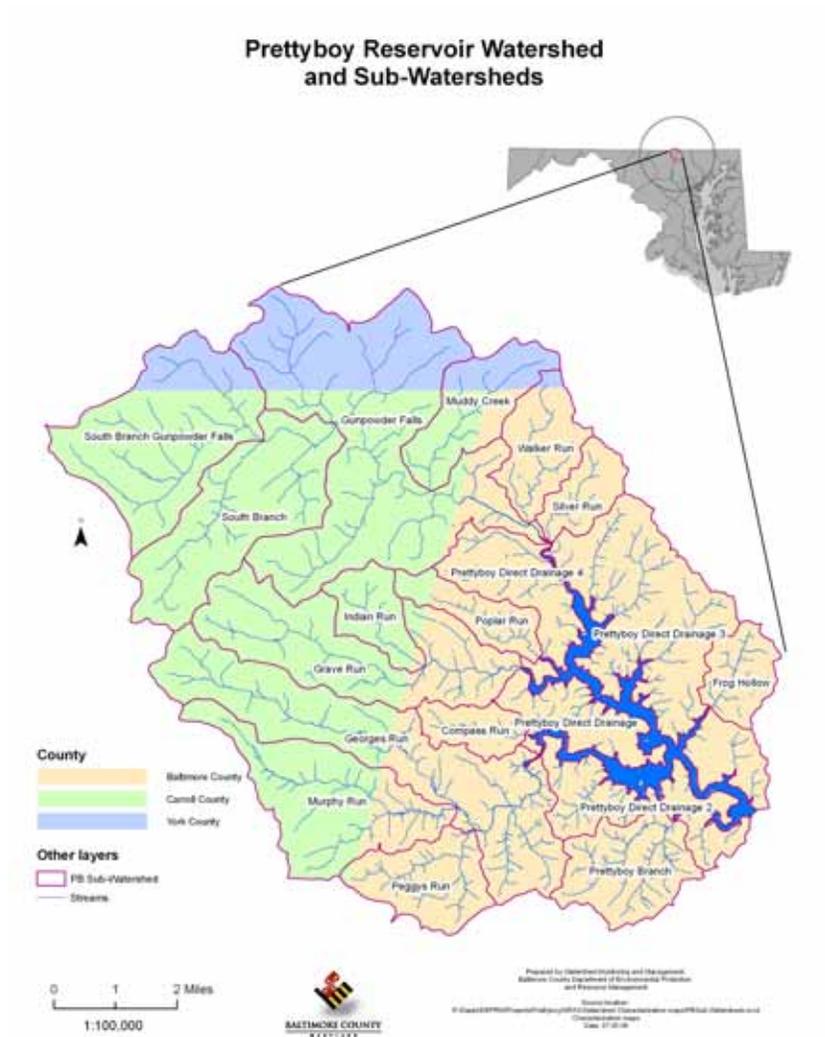


# Prettyboy Reservoir Watershed Restoration Action Strategy

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PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

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## Acknowledgement

### Prettyboy Steering Committee

The Prettyboy WRAS was developed with cooperation and input from citizen organizations and local state agencies that represent the interests of the Prettyboy Reservoir watershed.

<b>Organization</b>	<b>Representative</b>
<b>Prettyboy Watershed Alliance</b>	<b>Lucy Wright, Nancy Shaper, John Hobner, Carol Sillardoff</b>
<b>Gunpowder Valley Conservancy</b>	<b>Charlie Conklin, Karen Stupski</b>
<b>Trout Unlimited</b>	<b>Martin Eisman</b>
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<b>Stream Corridor Assessment – Baltimore County</b>	<b>Robin Pellicano, MDE</b>
<b>Stream Corridor Assessment – Carroll County</b>	<b>Dorsey Burger, Baltimore County DEPRM</b>
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<b>Watershed Characterization</b>	<b>Steve Stewart, Dorsey Burger DEPRM</b>

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## Executive Summary

The Prettyboy Reservoir watershed encompasses 51,145 acres (80 square miles) and lies entirely in the Piedmont physiographic region. The watershed is located in Baltimore (50%) and Carroll Counties (41%) in Maryland and York County (9%) Pennsylvania. The Prettyboy Reservoir watershed comprises the headwaters of the Gunpowder Basin, with the lower extent defined by the Prettyboy Reservoir dam. Water from the reservoir flows into the main stem of the Gunpowder River and supplies water to the Loch Raven Reservoir.

The Prettyboy Reservoir watershed is primarily rural in nature with agriculture the dominate land use (50%), followed by forest cover (38%), and only 12% in urban/suburban land uses (mainly as low density residential development). The Prettyboy Reservoir is one of a network of three reservoirs that provide public water supplies to Baltimore City and the surrounding jurisdictions, serving 1.8 million people. The Prettyboy Reservoir is a holding reservoir, supplementing the water supply provided by the Loch Raven Reservoir.

