L_73	1/4	60			X	X	X		X	50	Educate residents on buffer expansion/no-mow
NSA_L_74	1/8	40			X	X		X	X	100	
NSA_L_80	<1/4	80			X	X	X			0	Residential tree planting in duplex
NSA_L_81	<1/4	90	X		X	X			X	30	Stream restoration-concrete removal and daylighting

Hot Spot Assessment

Table 4-57 shows the 2 sites assessed in Stemmers Run for hot spot status.

Table 4-57. Summary of Hotspot Sites Recommendations

Status	Site ID	Description	Potential Sources of Pollution					
			Vehicle Operations	Outdoor Storage Materials	Waste Management	Physical Plant	Turf/Landscaping	Stormwater Management
Not a hotspot	HSI_L_601	Shopping Center			X			
Potential	HSI_L_602	Construction Business	X		X	X	X	

Institutional Site Assessment

Table 4-58 shows the two institutional areas assessed in the Stemmers Run subwatershed. Parkville Middle School provides an excellent opportunity to combine a lot retrofit, tree planting effort and stream naturalization effort with education. Perhaps an incentive to become a registered Green School could further chances of a successful cooperative effort.

Table 4-58. Summary of Recommendations for Schools and Places of Worship

Site ID	Name of Site	Public/ Private	Greening Opportunities						
			Nutrient Management	Tree Planting (#)	Stormwater Retrofit	Downspout Disconnection	Impervious Cover Removal	Trash Management	Notes
ISI_L_601	Parkville Senior Center	Public	N	20		X	X		
ISI_L_602	Parkville MS	Public	Y	60	X		X		Stream naturalization

lot retrofit and stream naturalization opportunities at ISI-L-602

Stream Assessment

A stream stability assessment was conducted by Parsons Brinkerhoff in the Stemmers Run watershed. The subwatershed deficiencies as outlined in the report are as follows:
Problems with the Stemmers Run subwatershed include moderate stream bank erosion, various channel disturbances and fish blockages. 69% of the in stream habitat was rated fair and 2% was rated good. Channel disturbances include culverts causing fish blockages and invasive species, as well as a large amount of waste and trash in some locations. Table 4-59 summarizes the stream assessment findings.

Table 4-59. Summary of Stream Conditions in Stemmers Run

Stream Opportunities	Number of Problems
Restoration/Stabilization	30
Buffer Enhancement	3
Bank Planting	20
Utility Conflicts	13
Wetland Enhancement	3
Yard Waste Education	27
Invasive Plant Removal	66
Trash Dumping	85

Illicit Discharges

Baltimore County uses a prioritization system for sampling outfalls for illicit discharges. Priority one describes an outfall with major problems including the presence of chemicals in the water. Priority two describes outfalls with moderate problems including erosion and trash but no chemical problems detected. Priority 1 outfalls are sampled four times per year and priority 2 outfalls are sampled once per year.

Stemmers Run contains four priority 2 outfalls and no priority 1 outfalls.

Baltimore County and Baltimore City will continue with their Illicit Discharge Detection and Elimination programs, seeking to improve techniques and methodologies for more effective reductions of these discharges.

Stormwater Retrofits and Pond Conversions

There were no retrofits opportunities and six pond conversions identified in Stemmers Run. Table 4-60 shows these conversions.

Table 4-60. Summary of SWM Pond Conversion Opportunities in Stemmer's Run

Pond #	Drainage Area (ac)	Priority
531	11.7	High
1283	6.4	Low
828	5	Low
1741	3.8	Low
471	2.4	Medium
1829	10.8	Medium

Pervious Area Restoration

Table 4-61 shows the one possible pervious area restorations identified during the assessment.

Table 4-61. Summary of Pervious Area Recommendations

Site	Location	Description	Size (acres)	Ownership
PAA_L_601	Golden Ring Park	Golden Ring Park	1.5	Public

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Increase the forested buffer area. Investigate neighborhoods shown in Table 4-56 to be encroaching on the buffer and extend/plant the buffer wherever possible.
2. Conduct appropriate downspout disconnection measures according to Table 4-56, focusing efforts on the multi-family neighborhoods. There are some opportunities for rain gardens in this subwatershed.
3. Engage citizens in a stormdrain stenciling program and conduct stenciling activities in the neighborhoods indicated in Table 4-56.
4. Educate citizens on the benefits of bayscaping and implement a program to encourage the establishment of bayscaping on resident's private lots.
5. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs like The Growing Home Campaign.
6. Plant street trees. Table 4-56 shows a potential for 760 street trees plantings.
7. Engage Institutions sited in Table 4-58 in respective restoration efforts, especially Parkville Middle which has multiple restoration opportunities.

Municipal Actions

1. Identify and conduct feasible stream restoration measures based on the many recommendations of the Parson's stream stability assessment (Table 4-59).
2. Parkville Middle has parking lot retrofit and stream channel naturalization opportunities identified through the ISI assessment.
3. Conduct or improve street sweeping in neighborhoods identified in Table 4-56.

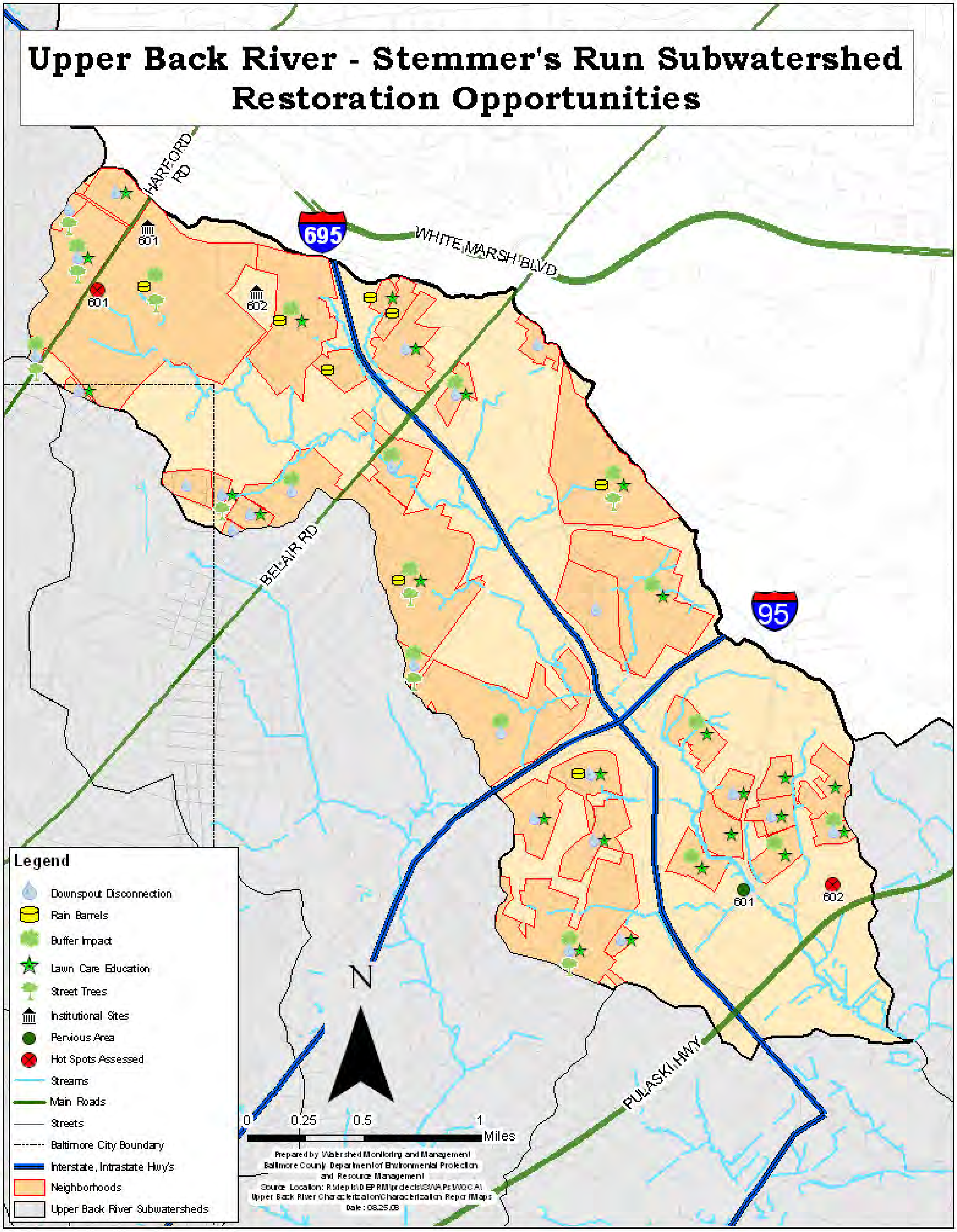


Figure 4-13- Restoration Opportunities in the Stemmer's Run Subwatershed

4.3.12 Tiffany Run

Subwatershed Description

Tiffany Run is an entirely piped stream system. The watershed begins along the Alameda near the Govans community. It flows through a network of pipes towards the south and east and then enters the mainstem of Herring Run just above Lake Montebello. Urban streams without any visible channels receive impacts from upland sources just the same as open channels. However, because of their hidden nature, it can become harder to trace the source of a pollution problem and difficult to engage the public to take action. Table 4-62 shows basic information about Tiffany Run.

Table 4-62. Basic Profile of Tiffany Run Subwatershed

Drainage Area	• 893.8 acres (1.4 mi^2)	
Stream length	• 0.16 miles	
Land Use	• Low-Density residential (0.0%) • Med-Density Residential (18.9%) • High-Density Residential (52.0%)	• Open Urban Land (0.4%) (includes forests) • Commercial (3.9%) • Institutional (20.7%)
Current Impervious Cover	• 40.5% of subwatershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (100%) • Baltimore County (0%)	
Soils	• A Soils – 0.0% • B Soils – 0.8%	• C Soils – 5.5% • D Soils – 93.7%
Stormwater management	• County - NA • City - No existing stormwater facilities were identified	

Neighborhood Assessment

Sixteen (16) distinct neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance. Subwatershed boundaries were not used to designate neighborhoods so some neighborhoods may exist in more than one subwatershed. Pollution prevention opportunities to address stormwater volume and pollutants include downspout disconnection, storm drain stenciling, street sweeping and tree planting.

There are 115 impervious building acres in Stemmers Run. Based on an average of 67.5% potential for disconnection, 77.6 impervious building acres were deemed feasible for downspout disconnection. Disconnection efforts should first concentrate on the 3 multi-family neighborhoods due to the efficiencies achieved by coordinating with one landowner instead of individual homeowners.

Many of the neighborhoods in Tiffany Run were assessed using the NSA jr form, which does not require a percent downspout disconnection number hence the ‘nd’ or no data entries in this associated column. Table 4-63 shows a summary of neighborhood recommendations for Tiffany Run.

Table 4-63. Summary of Neighborhood Assessment Recommendations

Site ID	Median lot size (acres)	Recommended Actions									
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Street Sweeping	Trash Mgmt.	Street Trees	Notes
NSA_L_118	Multifamily	nd		X	X					0	Tree planting/curb cut opportunity
NSA_L_170	<1/4	50	X		X	X		X		0	
NSA_L_171	1/8	nd			X			X		0	Alley retrofit
NSA_L_172	1/8	nd			X			X	X	0	Convert open space to parks
NSA_L_173A	Multifamily	nd			X					0	
NSA_L_173B	1/8	nd			X				X	0	
NSA_L_174	Multifamily	nd			X			X	X	0	Tree planting
NSA_L_175	<1/8	75			X	X			X	0	Plant empty parcels
NSA_L_176	<1/8	100			X					0	
NSA_L_20	<1/4	40		X	X		X	X		0	
NSA_L_21	<1/8	80			X	X	X	X	X	80	
NSA_L_49	<1/4	nd		X	X			X	X	0	Waste management
NSA_L_51	1/4	nd			X			X	X	0	Street sweeping
NSA_L_53	<1/4	70	X		X	X	X			0	
NSA_L_54	<1/8	50	X		X			X		0	Street sweep
NSA_L_55	<1/8	75	X		X			X	X	0	Waste mgmt

Hot Spot Assessment

There were no sites were assessed in Tiffany Run for hot spot status.

Stream Assessment

Due to the lack of open channel stream in this watershed, a stream assessment was not conducted here.

Illicit Discharges

Baltimore City will continue with their Illicit Discharge Detection and Elimination programs, seeking to improve techniques and methodologies for more effective reductions of these discharges.

Stormwater Retrofits and Pond Conversions

There were two retrofits and no pond conversions identified in Tiffany Run. Table 4-64 shows the retrofits.

Table 4-64. Summary of Retrofit Opportunities in Moore's Run

Site	Drainage Area (ac)	Description/Classification	Priority
R1	2.0	Dry Swale/Bioretention	Medium
R2	60	Wetpond/Wetland	Medium

Pervious Area Restoration
There were no pervious area assessments performed in Tiffany Run

Institutional Site Assessment

Table 4-65 shows the two institutional areas assessed in the Tiffany Run subwatershed. Parkville Middle School provides an excellent opportunity to combine a lot retrofit, tree planting effort and stream naturalization effort with education. Perhaps an incentive to become a registered Green School could further chances of a successful cooperative effort.

Table 4-65. Summary of Recommendations for Schools and Places of Worship

Site ID	Name of Site	Public/ Private	Greening Opportunities						
			Nutrient Management	Tree Planting (#)	Stormwater Retrofit	Downspout Disconnection	Impervious Cover Removal	Trash Management	Notes
ISI_L_153	Church of the Redeemer	Private	N	0					
ISI_L_154	Winston MS	Public	N	145			X	X	Paint dumping in storm drain

evidence of paint dumping at ISI-L-154

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures according to Table 4-63, focusing efforts on the multi-family neighborhoods.
2. Engage citizens in a storm drain stenciling program and conduct stenciling activities in the neighborhoods indicated in Table 4-63.
3. Raise awareness of trash problem and take measures to reduce litter in the neighborhoods listed in Table 4-63.
4. Engage Institutions sited in Table 4-65 in respective restoration efforts.

Municipal Actions

1. Conduct street sweeping in neighborhoods identified in Table 4-63.

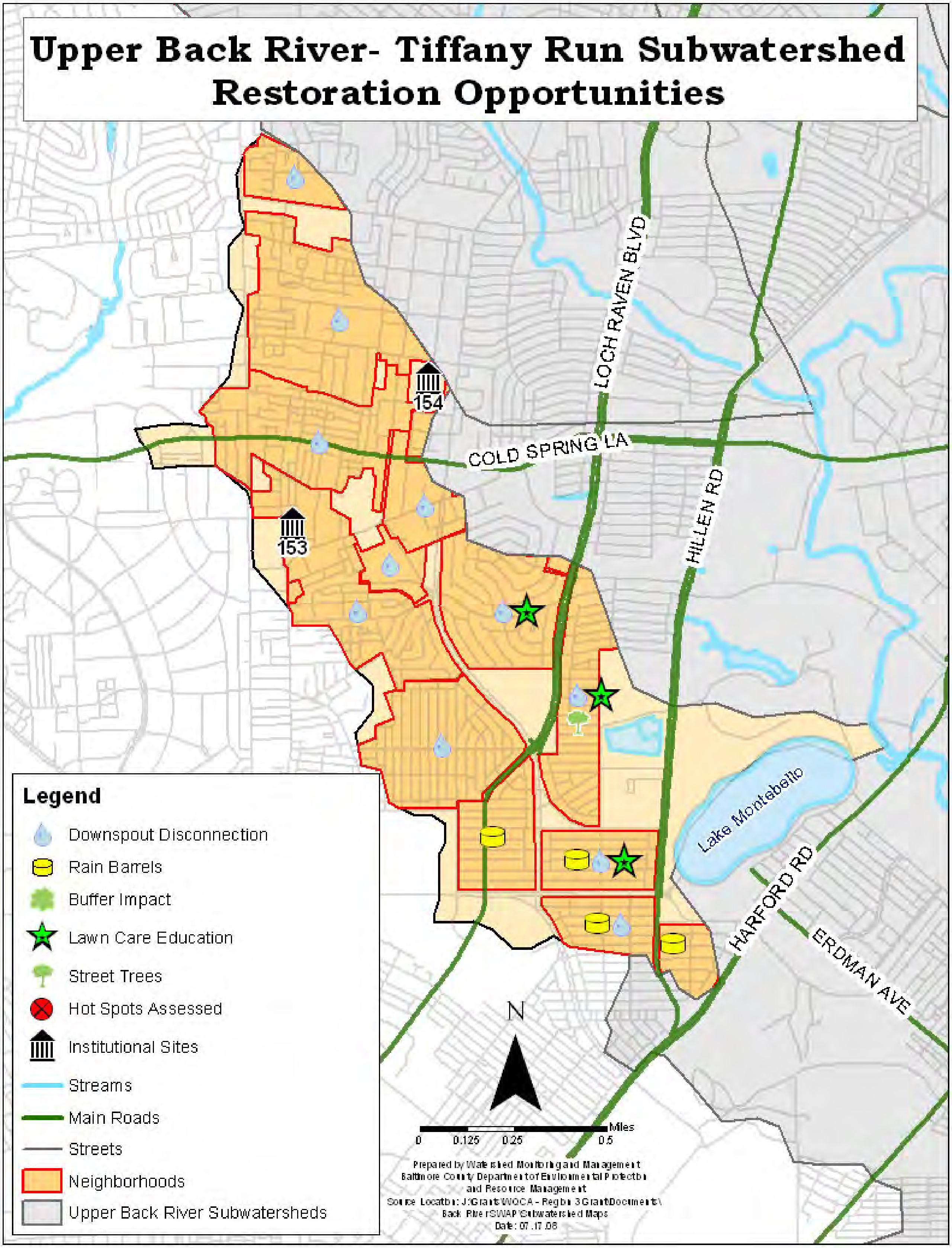


Figure 4-14 – Restoration Opportunities in Tiffany Run

4.3.13 Unnamed Tributary

Subwatershed Description

Unnamed Tributary begins east of 895 just south of the intersection with Erdman Ave. From here it flows east under the railway line and under North Point Blvd. And out to Herring Run. Percentage-wise, this is the most industrialized of the subwatersheds in the Upper Back River SWAP. Table 4-66 shows some basic information about the Unnamed Tributary subwatershed.

Table 4-66. Basic Profile of Unnamed Tributary Subwatershed

Drainage Area	• 580.3 acres (0.9 mi^2)	
Stream length	• 1.84 miles	
Land Use	• Low-Density residential (0.0%) • Med-Density Residential (0.0%) • High-Density Residential (4.5%)	• Open Urban Land (4.3%) (includes forests) • Commercial (29.8%) • Industrial (39.0%)
Current Impervious Cover	• 34.7% of subwatershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (100%) • Baltimore County (0%)	
Soils	• A Soils – 0.0% • B Soils – 0.6%	• C Soils – 16.5% • D Soils – 82.9%
Stormwater management	• City - No existing stormwater facilities were identified • County - NA	

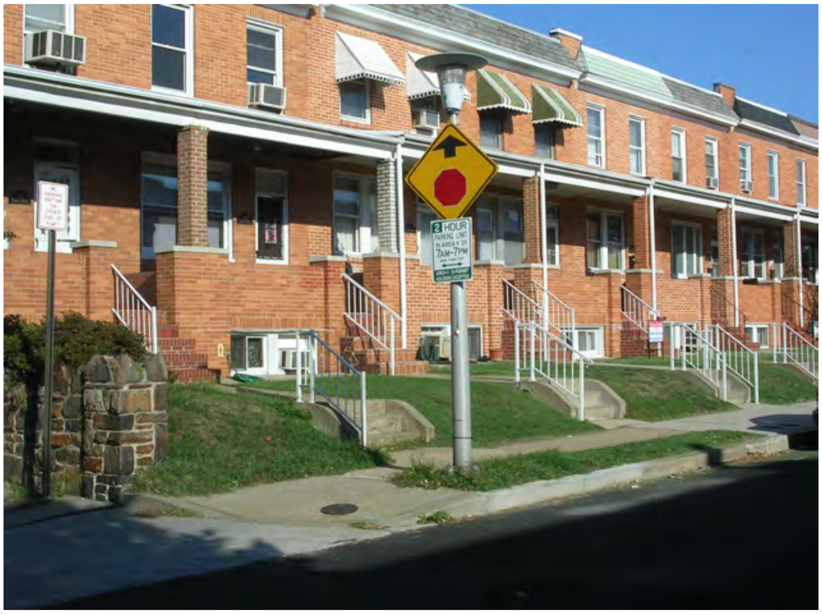
Neighborhood Assessment

Two (2) neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance totaling 28.6 acres Subwatershed boundaries were not used to designate neighborhood boundaries so some neighborhoods may exist in more than one subwatershed. In this case, only 14.6 acres of these two neighborhoods actually fall within the subwatershed.