While the Prettyboy Reservoir watershed is one of the least impacted watersheds in Baltimore County, a number of water quality issues have been identified. The Prettyboy Reservoir watershed is listed on the Maryland Department of the Environment 303(d) list of impaired waters as being impaired for nutrients, bacteria, methyl-mercury in fish tissue, and three of five subwatersheds are listed as being biologically impaired. A Total Maximum Daily Load (TMDL) was developed for nutrient impairment of the reservoir waters, by the Maryland Department of the Environment, and approved by the US Environmental Protection Agency in 2007. This TMDL identified phosphorus as the impairing nutrient in the reservoir and determined that a 54% reduction of watershed phosphorus loads are necessary to meet water quality standards. On the other hand, portions of the Prettyboy Reservoir watershed support good populations of brook trout, indicating high water quality.

The Prettyboy Reservoir Watershed Restoration Action Strategy (WRAS) includes a watershed restoration plan and implementation strategy that will serve as a work plan for restoring and protecting water quality, and aquatic terrestrial habitats, and for addressing the need for environmental outreach and education in the watershed. The WRAS defines eight goals and 35 associated objectives for water quality, aquatic and terrestrial biodiversity, habitat, ecologic and economic sustainability of forest, promotion of environmentally sensitive farming and development, and inter-governmental coordination. These goals and objectives have been translated into 88 actions that, when implemented over the next twenty years, will result in achieving the goals stated in the WRAS.

Implementation of the Prettyboy WRAS will require the cooperative effort among the three local jurisdictions, the respective Soil Conservation Districts, and local citizen-based environmental organizations. To facilitate this cooperative effort an Implementation Committee has been formed to coordinate efforts and jointly seek additional funding to increase the rate of implementation. The Implementation Committee will use an Adaptive Management approach to ensure maximum effectiveness in implementing actions, and when necessary adjusting the work plan to meet the goals.

## Chapter 1

### Introduction

#### 1.1 Project History and Background

The Baltimore County Department of Environmental Protection and Resource Management (DEPRM) initiated the Prettyboy Reservoir Watershed Restoration Action Strategy (WRAS) in 2005 to address issues relating to water quality, aquatic and terrestrial habitat. This project follows in the footsteps of prior and continuing efforts to address the environmental conditions of the Prettyboy Reservoir watershed and goes further in addressing protection of aquatic and terrestrial biological resources. The previous and continuing efforts include:

- Reservoir Management Agreement (1979 through 2005)
- Forest Management Plan for City Reservoirs (2003)
- Source Water Stewardship Project (2003)
- Source Water Assessment (2004)

#### *Reservoir Management Agreement*

Prettyboy Reservoir is one of three reservoirs in the Baltimore Metropolitan System serving 1.8 million people. Raw water is not withdrawn from the Prettyboy Reservoir, but it provides additional capacity for the Loch Raven Reservoir. It is owned and operated by Baltimore City. As a result of algae blooms within the reservoirs in the 1970s, a Reservoir Management Agreement was signed in 1979. The first Reservoir Watershed Management Agreement was signed by Carroll County, Baltimore City, and Baltimore County, in a coordinated effort to mitigate emerging pollution problems and establish the basis for continual water quality improvement in the reservoirs. In 1984, 1990, and 2005 the Reservoir Management Agreement was updated and re-signed by the cooperating jurisdictions and agencies. The updates strengthened the declarations within the Agreement. The primary goals of the Agreement are the reduction of phosphorus inputs to the reservoirs to prevent algal blooms and the resultant degradation of water quality, and the reduction of sediment input to the reservoirs to maintain capacity. The agreement sets up a Reservoir Technical Group to develop and implement a Reservoir Watershed Action Strategy. The Technical Group is composed of representatives of the jurisdictions and agencies signing the Agreement and is facilitated and coordinated by the Baltimore Metropolitan Council. The text of the latest agreement can be found at:

<http://www.baltometro.org/RWP/ReservoirAgreement2005.pdf>

The Reservoir Action Strategy can be found at:

<http://www.baltometro.org/RWP/RWPActionStrategy2005.pdf>

The website also contains updates on the status of the implementation of the Action Strategies.

### ***Forest Management Plan for City Reservoirs***

A Forest Management Plan for City Reservoirs was developed by the Department of Natural Resources in conjunction with Baltimore City in 2003. This plan assessed the current condition of the forest resources located on the reservoir lands owned by Baltimore City. The forest was found to exhibit a number of problems including even age stands, lack of seedlings for regeneration (due to deer grazing), lack of multi-layering of vegetation (less rainfall interception and soil erosion protection), and forest plant community types not growing on sites that optimize productivity and vigor. Based on these findings, the report provided recommendations for improvement of the forest condition to meet multiple goals, including source water protection, maintenance and restoration of regional biodiversity, management of woodlands to maximize forest habitat value, and provision of recreational opportunities.