There are 1.98 impervious building acres in the neighborhood where downspout disconnection is recommended in Armistead Run. Based on an 85% potential for disconnection, 1.7 impervious building acres were deemed feasible for downspout disconnection. NSA-L-61 is a privately owned neighborhood so, similar to multi-family apartment neighborhoods, this would be a good area to target. Table 4-67 shows a summary of neighborhood recommendations for Unnamed Tributary.

Table 4-67. Summary of Neighborhood Assessment Recommendations

		Recommended Actions									
Site ID	**Median lot size (acres)**	**% Opportunity for Downspout Disconnection**	**Rain Barrels**	**Rain Gardens**	**Stormdrain Stencils**	**Bayscape**	**Nutrient Management**	**Pet Waste**	**Buffer Enhancement**	**Street Trees**	**Notes**
NSA_L_168	<1/4	85	X							5	Clean well-kept neighborhood
NSA_L_61	Multifami	50	X		X	X			X	0	Tree planting



typical homes in NSA-L-168

Hot Spot Assessment

Table 4-68 shows the two sites assessed in Armistead Run for hot spot status. Both assessed as confirmed hot spots.

Table 4-68. Summary of Hotspot Sites Recommendations

Status	Site ID	Description	Potential Sources of Pollution					
			Vehicle Operations	Outdoor Storage Materials	Waste Management	Physical Plant	Turf/ Landscaping	Stormwater Management
Confirmed	HSI-L-201	Construction supply		X	X	X		X
Confirmed	HIS-L-202	Body shop/junkyard	X	X	X	X		X

Institutional Site Assessment

There were no institutional areas assessed in the Armistead Run subwatershed.

Stream Assessment

There were no stream assessments performed in Armistead Run.

Illicit Discharges

Baltimore City will continue with their Illicit Discharge Detection and Elimination programs, seeking to improve techniques and methodologies for more effective reductions of these discharges.

Stormwater Retrofits and Pond Conversions

There were no retrofits or pond conversions identified in Unnamed Tributary.

Pervious Area Restoration

There were no pervious area restoration sites assessed in the Unnamed tributary.

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures according to Table 4-67, focusing efforts on the multi-family neighborhoods.
2. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs like The Growing Home Campaign and TreeBaltimore.

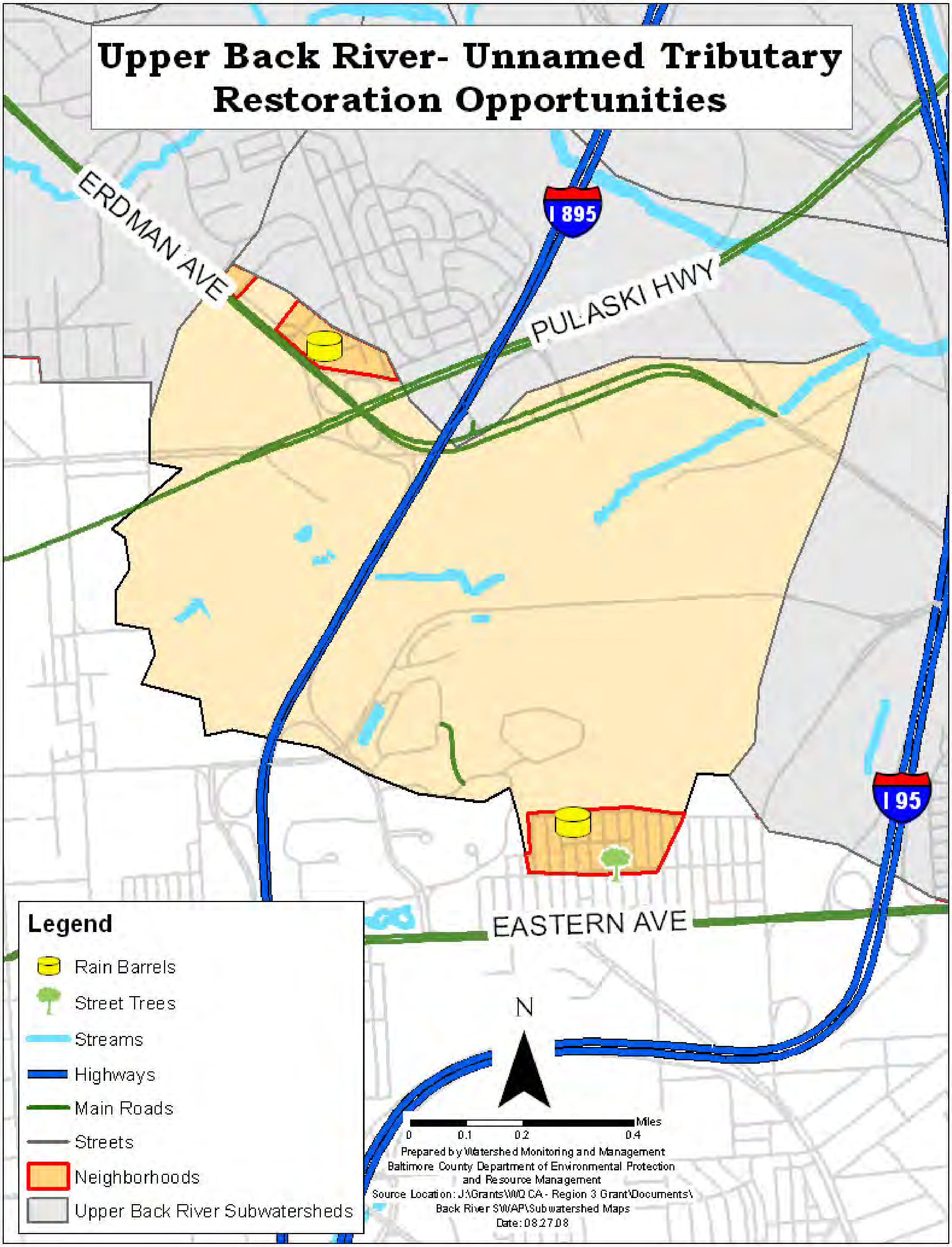


Figure 4-15 – Restoration Opportunities in Unnamed Tributary

4.3.14 West Herring Run

Subwatershed Description

Like Herring Run East, Herring Run West is composed of two tributaries that meet toward the middle of the subwatershed. The longer of the two begins near the intersection of Burke and Aigburth Avenues in Towson. From here it flows past Towson High School, through the southern portion of The Country Club of Maryland golf course and on past the Overlook Park where it joins the shorter tributary. This shorter of the two tribs begins along Loch Raven Boulevard near the Calvert Hall High School and Loch Raven Academy. It flows south past the Glenmont Apartments and the neighborhood of Glendale, past Glendale Park where it meets the first trib at Overlook Park. From the confluence at Overlook Park, Herring Run West flows southeast crossing Loch Raven Boulevard and Northern Parkway, through Mount Pleasant Golf Course where it joins with Herring Run East to form the Herring Run mainstem before crossing Perring Parkway. Table 4-69 shows some basic information about West Herring Run.

Table 4-69. Basic Profile of Herring Run West Subwatershed

Drainage Area	• 1879.7 acres (2.9 mi^2)	
Stream length	• 8.17 miles	
Land Use	• Low-Density residential (1.4%) • Med-Density Residential (37.5%) • High-Density Residential (27.3%)	• Open Urban Land (17.0%) (includes forests) • Commercial (7.1%) • Institutional (7.7%)
Current Impervious Cover	• 28.3% of subwatershed	
Jurisdictions as Percent of Subwatershed	• Baltimore City (23%) • Baltimore County (77%)	
Soils	• A Soils – 4.1% • B Soils – 46.3%	• C Soils – 23.2% • D Soils – 26.3%
Stormwater management	• City - No existing stormwater facilities were identified • County - Only 0.8% of the county portion of the watershed is treated by stormwater facilities	

Neighborhood Assessment

Thirty-three (33) distinct neighborhoods were identified and assessed within the subwatershed as part of the Unified Subwatershed and Site Reconnaissance. Subwatershed boundaries were not used to designate neighborhood boundaries so some neighborhoods may exist in more than one subwatershed. Pollution prevention opportunities to address stormwater volume and pollutants include downspout disconnection, storm drain stenciling, tree planting and public education (i.e. nutrient management). Buffer improvement and lot retrofits along with downspout disconnection seem to be the best opportunities here.

There are 164.6 impervious building acres in neighborhoods where downspout disconnection is recommended in Herring Run East. Based on an average of 51.7% potential for disconnection, 85 impervious building acres were deemed feasible for downspout disconnection. Disconnection efforts should first concentrate on the multi-family neighborhoods with high opportunities for disconnection due to the efficiencies achieved by coordinating with one landowner instead of individual homeowners. Table 4-70 shows a summary of neighborhood recommendations for West Herring Run.

poor sediment control in NSA-L-89

Table 4-70. Summary of Neighborhood Assessment Recommendations

Site ID	Median lot size (acres)	Recommended Actions									
		% Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Pet Waste	Buffer Enhancement	Street Trees	Notes
NSA_L_100	Multifamily	30		X	X	X			X	0	Dumpsters and mulch piles drain to stream
NSA_L_102A	Multifamily	40		X	X	X	X		X	0	Trees/buffer improvement/bioretention
NSA_L_107	Multifamily	15				X				30	Tree planting
NSA_L_108	Multifamily	10				X				50	Tree planting
NSA_L_110B	Multifamily	nd								0	Impervious removal/alley
NSA_L_111	Multifamily	85		X		X				0	
NSA_L_112	<1/4	30		X	X	X			X	0	Concrete buffer in park/
NSA_L_119	Multifamily	30	X		X		X			0	Lot retrofit
NSA_L_131	1/4	90		X	X	X	X			0	
NSA_L_132	1/8	60			X		X			nd	Street trees
NSA_L_133	1/3	90		X			X			0	
NSA_L_134	1/2	50		X	X	X	X			0	
NSA_L_135A	1/4	90		X		X	X		X	0	Cul de sac retrofits
NSA_L_135B	1/4	90		X		X	X		X	0	
NSA_L_136	1/3	80		X			X			nd	Street trees
NSA_L_137	1/3	80			X		X			0	
NSA_L_138A	1/3	20		X	X	X	X			0	
NSA_L_139	1/8	90			X	X	X			nd	Street trees
NSA_L_140	1/8	50			X	X	X			50	

Site ID	Median lot size (acres)	Recommended Actions: % Opportunity for Downspout Disconnection	Rain Barrels	Rain Gardens	Stormdrain Stencils	Bayscape	Nutrient Management	Pet Waste	Buffer Enhancement	Street Trees	Notes
NSA_L_24	1/2	40		X	X					50	
NSA_L_32	1/4	85	X	X		X				50	Tree planting
NSA_L_34	<1/8	nd	X		X					0	
NSA_L_37	1/8	80	X	X		X				20	
NSA_L_89	Multifamily	90		X	X	X	X		X	50	Sediment control issue
NSA_L_90	Multifamily	50		X	X	X	X			0	
NSA_L_91	Multifamily	100			X	X				15	Sediment control
NSA_L_92	Multifamily	90		X	X	X	X		X	0	Stream naturalization

Hot Spot Assessment

Table 4-71 shows the two sites assessed in Herring Run West for hot spot status

Table 4-71. Summary of Hotspot Sites Recommendations.