### ***Source Water Stewardship Project***

The Source Water Stewardship Project was implemented by the Trust for Public Land, in partnership with the University of Massachusetts and the USDA Forestry Service. This project was conducted in four pilot watersheds through the Eastern United States, Prettyboy Reservoir watershed was one of the four pilot projects. The focus of the project was on land conservation and forest management practices for source water protection.

The project resulted in a series of recommendations under the following categories:

- **Understanding the Watershed:** enhance the analysis of existing information, enhance monitoring and assessment efforts, develop consistent GIS data layers across political jurisdictions, ground truth existing maps and assessment results, and implement a stream stability study.
- **Inter-jurisdictional Coordination and Partnership Building:** amend the Reservoir Agreement to expand membership, create a Prettyboy Watershed Management Group, create a Watershed Assistance Grant program, increase water utility rates for use in watershed protection and management, and identify a watershed coordinator.
- **Land Conservation:** identify high-priority forestland and reforestation areas watershed-wide, revise criteria for county land preservation programs to prioritize land with forest cover, create “watershed forest” priority zoning overlays to discourage development in high-value forest areas.
- **Protecting Farms:** form a team of agricultural preservation staff and local land trusts, revise criteria for MALPF and the Rural Legacy Program to prioritize farm land with forest cover, and conduct a community character inventory in the watershed.
- **Funding Land Conservation:** recommendation divided into local funding, state funding, and federal funding categories.

- **Forest Management:** reduce the number of deer, diversify forest stand age classes, review forest stewardship plans to better incorporate water quality goals, hire a professional forest manager for City lands.

One of the primary recommendations was the development of a citizen-led watershed group. This was accomplished with the formation of the Prettyboy Watershed Alliance, an active citizen-based watershed association, and one of the primary groups represented on the Prettyboy Steering Committee.

The various documents and recommendations developed by the Source Water Stewardship Project can be found at:

[http://www.tpl.org/tier3\\_cdl.cfm?content\\_item\\_id=14388&folder\\_id=2007](http://www.tpl.org/tier3_cdl.cfm?content_item_id=14388&folder_id=2007)

### ***Source Water Assessment***

A Source Water Assessment was conducted by Maryland Department of the Environment to meet the requirements of Section 1453 of the Safe Drinking Water Amendments of 1996. This assessment found that nitrates were the most common pollutants found in groundwater supplies. Urban development and agricultural activities were the most common sources of contaminants. Agricultural land contributed nutrients and microbial pathogens. Runoff from urban land contributed excessive sediment and deicing compounds.

### ***Rationale for Selecting the Prettyboy Reservoir for the Development of a Watershed Restoration Action Strategy (WRAS)***

Based on the previous assessments and on the fact that the development of a Total Maximum Daily Load for nutrients was imminent, Baltimore County selected the Prettyboy Reservoir watershed for the development of a Watershed Restoration Action Strategy. The previously described assessment actions provided the initial information for the development of strategies to address the key issues within the Prettyboy Reservoir. With the support of Maryland Department of the Environment in conducting the synoptic survey and the Baltimore County portion of the Stream Corridor Assessment, and the Department of Natural Resources biological data synopsis, additional information on the sources and extent of impairment was obtained. The existence of citizen-based organizations (Prettyboy Watershed Alliance, Gunpowder Valley Conservancy, and Trout Unlimited) that had particular interest in the Prettyboy Reservoir watershed was an overriding factor in selecting the Prettyboy Reservoir watershed for WRAS development.

## **1.2 Watershed Overview**

The Prettyboy Reservoir (Basin No. 02130806) watershed is an 80 square mile watershed located in the Gunpowder River Basin, in the Piedmont region of Maryland. The watershed contains the headwaters of the Gunpowder Basin, with portions of the watershed in Carroll County and Baltimore County, Maryland and York County, Pennsylvania. Table 1-1 displays the distribution of acreage between the three jurisdictions, while Figure 1-1 depicts the location. Also shown in Figure 1-1 are the 19 subwatersheds within the Prettyboy Reservoir watershed.

**Table 1-1: Distribution of Prettyboy Reservoir Watershed Acreage**

County	Land		Water		Total	
	Acres	%	Acres	%	Acres	%
Carroll	21,069	42.5	0	0	21,069	41.2
Baltimore	24,022	48.4	1,516	100	25,538	49.9
York	4,538	9.1	0	0	4,538	8.9
<b>Watershed Total</b>	<b>49,629</b>	<b>100</b>	<b>1,516</b>	<b>100</b>	<b>51,145</b>	<b>100</b>

A series of studies documented the condition of the Prettyboy Reservoir watershed (Prettyboy Reservoir WRAS, Volume 2, Appendices F through L). In general, this rural watershed has good biological integrity, with populations of brook trout. Yet the watershed has three of five “12-digit” subwatersheds listed as being biologically impaired. The watershed has also been listed being impaired by nutrients, bacteria, and methyl-mercury (fish tissue). A Total Maximum Daily Load (TMDL) has been developed for the nutrient impairment (Appendix L) and found that a 54% reduction in annual phosphorus inputs is needed to achieve water quality within the reservoir. The synoptic survey (Appendix G) conducted by Maryland Department of the Environment revealed the relatively high nitrate/nitrite yields watershed-wide, compared to other watersheds, while orthophosphorus was found to be baseline for dry weather flows. The stream corridor surveys (Appendices I, J, and K) assessed selected subwatersheds for problems in the stream corridor.

Forest, while relatively extensive (38%) in the watershed, is often in poor condition and could benefit from additional forest planting. Land use is dominated by agriculture (50%), with much of agricultural activities devoted to raising of crops. The urban/suburban development is limited (12%), mainly occurring as low-density residential development.

## Prettyboy Reservoir Watershed and Sub-Watersheds

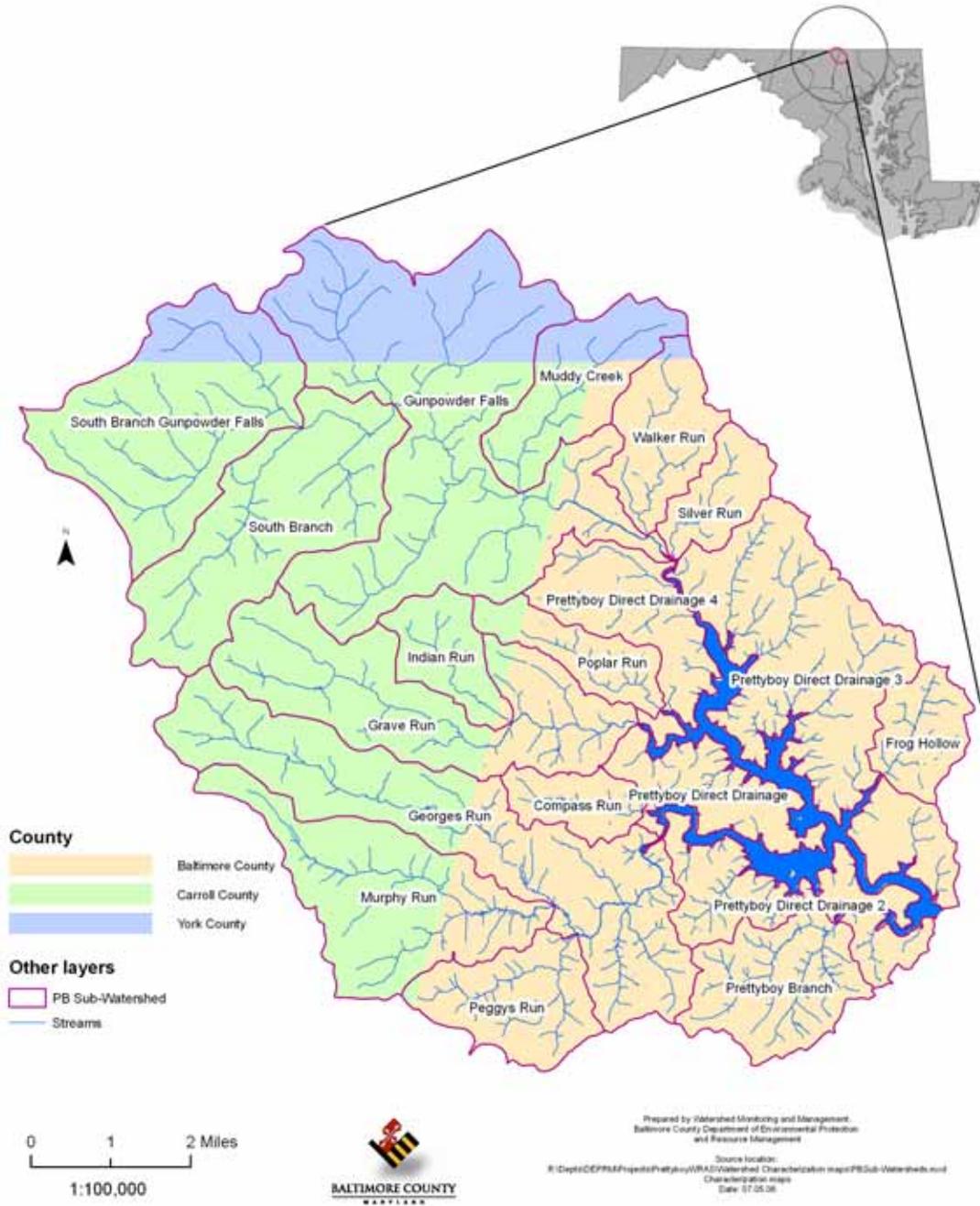


Figure 1-1: Prettyboy Reservoir Watershed Location in Maryland and Distribution Between the Three Counties.