Status	Site ID	Description	Potential Sources of Pollution: Vehicle Operations	Outdoor Storage Materials	Waste Management	Physical Plant	Turf/Landscaping	Stormwater Management
Potential	HSI_L_501	Shopping center			X	X	X	X
Not a hotspot	HIS_L_502	Shopping center						X

Institutional Site Assessment

Table 4-72 shows the ten institutional areas assessed in the Herring Run West subwatershed.

Table 4-72. Summary of Recommendations for Schools and Places of Worship

Site ID	Name of Site	Public/ Private	Greening Opportunities: Nutrient Management	Tree Planting (#)	Stormwater Retrofit	Downspout Disconnection	Impervious Cover Removal	Trash Management	Notes
ISI_L_501	Stoneleigh ES	Public	N	100	X	X			stream naturalization
ISI_L_503	Loch Raven Academy	Public	Y	65	X				
ISI_L_504	Calvert Hall	Private	Y	55					poor sediment control for construction

Site ID	Name of Site	Public/ Private	Greening Opportunities						
			Nutrient Management	Tree Planting (#)	Stormwater Retrofit	Downspout Disconnection	Impervious Cover Removal	Trash Management	Notes
ISI_L_514	Mercy HS	Private	Y	75					
ISI_L_515	Yorkwood ES	Public	N	135			X		
ISI_L_522	Country Club of MD	Private	Y	0					
ISI_L_527	Towson HS	Public	Y	120				X	sediment control, invasive removal by stream
ISI_L_529	St. Andrews Epic.	Private	N	20		X			
ISI_L_530	Loch Raven Methodist	Private	N	20		X			
ISI_L_534	Emmanuel Lutheran Church	Private	N	110					

Stream Assessment

A stream stability assessment was conducted by Parsons Brinkerhoff in the county portion of the Herring Run subwatershed. The stream assessment performed did not discern between the Eastern and Western Branches, so the data is presented here as a combination of those two subwatersheds.

The subwatershed deficiencies as outlined in the PB report are as follows:
Problems with the Herring Run subwatershed include moderate bank erosion potential, various channel disturbances, fish blockages and only 67% of in-stream habitat rated fair. Channel disturbances include culverts causing fish blockages and invasive plants. Table 4-73 shows a summary of the problems found during the stream assessment in the county portion of Herring Run.

Table 4-73. Summary of Stream Conditions in Herring Run

Stream Opportunities	Number of Problems
Restoration/Stabilization	24
Buffer Enhancement	5
Bank Planting	54
Utility Conflicts	0
Wetland Enhancement	5
Yard Waste Education	13
Invasive Plant Removal	17
Trash Dumping	25

Illicit Discharges

Baltimore County uses a prioritization system for sampling outfalls for illicit discharges. Priority one describes an outfall with major problems including the presence of chemicals in the water. Priority two describes outfalls with moderate problems including erosion and trash but no chemical problems detected. Priority 1 outfalls are sampled four times per year and priority 2 outfalls are sampled once per year. There is one priority 1 outfall and five priority 2 outfalls in county portion of Herring Run West.

Baltimore County and Baltimore City will continue with their Illicit Discharge Detection and Elimination programs, seeking to improve techniques and methodologies for more effective reductions of these discharges.

Stormwater Retrofits and Pond Conversions

There were five retrofits and no pond conversions identified in West Herring Run. The retrofits are shown in Table 4-74.

Table 4-74. Summary of Retrofit Opportunities in West Herring Run

Site	Drainage Area (ac)	Description/Classification	Priority
R1	0.4	Rain Gardens	High
R2A	0.3	Permeable Pavers	Medium
R6A	1.0	Impervious Cover Removal	High
R6B	17.5	Piedmont Outfall	Medium

Pervious Area Restoration

Table 4-75 shows the two possible pervious area restoration sites identified during the assessment. Both sites exhibit opportunity for tree planting. Pervious area restoration has the potential to convert areas of turf, sometimes a relatively high nutrient input land use, to forest which can absorb rather than shed nutrients.

Table 4-75. Summary of Pervious Area Recommendations

Site	Location	Description	Size (acres)	Ownership
PAA-L-501	Loch Raven Blvd	Loch Raven Academy	6	Public
PAA-L-502	Glendale & Queens Ferry	Neighborhood open space	1	Public

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Provide lawn care education to neighborhoods identified with high turf management in Table 4-70. Note all these neighborhoods are in the northern half of the subwatershed. Work with homeowners in these neighborhoods to reduce the amount of nutrients applied to their lawn and other pollution prevention measures.
2. Conduct appropriate downspout disconnection measures according to Table 4-70, focusing efforts on the multi-family neighborhoods. Many of the neighborhoods in Herring Run West have lots where rain gardens are recommended.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs like The Growing Home Campaign and TreeBaltimore.
4. Engage Institutions sited in Table 4-72 in restoration efforts, especially tree plantings.
5. Engage citizens in a storm drain stenciling program and conduct stenciling activities in the neighborhoods indicated in Table 4-70.

Municipal Actions

1. Evaluate 2,000 ft. of concrete stream channel below Overbrook Park to the city/county line for potential naturalization.
2. Identify and conduct feasible restoration measures based on the many recommendations of the Parson's stream stability assessment (Table 4-73).

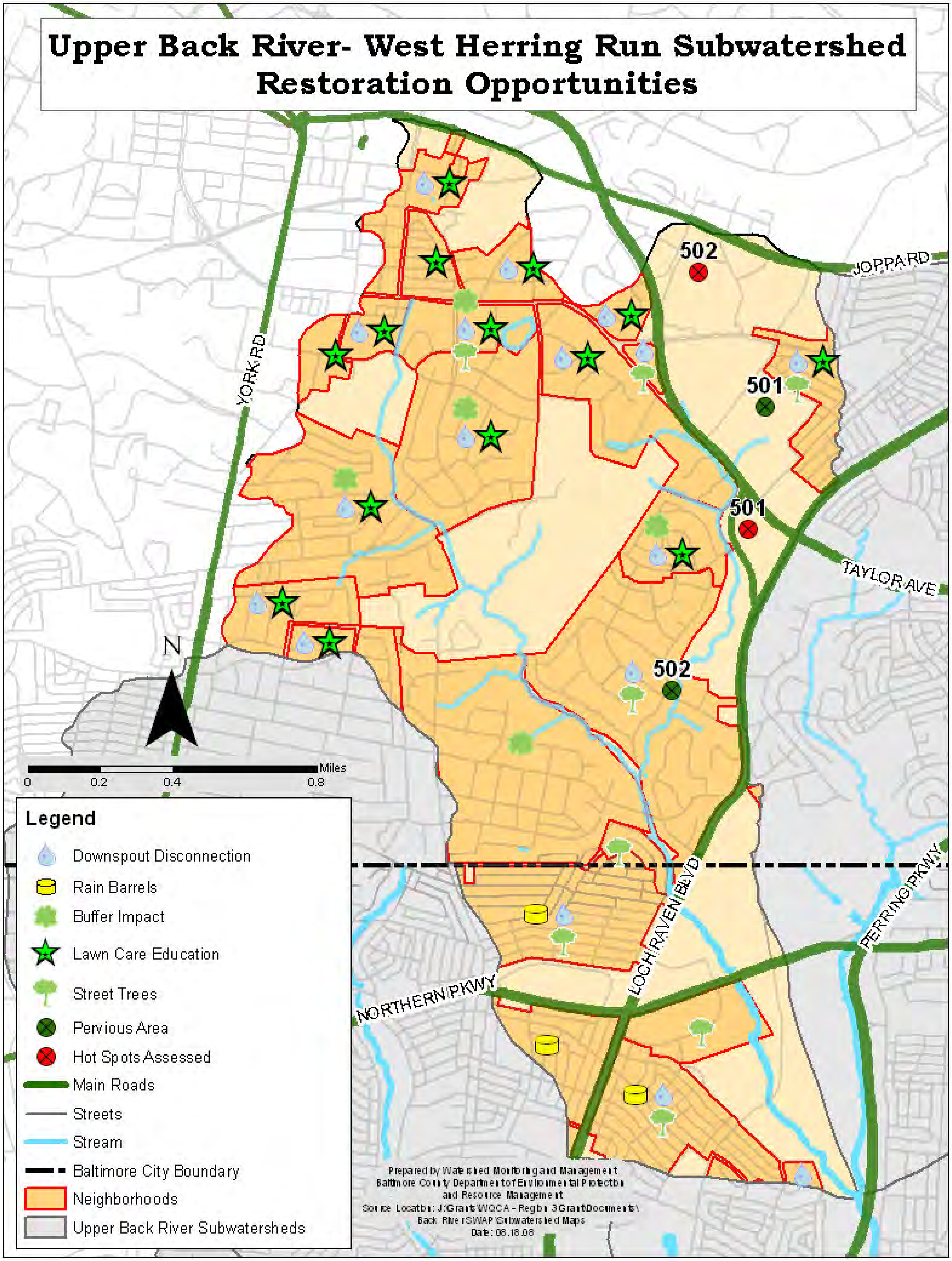


Figure 4-16 – Restoration Opportunities in the West Herring Run Subwatershed

CHAPTER 5

EVALUATION

5.1 Interim Measurable Milestones

The Upper Back River Small Watershed Action Plan (SWAP) Steering Committee plans a 20-year implementation schedule, with annual milestones as laid out in the actions detailed in Appendix A. This timeframe is necessary because of extensive restoration work that is needed to meet the nutrient TMDL, the available staff time, and funding considerations. The Upper Back River SWAP Implementation Committee (an outgrowth of the Upper Back River Steering Committee) will meet twice yearly to assess progress in meeting the goals and objectives, and to discuss funding options. The performance measures for each action are detailed in Appendix A and will be used to gauge progress. An annual progress report and a biennial report on water quality monitoring results will be produced.