### 1.3 Document Organization

This report is organized in five chapters. Chapter 1 presents an overview of why the Prettyboy Reservoir watershed was selected for the development of the Watershed

Restoration Action Strategy (WRAS) and a general location and acreage distribution among the three local jurisdictions.

Chapter 2 presents the vision statement, goals, and objectives developed by the Prettyboy WRAS Steering Committee and watershed stakeholders.

Chapter 3 presents the restoration strategies in three broad categories - urban/suburban, agricultural, and forest management. The specific restoration actions are presented in Appendix A.

Chapter 4 summarizes the condition and subwatershed-specific restoration strategies for the 19 subwatersheds in the Prettyboy Reservoir watershed.

Chapter 5 describes the implementation tracking and monitoring methods planned to measure success in meeting the goals and objectives.

A series of appendices provides additional detailed information used in the development and support for the Prettyboy WRAS. These appendices include:

- Appendix A – A table of specific restoration actions related to the goals and objectives presented in Chapter 2 are presented along benefits, timeline, performance measure, estimated cost, and responsible party(s).
- Appendix B – A description on how the Prettyboy WRAS process meets the US Environmental Protection Agencies 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.
- Appendix E – Provides a calculation of phosphorus pollutant loads and load reductions to meet the 54% reduction requirement for the Prettyboy nutrient TMDL.

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

- Appendix F – Prettyboy Reservoir Watershed Characterization Report (DEPRM 2007)
- Appendix G – Report on Nutrient Synoptic Survey in the Prettyboy Watershed, Baltimore and Carroll Counties Maryland, April, 2005 as part of a Watershed Restoration Action Strategy (MDE 2006)
- Appendix H – Aquatic Conservation Targets: prioritization of streams in need of restoration and protection and the assessment of stream conditions in 2005 Watershed Action Strategy (WRAS) watersheds: Deer Creek, Prettyboy Reservoir, Port Tobacco River, Miles River and Assawoman Bay (Kilian, et al. 2006)
- Appendix I – Stream Corridor Assessment Survey for the Prettyboy Reservoir Watershed, Baltimore County, Maryland (MDE 2006)
- Appendix J – Stream Corridor Assessment Survey for the Prettyboy Reservoir Watershed, Carroll County, Maryland (DEPRM 2006)

- Appendix K – Prettyboy Reservoir Stream Stability Assessment (Compass Run & Frog Hollow Subwatersheds) (Parsons, Brinkerhoff 2006)
- Appendix L – Total Maximum Daily Loads of Phosphorus and Sediments for Loch Raven Reservoir and Total Maximum Daily Loads of Phosphorus for Prettyboy Reservoir, Baltimore, Carroll and Harford Counties, Maryland (MDE 2007)

## Chapter 2

### Vision Statement and Goals

#### 2.1 Vision Statement

The Prettyboy Reservoir Steering Committee adopted the following vision statement that served as a guide in the development of the WRAS.

*Our vision for the Prettyboy Reservoir watershed in 2050 is a watershed with a balance of responsible land uses; sustainable development with environmentally sensitive site design and smart growth practices implemented in the watershed; agriculture as a viable, productive, and environmentally responsible land use; a healthy forest that is economically and ecologically sustainable; habitat that supports terrestrial biodiversity; clean and adequate water supply to the users of ground water for private wells and the users of the reservoir for drinking water; healthy water quality that sustains a balanced ecosystem; a sustainable cold water fishery; an informed citizenry who practice proper stewardship and understand their impact on the watershed; and responsible use of the watershed for recreation.*

#### 2.2 Prettyboy Reservoir WRAS Goals

The goals for the Prettyboy Reservoir watershed grew out of the vision statement and input from both the Steering Committee and the wider Stakeholder Group. The Steering Committee formulated the objectives for each goal during a series of meetings. The actions associated with the goals and objectives are presented in Appendix A. A total of 8 goals were identified. This reflects the diversity of natural resources in the Prettyboy Reservoir watershed, which has broadened the scope of this Watershed Restoration Action Strategy beyond water quality. Education and was initially a separate goal, but was recognized to part of most other goals and thus has been included as objectives and actions within each goal. Likewise, many of the actions will 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. liner 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. Any changes will still be within the framework of achieving the goals and objectives by 2028.