The Upper Back River Steering Committee anticipates using an adaptive management approach for meeting the goals and objectives detailed in this report. As an annual interim measure, the annual progress and success of each action (Appendix A) will be evaluated, along with proposed new actions. Incorporated in this evaluation will be the inclusion of any new best management practice efficiencies and their effect on the overall progress in meeting the SWAP goals. Based on the evaluation, the action strategy may be changed to facilitate meeting the goals and objectives. The ability to implement this plan within the 20-year timeframe is dependent on the availability of staff and sufficient funding.

Additional interim measurable milestones include:

- Nutrients: Achieve a 5% reduction of both phosphorus and nitrogen after 5 years of implementation. This will be based both on the implement tracking and on the monitoring described below.
- Bacteria: Achieve a 40% reduction after 5 years of implementation, based on the Bacterial Source Tracking Monitoring Program described below.

If additional TMDLs are developed (Chesapeake Bay TMDL anticipated in 2010), or other water quality issues arise, the Upper Back River SWAP Implementation Committee will initiate a revision of the plan within six months of the TMDL approval, or the water quality issue arises, to address the water quality improvements needed to meet the new TMDL or address the issue.

5.2 Criteria for Load Reduction

The Upper Back River SWAP Steering Committee has determined that the average pollutant load reductions approved by the EPA Chesapeake Bay Program will be used to measure progress in meeting the TMDL phosphorus and nitrogen reduction goal (15% reduction). These reduction efficiencies are detailed in Appendix D. The current load reduction scenarios for phosphorus and nitrogen are presented in Chapter 3, along with specific information on how the load reductions were calculated. The Chesapeake Bay Program is currently reassessing the pollutant load reduction efficiencies. When the new efficiencies are available, they will be used to reassess the actions needed to meet the nitrogen and phosphorus load reductions in the Upper Back River watershed.

5.3 Implementation Tracking

The Upper Back River SWAP Implementation Committee will within two years develop an implementation-tracking tool that accounts for all restoration activities. Currently, there is no consistent tracking mechanism used by Baltimore County, Baltimore City, and Herring Run Watershed Association. This tracking will be developed in conjunction with the Baltimore Watershed Agreement participants to provide a consistent restoration tracking system for all Baltimore County and Baltimore City watersheds.

This tracking tool will permit the assessment of progress in meeting the interim mile stones by comparing the progress to the Performance Measures listed for each action in Appendix A. The tracking tool will also provide information on the pollutant load reduction progress that has been accomplished through the implementation of the restoration projects.

5.4 Monitoring

Baltimore County, Baltimore City, and the Herring Run Watershed Association currently conduct monitoring programs within the Upper Back River watershed (5.4.1), but additional monitoring is anticipated to assess the effectiveness of restoration projects and progress in meeting the load reductions for the nutrient TMDL (5.4.2).

5.4.1 Existing Monitoring

The existing monitoring programs described in Upper Back River – Characterization Report (Appendix E), will continue. These programs consist of:

- Chemical monitoring at fixed sentinel sites, conducted by both Baltimore County and Baltimore City
- Biological monitoring at both fixed and randomly chosen sites, conducted by both Baltimore County and Baltimore City,
- Citizen based Stream Watch Program, coordinated by Herring Run Watershed Association and
- Illicit connection monitoring conducted by both Baltimore County and Baltimore City.

Coordination of these monitoring activities among the SWAP participants (Baltimore County, Baltimore City, and Herring Run Watershed Association) will be enhanced through participation in the Upper Back River SWAP Implementation Committee and through coordination activities identified by the Baltimore Watershed Agreement Action Strategies.

5.4.2 Implementation Monitoring

Monitoring activities specific to this Small Watershed Action Plan will be focused on project specific monitoring for effectiveness and targeted monitoring of subwatersheds to measure overall improvement in water quality from multiple restoration actions within a subwatershed. The initial subwatershed targeted for monitoring is Redhouse Run, and the initial project monitoring will focus on the St. Patrick Road Stream Restoration Project. A Quality Assurance Project Plan (QAPP) is currently being developed for this monitoring component.

Additional monitoring activities targeting specific projects will be identified as restoration progresses. Given the number of restoration actions called for in the SWAP, it will not be possible to monitor all restoration projects. Additional project monitoring will be targeted at those activities that have limited monitoring data on efficiencies, such as, lawn care education and various types of rooftop disconnects. Where possible these additional monitoring activities will be conducted in Redhouse Run above the subwatershed monitoring station, and the project specific QAPP incorporated into the Redhouse Run QAPP.

During the first two years of implementation, Baltimore County and Baltimore City will develop and implement a Bacterial Source Tracking monitoring programs to address the uncertainty in the location of bacterial sources. This program will be used to target restoration activities that address the reduction in bacteria to meet the bacteria TMDL reduction requirements. Data generated by the Bacteria Source Tracking Program will also be used to determine bacteria concentration trends over time and assist Maryland Department of the Environment in determining if bacteria water quality standards are being met.

ACKNOWLEDGEMENTS

UPPER BACK RIVER STEERING COMMITTEE

The Upper Back River Small Watershed Action Plan was developed with cooperation and input from citizen organizations and local agencies that represent the interests of the Upper Back River watershed.

Organization	*Representative*
Herring Run Watershed Association	Mary Roby, Darin Crew
Baltimore City Department of Public Works – Water Quality Office	Bill Stack
Baltimore County Department of Environmental Protection and Resource Management	Steve Stewart, Nancy Pentz, Nathan Forand, Chris Barnes
Center for Watershed Protection	Paul Sturm, Julie Tasillo
Consultant	Fran Flanigan, Christel Cothran

TECHNICAL ASSISTANCE/REPORTS

Development of the Upper Back River Small Watershed Action Plan was supported technically by the following assessments and technical reports:

Technical Report	*Representative*
Upland Surveys (Neighborhood Source Assessments, Hotspot Assessments, Pervious Area Assessments, and Institutional Site Assessments)	Nathan Forand, Angela Johnson, Megan Brosh – DEPRM Paul Sturm, Mike Novotney, Julie Tasillo, Tiffany Wright, Lisa Fraley-McNeal, Hye Yeong Kwon – Center for Watershed Protection Darin Crew – Herring Run Watershed Association
Stream Corridor Stability Assessment	Parsons, Brinkerhoff, Inc. in association with Coastal Resources, and EBA Engineering
Stormwater Facility Assessment	Steve Stewart, Hee Song (intern) – DEPRM
Watershed Characterization	Steve Stewart, Nathan Forand, Chris Barnes DEPRM

This project was funded in part by the US Environmental Protection Agency (EPA), Region III – Water Quality Assistance Grant CP-973423. Although this project is funded in part by the EPA, it does not necessarily reflect the opinion or position of the EPA.

APPENDIX A

SMALL WATERSHED ACTION PLAN STRATEGIES

This appendix presents the actions related to the goals and objectives presented in Chapter 2, including the expected benefits, the timelines, the performance measures, estimated unit costs, and responsible parties. In many cases, the actions fall under a number of goals and objectives. When this occurs, multiple goals and objectives are indicated as being associated with the action.

The actions are grouped according to the type of activity. The groupings are:

- Restoration Actions
- Awareness Activities
- Monitoring Activities
- Funding Activities
- Reporting Activities

The responsible parties are indicated by numeral with the code shown in Table A-1.

Table A-1: Codes for Responsible Parties Listed for Actions in Table A-2

Organization	Numeric Code
Baltimore County Dept. of Environmental Protection and Resource Management	1
Baltimore City Government	2
Herring Run Watershed Association	3
Upper Back River SWAP Implementation Committee	4

Implementation progress will be dependant on future funding availability for the various organizations involved. The funding would be for additional staff and implementation of projects identified within Table A-2. The Upper Back River SWAP Implementation Committee will aggressively pursue grant opportunities as they become available, subject to staff capacity to manage the grants and availability of matching funds.

Table A-2: Recommended Actions to Meet the Upper Back River SWAP Goals and Objectives

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
Restoration Actions							
2 3 5	4 1, 2 3	Restore 12.5 miles of eroded stream banks (based on 30% unstable streams assessed in SR,HR,BR)	Water quality and aquatic habitat improvement	20 years	0.65 miles per year	$300/ linear foot	1, 2
1 5 7	1, 2 5 2	Convert 17 of 23 feasible existing dry detention stormwater ponds to an enhanced treatment method within 17 years addressing 103 acres of urban land.	Provides water quality improvement	17 years	1 Stormwater conversion installed per year	$120,000/ pond	1, 2
1 5 6	1, 2, 5 1,2,3,5 1	Investigate the feasibility of installing the 66 identified retrofit opportunities.	Identifies water quality opportunities	2 years	Feasible retrofits identified	Existing Staff	1, 2
1 5 6	1, 2, 5 1, 2, 3 1	Install stormwater 50 retrofits at the feasible sites.	Provides water quality	17 years	3 Stormwater retrofit installed per year	$50,000/ retrofit	1, 2, 3
6	2	Ensure that the 33 hotspots investigated have, if required, NPDES general stormwater discharge permits and are in compliance.	Provides facilities with pollution prevention plans to address spill events and other discharges	11 years	3 per years	Existing Staff	1, 2
3 5 6	2, 3 3 1	Investigate the feasibility of planting riparian buffers on publicly owned land.	Provides water quality and enhances terrestrial and aquatic habitat	2 years	Public land riparian buffers planted	Existing Staff	1, 3
3 4 7 8	2 1, 4 4 1	Reforest 200 acres of riparian buffers, minimum width of 35 feet.	Water quality improvement, stream temperature moderation, increased terrestrial and aquatic habitat	20 years	10 acres per year	$4,250/ ac.	1, 2, 3
3 4 7 8	2 1, 4 4 1	Plant forest on 50 acres PAA exhibiting “open pervious” cover type and “minimal site prep”.	Land use conversion	20 years	2.5 acre of converted forest cover per year	$4,250/ acre	3
3 4 7 8	2 1, 4 4 1	Plant street trees. Maximum potential 4,000 (10 acres)	Land use conversion	20 years	200 trees per year	$4,250/ acre	3
3	2	Baltimore County and Baltimore City shall continue to require riparian buffers and forest conservation for all new development and redevelopment.	Preserves existing riparian forest buffer	On-going	Acres preserved	Existing Staff	1, 2

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
4 8	1,4 1	Encourage institutions to plant trees on available open space.	Potential land use conversion	10 years	1 Institution per year	Existing Staff	1, 2, 3
5	2	Remove impervious cover at the 10 institutions where removal was recommended.	Land use conversion	10 years	1 Institution per year	$	1, 2, 3
1	1,2	Assure that all turf management operations have an Urban Nutrient Management Plan when required by COMAR	Improves water quality, economic savings for lawn care operations	5 years	100% of turf management operations have an Urban Nutrient Management Plan	Existing Staff	1, MDA
1 8	1, 2 4	Reduce fertilizer use on 3,000 acres of residential high maintenance lawns.	Reduces nutrient load	20 years	150 acres per year	Existing Staff	3
6 8	1 1,2,3	Reduce lawns and plant bayscapes in the 177 neighborhoods identified.	Reduces nutrient load and lawn maintenance	20 years	9 neighborhoods per year	Existing Staff	3
1 5	1, 2 1,4	Disconnect downspouts and redirect to lawn. Install raingardens or rainbarrels on 180 acres of impervious roof top.	Water quality improvement	20 years	Address 9 impervious acres/yr..	$150/ house	3
1	1, 2	Continue municipal road maintenance street sweeping activities. Investigate the 228 miles of streets that appeared to need enhanced street sweeping for potential increase in frequency.	Reduces nutrient and sediment loads	On-going	lbs. collected	Existing operations	1, 2
7	2,4	Participate and support Project Clean Stream	Reduces trash	On-going	Lbs trash removed per year	Existing staff and volunteers	1, 2, 3
3 4 7	3 4 4	Organize 1 exotic invasive species removal activity addressing 2 acres per year.	Improves forest habitat	20 years	Exotic species removed from 2 acres per year	$500	3
6 4	1 3	Provide for on-going maintenance through periodic inspection of implemented BMPs.	Assures continued functioning of BMPs	20 years	Inspections completed	Existing Staff	1, 2, 3, 4
1 7	1,2,4 1	Baltimore County and Baltimore City shall continue to remove illicit connections when discovered through the respective Illicit Connection Programs	Reduces pollutants	On-going	Reported annually in NPDES MS4 Permits	Existing Staff	1
6	1	Implement the recommendations detailed by the Baltimore County Builders for the Bay.	Reduces impact of new development	3 years	Recommendations implemented	Existing Staff	1
6	1	Baltimore City will continue with the on-going Builders for the Bay process.	Reduces impact of new development	1 year	B4B Report produced	$115,000	3

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
2	1	Review and comment on the Biological TMDL when developed by Maryland Department of the Environment.	Assures understanding of the TMDL	When developed by MDE	Comments produced	Existing Staff	1, 2
1 1 7	3 4 1	Baltimore County and Baltimore City shall continue to meet the requirements of there respective consent decrees for the elimination of sanitary sewer overflows	Reduces nutrients, bacteria and other pollutants	On-going	Status report	Existing Staff	1, 2
Raising Awareness							
1 8	1,2 1,4	Conduct education on urban nutrient management and create materials if needed.	Improves water quality	20 years	Distribute materials	$5,000/ year, Existing Staff	4
5 6	4 2	Prepare information for facilities that are either potential or confirmed hotspots. Include NPDES general stormwater requirements and guidance on reducing risk of having an episodic event that impacts water quality and aquatic life.	Watershed awareness to business groups	2 years	Outreach material developed	Existing Staff	1, 2
5 6	4 2	Distribute information to hotspots and provide guidance/workshops. 34 hotspots identified.	Watershed awareness to business groups	6 years	1 workshop every two years. Outreach material distributed	Existing Staff	1, 2
7	4	Continue to implement Stream Watch, a citizen-based program, to increase the ability to identify sources of water quality and habitat degradation.	Watershed education, additional identification on sources of impairment, and potential restoration locations	20 years	# of stream miles adopted.	Existing Staff	1, 3
3 4 5 8	3 4 4 4	Inform community groups about the BMPs recommended in the NSA assessment.	Watershed awareness to community groups	20 years	5 neighborhood informational meetings per year	Existing Staff $50/event	1, 2, 3, 4
3 8	3 1,2,3, 4	Inform community groups and other County and City agencies about the BMPs recommended in the PAA assessment.	Watershed awareness to community groups and government agencies	20 years	1 every two years neighborhood meetings per year	Existing Staff $50/event	1, 2, 3, 4
3 4 5 6 8	2,3 1,4 1,2,4 1 1,4	Inform institutional partners about the BMPs recommended in the ISI assessment.	Watershed awareness to institutions	20 years	2 Institution meetings per year	Existing Staff $50/event	1, 2, 3, 4

Goal	Objec tive	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
Measuring and Monitoring							
1 7	1,2,4 1	Baltimore County to continue the illicit connection monitoring at the 82 major outfalls in the UBR and complete one inspection at each of the 266 minor outfalls.	Identifies pollutant locations	5 years	70 outfalls per year	Existing Staff	1
1 7	1,2,4 1	Baltimore City to continue the illicit connection monitoring at the 14 sites in Upper Back River and conduct Pollution Source Tracking investigations.	Identifies pollutant locations	5 years	~ 500 samples per year	Existing Staff	2
2	2	Develop in conjunction with the Maryland Biological Stream Survey (MBSS) a methodology to assess the biological improvements of urban streams as a result of restoration.	Provides an accounting of biological improvements	3 years	Urban biological indicators developed	Existing Staff	1, 2
2	3	Baltimore County shall continue its program of probabilistic biological monitoring. Baltimore City to continue its biological monitoring program (every third year)	Provides data on the biological health of streams	Even number years	Stations monitored and report produced	Existing Staff, $4,500/ station (BA)	1
1	3,4	Develop and implement a bacteria source tracking and monitoring program.	Address bacterial impairment.	2 years	Develop a bacteria source tracking monitoring program	Existing Staff	4
1	1,2,4	Develop Quality Assurance Project Plans for monitoring projects and subwatersheds to measure restoration progress	Provides quality data to measure restoration progress	As needed (Redhouse Run QAPP within 6 months)	Progress tracking	Existing Staff	1, 2
4	2,3	Develop an urban tree management program that increases a healthy urban tree canopy and includes monitoring of the quantity and health of trees	Land use conversion	2 years	Coordinated effort for improving urban tree canopy	Existing Staff	1, 2, 3, 4
1	1,2	Develop a method to measure and monitor residential fertilizer use	Provides an accounting of nutrient reductions	5 years	Monitoring protocols developed for residential fertilizer use	Existing Staff	1, MDA

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
1	1,2,4	Continue supporting USGS gages to enhance the ability to measure flow and calculate pollutant loads.	Provides data for the calculation of pollutant loads	On-going	USGS annual data report	$7,215	1, 2
2 4 6 7	3 1, 2, 3 1 3	Implement the monitoring and measuring actions developed under the Baltimore Watershed Agreement (BWA).	Additional data for measuring improvements to streams	10 years	BWA Action Strategy Document	Existing Staff	1, 2
Funding							
1 3 5	3,5 2 5	Coordinate grant funding requests to secure funding and implement restoration projects to meet TMDL nutrient and bacteria reductions requirements within 20 years. Seek a minimum of 3 grants per year	Accelerated restoration	20 years	3 grant proposals submitted per year	Existing Staff	4
4 5	5 2,4	Increase applications for the Baltimore County – Green Building Tax Credit Program as a model.	Provide incentive for landowners to install best management practices to address water quality and habitat	10 years	Number of applications	Existing Staff	4
Reporting							
All	All	Upper Back River SWAP Implementation Committee to meet on a semi-annual basis to discuss implementation progress and assess any changes needed to meet the goals.	Assures continued progress in implementation and adaptive management	20 years	2 meeting per year	Existing Staff	4
All	All	Coordinate restoration activities between and among Baltimore County, Baltimore City, and the Herring Run Watershed Association.	Assures continued progress in implementation and adaptive management	On-going	NPDES Annual reports	Existing Staff	4
1	3	Designated County and City personnel should provide updates to the SWAP Implementation Committee/ Sewer Coalition on the status of the Consent Decree projects for sewer infrastructure repairs.	Provides coordination between local government and citizens on issues related to the Consent Decree,	10 years	Minutes from meetings	Existing Staff	1, 2
All	All	A water quality monitoring report in conjunction with the Baltimore Watershed Agreement will be produced biennially.	Summarizes the state of the watershed	Every 2 years	Report produced	Existing Staff	1, 2

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
All	All	Develop a unified restoration tracking system to track progress toward meeting TMDL reduction requirements	Provides a consistent method for tracking restoration progress	2 years	Tracking system developed	Existing Staff	4
3 4 5 7 8	3 4 1, 4 2, 4 1, 4	Continue to update the status of citizen based restoration projects and BMPs.	Provides an accounting of progress made	2 years	NPDES Annual reports	Existing Staff	3
1 2 5	1, 2, 3 4 5	Continue to update status of County and City Capital budget restoration projects and BMPs.	Provides an accounting of progress made	2 years	NPDES Annual reports	Existing Staff	1, 2

APPENDIX B

US ENVIRONMENTAL PROTECTION AGENCY

A THROUGH I CRITERIA FOR WATERSHED PLANNING

This appendix will provide information on how the development of the Upper Back River Small Watershed Action Plan addresses the 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. A more detailed discussion of how the document meets the A through I Criteria is provided below Table B-1.