The remainder of this Chapter is devoted to stating the goals and objectives, along with a discussion of the impetus for the goal.

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

Goal Statement: *Ensure that the Prettyboy Reservoir and its watershed will continue to serve as a source of high-quality raw water for the Baltimore metropolitan water-supply system.*

This goal is intended to address the impairment to water quality as identified through the Maryland 303(d) list of impaired waters. Prettyboy Reservoir watershed is identified as being impaired by nutrients, bacteria, methyl-mercury, and as being biologically (three of five “12-digit” subwatersheds) impaired. Total Maximum Daily Load (TMDL) analysis has been completed for nutrients and methyl-mercury. The objectives below are designed to remove Prettyboy Reservoir watershed from the impairment listing for bacteria and meet the phosphorus TMDL reduction requirements.

1. Reduce annual average Total Phosphorus loadings to Prettyboy Reservoir by 54%, compared to loading estimated for the baseline period. This objective is set by the Gunpowder Reservoirs Total Maximum Daily Load analysis.
2. Reduce bacteria to meet water quality standards.
3. Identify impaired streams and probable sources of pollution.
4. Conduct outreach and education for homeowners and other watershed landowners to raise awareness of water quality best management practices they can employ on their properties.
5. Consider tax credits or other tax incentives to landowners that install specific water quality enhancement practices or structures.
6. All signatory governments and agencies will carry out the commitments contained in the 2005 Reservoir Watershed Action Strategy.

### 2.4 Goal 2: Restore and Maintain Aquatic Biodiversity

Goal Statement: *Maintain existing aquatic biodiversity and recreational fishing opportunities in the Prettyboy Reservoir Watershed, while exploring opportunities to expand and restore them in currently unsuitable areas.*

Portions of the Prettyboy Reservoir watershed support populations of brook trout, a watch list species; and generally have good aquatic diversity. Yet three of the five 12-digit watersheds are listed as being biologically impaired. The objectives are related to maintenance and enhancement of the existing aquatic biodiversity and the restoration of aquatic biodiversity in areas where it is impaired. This goal specifically focuses on brook trout habitat and the maintenance and expansion of brook trout populations.

1. Using Maryland Biological Stream Survey (MBSS) and MBSS based methodology, survey stream reaches in the watershed to identify areas for fish habitat enhancement.
2. Lobby landowners to allow and participate in in-stream habitat enhancement or preservation on their properties.
3. The two counties, through their existing preservation programs, and the Soil Conservation Districts (SCDs) will encourage landowners and offer help to protect the existing forested stream buffers along the tributary streams in the watershed.
4. Maintain, enhance and restore brook trout populations in the Prettyboy Reservoir watershed.

5. Maintain and/or expand recreational fishing opportunities in the watershed.

## 2.5 Goal 3: Support Wildlife Habitat, Recreation, and Aesthetics

Goal Statement: *Ensure that all surface waters in the watershed will support existing environmental, wildlife-habitat and aesthetic purposes, and will support beneficial recreational uses.*

Goal 3 focuses specifically on the biological impairment listing for three of the five 12-digit subwatersheds within the Prettyboy Reservoir watershed. The objectives related to this goal relate to the improvement of degraded stream conditions that result in poor aquatic biological condition. Achievement of this goal would result in the “delisting” of the subwatersheds for biological impairment.

1. Implement habitat restoration projects to remove the biological impairment in the Prettyboy Watershed.
2. Through the use of monitoring identify sources of water quality and aquatic habitat degradation, improvements related to BMP practices, and trends over time.
3. Use the information collected to identify, prioritize and implement stream cleanups, and stream and aquatic habitat restoration projects.

## 2.6 Goal 4: Restore and Maintain Terrestrial Biodiversity

Goal Statement: *Restore, maintain and create riparian, wetland and upland wildlife habitat that provide for terrestrial biodiversity.*

This goal recognizes the importance of the upland habitat and terrestrial biodiversity. The rural nature of the Prettyboy Reservoir watershed provides an opportunity to achieve terrestrial biodiversity that is not available in many other watersheds. The extent of designation of Ecologically Significant Area by the DNR Natural Heritage Program highlights the importance of the Prettyboy Reservoir watershed in the maintenance of terrestrial biodiversity. The objectives below are related to the protection of this existing terrestrial biodiversity.

1. Coordinate with DNR’s Natural Heritage Program to identify and implement activities that can be carried out to restore and / or create habitat targeted for species of concern.
2. Conduct outreach and education for the public about the plight of species in need of conservation.
3. Promote the purchase, by government or private conservation groups, of properties containing populations of species of concern so as to afford them the maximum protection.