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

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

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

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

d) An estimate of the 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 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 B-1: Where to Locate Information for Each Criteria Element

	EPA Criteria Element								
Section of the Report	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Chapter 1		X							
Chapter 2		X							
Chapter 3	X	X	X		X				
Chapter 4			X		X				
Chapter 5							X	X	X
Appendix A			X	X	X	X	X		
Appendix B									
Appendix C				X					
Appendix D		X						X	
Appendix E	X								
Appendix F									
Appendix G	X								
Appendix H	X								
Appendix I	X								
Appendix J	X								
Appendix K									

The following will provide a discussion on how the development of the Upper Back River Small Watershed Action Plan addresses the US Environmental Protection Agency (EPA) A through I criteria for watershed planning. It will serve as a guide to the location within the document, including the appendices, where each criteria 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 Back River watershed is listed on the 303(d) list as impaired by nutrients (tidal waters), bacteria (Herring Run), chlordane in fish tissue (tidal waters), PCBs in fish tissue (tidal waters), total suspended solids (tidal waters), and biologically impaired (streams). TMDLs that have been developed for nutrients, bacteria, and chlordane, that identify the causes and sources of pollutants that will need to be controlled to meet the load reductions to achieve water quality standards. These documents can be found in:

- Appendix H – Total Maximum Daily Loads of Nitrogen and Phosphorus for Back River in Baltimore City and Baltimore County, Maryland (MDE 2005)
- Appendix I – Total Maximum Daily Loads of Fecal Bacteria for Northern Portion of Herring Run in Baltimore County and Baltimore City, Maryland (MDE 2006)
- Appendix J – Total Maximum Daily Load Documentation for Chlordane in Back River (MDE 1999)

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 the Upper Back River Characterization Report (Appendix E), Chapter 4. The stream corridor assessment results are presented in Back River Characterization Report (Appendix E), Chapter 3 and Appendix G (Upper Back River Watershed Stream Stability Assessment (Parsons, Brinkerhoff (2008).

Further analysis of pollution sources are provided by a GIS analysis of potential landscape indicators of pollution presented in the Upper Back River Characterization Report (Appendix E), Chapter 2 and a specific analysis of the contribution of sanitary sewer overflows the Upper Back River Characterization Report (Appendix E), Chapter 3, pages 3-12 to 3-15.

Further pollutant load analysis is provided in the Upper Back River Characterization Report (Appendix E), Chapter 3-17 through 3-24.

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 phosphorus load reductions were based on the EPA - Chesapeake Bay Program load reduction criteria used in their Phase 5 model for the water quality impairments of the tidal Chesapeake Bay. These load reductions are presented in Appendix D. Using the information in Appendix D, the phosphorus load reductions for the various actions were calculated and presented in Appendix E (Table E-4).

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, pages 3-6 through 3-11. Chapter 4 details the management measures for each subwatershed in the Upper Back River.

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 C 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 earl 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 (pages 3-5 and 3-6) detail 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 20-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, an annual report on implementation progress will be produced by the Implementation Committee.

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 D). 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 h above.

APPENDIX C

COST ANALYSIS AND A LISTING OF POTENTIAL FUNDING SOURCES

This Appendix provides an analysis of the potential cost of implementation of the Upper Back River Small Watershed Action Plan and a listing of potential funding sources. The cost analysis is a best estimate of the cost of implementation in today's dollars and has not been annualized over the anticipated 20-year implementation timeframe. In order to provide an assessment of the benefits of implementation, where possible, the cost is also expressed in dollars per pound of phosphorus removal. This is usually not the only criteria in selecting the restoration options, but does provide an additional tool for assessing which best management practices to use.

C.1 Cost Analysis

Table C-1 presents the cost analysis. The cost analysis is based on the actions detailed in Appendix A and the nitrogen and phosphorus load reductions in Chapter 3. This analysis does not include the cost of existing staff. Best estimates of the cost were used based on local information and cost information gleaned from previous Watershed Restoration Action Strategies. The table presents:

- BMP or Action
- units (acres, linear feet, number)
- pounds of nitrogen and phosphorus removal (this is for full implementation)
- the unit cost
- extended cost – the unit costs times the number of applicable units
- cost per pound of nitrogen and phosphorus removal – extended costs/pounds of nitrogen and phosphorus removal
- cost over the 20 year timeframe of implementation – this is based on the comments column, in some cases the costs in the extended column are based on an annual basis, in others it is based on full implementation
- comments – indicate whether extended cost is annual or one costs (20 years)

The total cost of implementation exclusive of staffing costs is approximately $27,000,000.00.

C.2 Funding Sources

The funding sources for implementation of this Small Watershed Action Plan include local government funding for Baltimore County and Baltimore City, contributions both in money and time to the Herring Run Watershed Association, and various grants as described below.

Baltimore County uses general funds to support staff, while Baltimore City uses Metropolitan District and Motor Vehicle funds to support staff, whose responsibility is to monitor and improve water quality through implementation of various programs including capital restoration projects. Baltimore County has a Waterway Improvement Capital Program that is funded by a combination of general funds and bonds. Approximately, $4 million per year is allocated for various restoration projects throughout the County. The capital budget is projected for six years, with a two-year cycle for changes. The Back River watershed as a whole currently has $2.95 million allocated for restoration projects over the six-year period. Baltimore County provides a $30,000 annual grant to the Herring Run Watershed Association 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 the actions in Appendix A and to meet the anticipated funding needs for those actions (Table C-1) additional funding from grants will be required. Table C-2 presents the potential funding sources for implementation of the Upper Back River Small Watershed Action Plan. It presents the funding source, applicant eligibility, eligible projects, funding amount, cost share requirements, and grant cycle.

While grant funding will be sought from all of the potential funding sources, the major grant funding sources are anticipated to be:

- **The Chesapeake and Atlantic Coastal Bays 2010 Trust Fund (2010 Trust Fund)** was established during the 2008 Legislative Session by Senate Bill 213 to provide financial assistance to local governments and political subdivisions for the implementation of nonpoint source pollution control projects to achieve the State's tributary strategy developed in accordance with the Chesapeake 2000 Agreement and to improve the health of the Atlantic Coastal Bays and their tributaries. The BayStat Program directs the administration of the 2010 Trust Fund, with multiple State agencies receiving moneys from the 2010 Trust Fund - the Maryland Department of Environment (MDE), Department of Natural Resources (DNR), Maryland Department of Agriculture (MDA), and Maryland Department of Planning.

- **319 Non-point Pollution Grants –** Approximately $1,000,000 of federal money for restoration implementation is available annually through Maryland Department of the Environment.

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

- **Stormwater Pollution Control Cost Share Program (MDE)** - The Maryland Stormwater Pollution Control Cost-Share Program provides grant funding for stormwater management retrofit and conversion projects in urban areas developed prior to 1984. These projects reduce nutrients, sediments and other pollutants 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, in partnership with EPA and the Chesapeake Bay Program, will award grants on a competitive basis of between $200,000 and $1 million each to support the demonstration of innovative approaches to expand the collective knowledge about the most cost effective and sustainable approaches to dramatically reduce or eliminate nutrient and sediment pollution to the Chesapeake Bay and its tributaries.

- **Chesapeake Bay Stewardship Fund** - The goal of the Chesapeake Bay Stewardship Fund is to accelerate local implementation of the most innovative, sustainable and cost-effective strategies to restore and protect water quality and vital habitats within the Chesapeake Bay watershed. The Stewardship Fund offers four grant programs: The Chesapeake Bay Small Watershed Grant Program, the Chesapeake Bay Targeted Watersheds Grant Program, the Chesapeake Bay Conservation Innovation Grant Program, and the Innovative Nutrient and Sediment Reduction Program. Major funding for the Chesapeake Bay Stewardship Fund comes from the U.S. Environmental Protection Agency (EPA), 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 Transportation Enhancement Program –** 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. Included 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 Bay restoration actions at the small watershed scale and establish replicable model of restoration that can be transferred and used throughout the Bay region.

Table C-1: Estimated Cost for Upper Back River Small Watershed Action Plan Implementation (Exclusive of Existing Staffing)

BMP or Action	Acres/ linear feet/no	# TP Removal	# TN Removal	Unit Cost	Extended Cost	Cost/# of Phosphorus Removal	Cost/# of Nitrogen Removal	Cost Over 20 Years	Comments
Stream Restoration	66,000	2,356.1	13,343.6	$300	$19,800,000	$8,404	$1,484	$19,800,000	One time cost
Stormwater Pond Conversions	17 ponds (155 acres)	89.7	827.4	$120,000	$2,040,000	$22,742	$2,466	$2,040,000	One time cost
Stormwater Retrofit Installations	50 retrofits (1600 acres)	1,126.7	5,808.7	$50,000	$2,500,000	$2,219	$430	$2,500,000	One time cost
Buffer Reforestation	200 acres	722.7	5078.4	$4,250	$850,000	$1,176	$167	$850,000	One time cost
Reforestation on PAAs	50 acres	111.4	713.9	$4,250	$212,500	$1,908	$298	$212,500	One time cost
Plant Street Trees	4,000 trees (10 acres)	22.8	146.2	$4,250	$42,500	$1,864	$291	$42,500	One time cost
Reduce Fertilizer use on 3,000 acres of lawn by conducting education on urban nutrient management and create materials if needed.	3,000 acres	1,438.1	7,686.0	$5000	$5000	$70	$13	$100,000	Annual Cost
Disconnect 180 acres of Impervious Rooftop Through Downspout Disconnection	180 acres 7,740 houses	63.7	718.5	$50/house	$387,000	$6075	$539	$387,000	One time cost
Organize 1 exotic/ invasive species removal activity addressing 10 acres per year	200 acres	NA	NA	$500	$500	NA	NA	$10,000	Annual cost
Inform community groups about the BMPs recommended in the NSA assessment.	5 meetings per year	NA	NA	$50	$250	NA	NA	$5,000	Annual cost
Inform community groups and other governemnt agencies	1 meeting every 2 years	NA	NA	$50	$25	NA	NA	$2,500	Annual cost