## 2.7 Goal 5: Promote Ecological and Economic Sustainability of Forest

Goal Statement: *Achieve ecological and economic sustainability of forest resources, including retention and expansion of existing forest cover, expansion of riparian buffers, control of exotic and invasive species, and education about and promotion of sustainable forestry practices.*

Forest cover accounts for 41% of the land use within the Prettyboy Reservoir watershed. The Maryland Department of Natural Resources – Green Infrastructure recognizes over 9,000 acres of forest hubs and connecting forest corridors in the watershed. Forest provides terrestrial habitat and promotes water quality. Forest assessments in the

Prettyboy Reservoir watershed have indicated that much of the existing forest is degraded to various degrees. This goal recognizes the importance of forest in the overall functioning of the ecosystem and its economic value to private landowners. The objectives relate to the improvement of forest health, the expansion of the amount of forest, and environmentally sensitive timber harvesting.

1. Assist large and small woodlot owners through educational programs to better manage their existing forested areas for habitat and/or wood products production.
2. Identify funding opportunities for preservation and restoration of existing high priority forest.
3. Engage volunteer groups in the work of removal/ control of exotic & invasive plant species in existing forested areas on municipal properties, farms and open space areas in residential developments.
4. Encourage landowners on all levels to afforest existing non-forested riparian areas.
5. Help to promote the support or establishment of small-scale timber harvesting, especially those using low-impact techniques (i.e. horses) to serve the needs of small woodlot owners.
6. County agencies and private citizen groups will work with private landowners to encourage sound forest management, expansion and enhancement.
7. The two counties will continue to enforce the floodplain-management and forest-protection measures already contained in the respective local laws and regulations.
8. Under the 2005 Action Strategy, Baltimore County commits to carry out its new Forest Sustainability program. Baltimore City commits to reviewing DNR's (2003) Forest Conservation Plan for the City-owned watershed forests and to developing a list of actions from that study, which are recommended for short-term implementation.

## 2.8 Goal 6: Promote Environmentally Sensitive Farming

Goal Statement: *Encourage farmers to continue farming and protect farms by supporting their "right to farm," through conservation planning and implementation of best management practices, in an effort to improve water quality and to maintain and preserve the existing agricultural land within the Prettyboy Reservoir watershed.*

This goal recognizes that the extensive farming (60% of land use) in the Prettyboy Reservoir watershed is the desired land use, while at the same time promoting farming best management practices to meet other goals within the watershed. Much of the 54% phosphorus reduction required under the TMDL will have to come from implementation of agricultural best management practices. Data from the Maryland Department of Agriculture Water Quality Cost Share (MACS) Program indicate that the agricultural community is already one-third of the way to the reduction target. There are, however, practices that are not MACS-funded and therefore are not included in the above assessment. The objectives below support both the preservation of farming and the reduction of nutrients.

1. Promote the widespread use of agricultural Best Management Practices.
2. Build rapport between watershed residents, the agricultural community and local government via the local farm bureau and the Baltimore County Extension Service.
3. The two Soil Conservation Districts (SCDs) will continue to provide a variety of technical services, tools and cost share assistance for farmers and farm owners, in order to minimize soil erosion and nutrient loss from farmlands.

4. Both counties will continue to promote agricultural land preservation through the purchase of easements and other legal mechanisms.

## 2.9 Goal 7: Promote Environmentally Sensitive Development

Goal Statement: *Employ zoning categories and apply development regulations and guidelines that are protective of the natural resources in Prettyboy Reservoir watershed, and require environmentally sensitive design for any future development.*

Developed lands represent 12% of the land in Prettyboy Reservoir watershed, with additional, though limited growth potential. This goal is intended to focus on both the limitation of additional suburban growth in the watershed and to ensure that what growth occurs is developed in an environmentally sensitive manner. Actions to reduce pollutants and impacts from existing development are listed under Goal 1.

1. Support implementation of the Builders for the Bay process to improve the environmental sensitivity of the current development regulations.
2. Promote and support further application of downzoning during the next Comprehensive Rezoning Process for Baltimore County.

## 2.10 Goal 8: Inter-governmental Commitments

Goal Statement: *Support existing inter-governmental commitments and mandates for management of environmental resources.*

This goal serves to recognize existing inter-governmental relationships and to ensure coordination of the implementation of the Prettyboy Reservoir Watershed Restoration Action Strategy through the establishment of an Implementation Committee. There is already an existing framework for coordination through the Baltimore Reservoir Agreement and a Reservoir Technical Group that focuses on the three regional drinking water reservoirs. The Prettyboy WRAS Implementation Committee will focus specifically on coordination of the actions identified in this document and tracking the implementation progress.