BMP or Action	Acres/ linear feet/no	# TP Removal	# TN Removal	Unit Cost	Extended Cost	Cost/# of Phosphorus Removal	Cost/# of Nitrogen Removal	Cost Over 20 Years	Comments
about the BMPs recommended in the PAA assessment.									
Inform institutional partners about the BMPs recommended in the ISI assessment.	2 meetings per year	NA	NA	$50	$100	NA	NA	$2,000	Annual cost
Baltimore County shall continue its program of probabilistic biological monitoring. Baltimore City to continue its biological monitoring program (every third year)	13 sites per year	NA	NA	$4,500	$58,500	NA	NA	$1,170,000	Annual cost
Continue supporting USGS gages to enhance the ability to measure flow and calculate pollutant loads.	1 gage	NA	NA	$7,215	$7,215	NA	NA	$144,300	Annual cost
Estimated Total Cost Over 20 Year Period								**$27,265,800**	

Table C-2: Upper Back River Small Watershed Action Plan – Potential Funding Sources

Funding Source Name (Managing Agency)	Applicant Eligibility	Eligible Projects	Funding Amount	Cost Share? / In-Kind	Project Period
Small Creeks and Estuaries Restoration Program (MDE)	Local Governments	Stream Channel Reconstruction; Stream Bank Stabilization; Vegetative Buffers; Wetlands Creation; Treatment of acid mind drainage and dredging	No specified limits	50% YES	None Specified
Targeted Watersheds Grant Program – Implementation Grant Program (EPA)	Non-profit 501(c) Universities Local Government State Government	Watershed Restoration and/or Protection Projects; must include a monitoring component	$600,000 to $900,000	25% YES	3-5 years
Targeted Watersheds Grant Program – Capacity Building Grant Program (EPA)	Non-profit organizations and institutions Local Government State Government	Promote organizational development of local watershed partnerships; Provide training and assistance to local watershed groups	$400,000 to $800,000	25% YES	2 years
Chesapeake Bay Targeted Watersheds Grant Program (NFWF)	Non-profit 501(c) Universities Local Government State Government	Innovative demonstration type restoration projects	$400,000 to $1,000,000	25% YES	2-3 years
Global ReLeaf Program (American Forests)	All Public Lands or Public-Accessible Lands Local Government State Government	Public Lands Restoration Projects which include local organizations; Use innovative restorative practices with potential for general application; minimum 20 acre project area	$1 per tree planted	Covers costs associated with tree plantings YES	6 months (?)
Chesapeake Bay Small Watersheds Grant Program (NFWF)	Non-Profit 501(c) organizations Local Government	Related to water quality restoration/conservation; Projects using innovative approaches	$20,000 to $200,000	25%	1-5 Years (?)
Targeted Watershed Initiative Grant Program (Chesapeake Bay Trust)	Non-Profit 501(c) organizations and institutions Soil/Water Conservation Districts Local Government	Involve local organizations; Address non-point source pollution; Projects related to water quality and habitat restoration	$50 to $200,000	0% YES	1-2 Years
Capacity Building	Non-Profit 501(c)	Strengthen an organization through management	$15,000 per	0%	3 Years

Funding Source Name (Managing Agency)	Applicant Eligibility	Eligible Projects	Funding Amount	Cost Share? / In-Kind	Project Period
Initiative Grant Program (Chesapeake Bay Trust)	organizations with a board on which half the members participate meaningfully and at least one paid staff (or a part-time paid staff and volunteer)	operations, technology, governance, fundraising, and communications	year	YES	
Clean Water Action Plan Nonpoint Source Program 319 Grant (DNR)	Non-Profit 501(c) organizations Universities Soil/Water Conservation Districts Local Governments State Governments	Located in a Category I and Category III watershed as outlined in the MD unified watershed assessment; Establish cover crops; Address Stream restoration and riparian buffers	$5,000 to $40,000	40%	Annual
Stewardship Grant Program (Chesapeake Bay Trust)	501(c)3 Private Non-profit organizations, Community associations Government agencies Soil/Water Conservation districts Schools Universities	Raise awareness about watershed restoration; Design plans which educate citizens on things they can do to aid watershed restoration; Educate students about local watersheds; Projects geared towards watershed restoration and protection	$5,001 to $25,000	0% YES	1 Year
Watershed Operations Program (NRCS)	State Governments Local Governments Tribes	Address watershed protection, flood mitigation, water quality, soil erosion, sediment control, habitat enhancement, and wetland creation and restoration	No specified limits	(?)% YES?	None Specified
Kodak American Greenways Awards Program (Eastman Kodak Company)	Non-profit 501(c)3 State Governments Local Governments	Have demonstrated community support and are important to local greenway development efforts; Are likely to be completed and have tangible results	$500 to $2,500	(?)% YES	None Specified
Chesapeake Bay Small Watersheds Grant Program (NFWF)	Non-profit 501(c) Local Governments	Promote locally-based protection and restoration efforts that complement watershed management strategies; directly address one of the goals of the Chesapeake 2000 Agreement	$5,000 to $50,000	(?)%	None Specified

MDE- Maryland Department of the Environment
NFWF- National Fish and Wildlife Foundation
EPA = U.S. Environmental Protection Agency
FWS = U.S. Fish and Wildlife Service

APPENDIX D

CHESAPEAKE BAY PROGRAM POLLUTANT LOAD REDUCTION EFFICIENCIES

Table 1: Nonpoint Source Best Management Practices that have been Peer-Reviewed and CBP-Approved for Phase 5.0 of the Chesapeake Bay Program Watershed Model
Revised 1/12/06

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

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

Agricultural BMPs (continued)	How Credited	TN Reduction Efficiency	TP Reduction Efficiency	SED Reduction Efficiency
Conservation Plans - Agriculture[1] (Solely structural practices such as installation of grass waterways in areas with concentrated flow, terraces, diversions, drop structures, etc.):	Efficiency			
Conservation Plans on Conventional-Till	Efficiency	8%	15%	25%
Conservation Plans on Conservation-Till and Hay	Efficiency	3%	5%	8%
Conservation Plans on Pasture	Efficiency	5%	10%	14%
Cover Crops[1]:	Efficiency			
Cereal Cover Crops on Conventional-Till:	Efficiency			
Early-Planting - Up to 7 days prior to published first frost date	Efficiency	45%	15%	20%
Late-Planting - Up to 7 after published first frost date	Efficiency	30%	7%	10%
Cereal Cover Crops on Conservation-Till:	Efficiency			
Early-Planting - Up to 7 days prior to published first frost date	Efficiency	45%	0%	0%
Late-Planting - Up to 7 after published first frost date	Efficiency	30%	0%	0%
Commodity Cereal Cover Crops / Small Grain Enhancement on Conventional-Till:	Efficiency			
Early-Planting - Up to 7 days prior to published first frost date	Efficiency	25%	0%	0%
Late-Planting - Up to 7 after published first frost date	Efficiency	17%	0%	0%
Commodity Cereal Cover Crops / Small Grain Enhancement on Conservation-Till:	Efficiency			
Early-Planting - Up to 7 days prior to published first frost date	Efficiency	25%	0%	0%
Late-Planting - Up to 7 after prior to published first frost date	Efficiency	17%	0%	0%
Off-stream Watering with Stream Fencing (Pasture)	Efficiency	60%	60%	75%
Off-stream Watering without Fencing (Pasture)	Efficiency	30%	30%	38%
Off-stream Watering with Stream Fencing and Rotational Grazing (Pasture)	Efficiency	20%	20%	40%

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

Agricultural BMPs (continued)	*How Credited*	*TN Reduction Efficiency*	*TP Reduction Efficiency*	*SED Reduction Efficiency*
Animal Waste Management Systems - Applied to model manure acre where 1 manure acre = runoff from 145 animal units:	Reduction in manure acres			
Livestock Systems	Reduction in manure acres	100%	100%	N/A
Poultry Systems	Reduction in manure acres	100%	100%	N/A
Barnyard Runoff Control / Loafing Lot Management	Reduction in manure acres	100%	100%	N/A
Conservation-Tillage[1]	Landuse conversion	N/A	N/A	N/A
Land Retirement - Agriculture	Landuse conversion	N/A	N/A	N/A
Tree Planting - Agriculture	Landuse conversion	N/A	N/A	N/A
Carbon Sequestration / Alternative Crops	Landuse conversion	N/A	N/A	N/A
Nutrient Management Plan Implementation - Agriculture	Built into simulation	135% of modeled crop uptake	135% of modeled crop uptake	N/A
Enhanced Nutrient Management Plan Implementation – Agriculture[1]	Built into simulation	115% of modeled crop uptake	115% of modeled crop uptake	N/A
Alternative Uses of Manure / Manure Transport	Built into preprocessing	Reduction in nutrient mass applied to cropland	Reduction in nutrient mass applied to cropland	N/A
Poultry Phytase	Built into preprocessing	N/A	Reduction in nutrient mass applied to cropland	N/A

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

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

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

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

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

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

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

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

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

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

Table 3: Nonpoint Source Best Management Practices that have been Peer Reviewed and CBP Approved for the Chesapeake Bay Water Quality Model
Revised 1/12/06

Shoreline BMPs	How Credited	TN Reduction Efficiency	TP Reduction Efficiency	SED Reduction Efficiency
Structural Tidal Shoreline Erosion Control	Water Quality Model	N/A	N/A	N/A
Non-Structural Tidal Shoreline Erosion Control	Water Quality Model	N/A	N/A	N/A

Table 4: Nonpoint Source Best Management Practices Requiring Additional Peer Review for the Chesapeake Bay Water Quality Model
Revised 1/12/06

Resource BMPs	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***	***CBP Lead Status Estimated Completion Date***
Coastal Floodplain Flooding	TBD	TBD	TBD	TBD	Sediment Workgroup TBD TBD
SAV Planting and Preservation	Water Quality Model	TBD	TBD	TBD	Living Resources Subcommittee TBD TBD
Oyster Reef Restoration and Shellfish Aquaculture	Water Quality Model	TBD	TBD	TBD	TBD TBD TBD
Structural Shoreline Erosion Controls:					Sediment Workgroup TBD TBD
Shoreline hardening	Water Quality Model	TBD	TBD	TBD	Sediment Workgroup TBD TBD
Resource BMPs (continued)	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***	***CBP Lead Status Estimated Completion Date***
Off-shore breakwater	Water Quality Model	TBD	TBD	TBD	Sediment Workgroup TBD TBD
Headland control	Water Quality Model	TBD	TBD	TBD	Sediment Workgroup TBD TBD
Breakwater systems	Water Quality Model	TBD	TBD	TBD	Sediment Workgroup TBD TBD