1. Establish a Prettyboy WRAS Implementation Committee to coordinate efforts and track progress in meeting the goals and objectives.
2. Establish a collaborative monitoring program based on the results of the planned USGS Study of Baltimore City, Baltimore County, and Carroll County monitoring programs as they relate to the reservoirs.
3. Work with the Baltimore County Deer Management Plan Workgroup to develop an effective deer management program for public lands within Baltimore County.
4. Encourage public agencies that hold land in the watershed to look at implementing riparian planting, storm water quality measures, and storm drain retrofits etc.

## **Chapter 3**

### **Restoration Strategies**

#### **3.1 Overview**

This chapter discusses the restoration strategies developed by the Prettyboy WRAS Steering Committee with input from the watershed stakeholders. The strategies are associated with each individual goal.

- Goal 1: Improve and Maintain Clean Water
- Goal 2: Restore and Maintain Aquatic Biodiversity
- Goal 3: Support Wildlife Habitat, Recreation, and Aesthetics
- Goal 4: Restore and Maintain Terrestrial Biodiversity
- Goal 5: Promote Ecological and Economic Sustainability of Forest
- Goal 6: Promote Environmentally Sensitive Farming
- Goal 7: Promote Environmental Sensitive Development
- Goal 8: Inter-governmental Commitments

While initially a goal in itself, it was determined that “education and citizen awareness” crosscut through each of the other goals.

#### **3.2 Goal 1: Improve and Maintain Clean Water**

The restoration strategies for this goal revolve around implementation of best management practices to address water quality, particularly phosphorus. The extent of the actions are defined by the requirement to reduce phosphorus loads to the reservoir by 27,340 pounds or 54% of the baseline load determined by the model run by Maryland Department of the Environment (Appendix L). The restoration actions are targeted at both developed land and agricultural lands (see Appendix E for the Pollutant Load Reduction Analysis). In addition to addressing water quality impairments from existing developed lands, the strategy calls for growth control and environmentally sensitive design of new development.

The restoration strategy specifically recognizes the 2005 Reservoir Watershed Action Strategy and by reference incorporates those actions into the Prettyboy Reservoir Watershed Restoration Action Strategy (WRAS). The WRAS goes beyond the 2005 Reservoir Watershed Action Strategy in specifying target acreages for the installation of best management practices.

The Maryland Department of Agriculture has supplied information regarding the extent of the MACS-funded agriculture best management practices within the Prettyboy

Reservoir watershed (Appendix E). This information indicates that we are approximately one-third of the way to the phosphorus reduction goal. However, this only counts those practices that have received cost-share funding and does not account for practices utilized or installed on individual farms that have not received funding. Therefore, the Prettyboy WRAS Steering Committee has identified tracking of existing practices and of future implementation as necessary to assure the meeting the phosphorus reduction goal.

The strategy also calls for the investigation of additional incentives to entice landowners to install water quality enhancement measures. The educational component will target urban/suburban residential properties for nutrient reductions from lawn fertilizer use. Specifically, the booklet *From My Backyard to Our Bay* will be utilized as an education tool.

The strategy specifically sets up the framework for addressing the bacterial impairment at the point in time when the model for bacterial loadings is developed by Maryland Department of the Environment. However, many of the actions related to livestock will help in reducing bacterial contamination prior to that time.

In order to address the small farm operation that is not eligible for Maryland Cost Share funding, Baltimore County recently instituted a pilot program to provide cost-share funding to small farmers. This pilot program is initially funded at \$25,000, with a maximum of \$5,000 for each farm. Depending on the successes of the pilot, this program may be expanded in future years.

### **3.3 Goal 2: Restore and Maintain Aquatic Biodiversity**

The strategy for pursuing this goal is to focus on brook trout populations and those areas with good biological integrity. Those subwatersheds that exhibit those characteristics will be further assessed for opportunities to preserve forested riparian buffer and to plant additional forest within the riparian zone, in order to maintain temperatures conducive to brook trout. In addition, degraded habitat will be improved to permit the increase and expansion of existing brook trout populations. The educational component will be related to the importance of forested riparian buffers to maintenance of high-quality aquatic biological communities that support brook trout.

### **3.4 Goal 3: Support Wildlife Habitat, Recreation, and Aesthetics**

The strategy for this goal is to focus on impaired biological integrity and to implement restoration practices that will remove listings for biological impairment. The data indicate that the degraded conditions that have resulted in the biological impairment listings are localized to specific subwatersheds (Appendix F – Characterization Report). Thus by using targeted restoration work that addresses both habitat and water quality impairment, these aquatic biological communities can be improved with the resultant “delisting” for biological impairment.

### **3.5 Goal 4: Restore and Maintain Terrestrial Biodiversity**

The Prettyboy Reservoir watershed is the home of many species in need of conservation, as evidenced by the large areas designated by Maryland Department of Natural Resources as ecologically significant areas. The strategy for this goal is to develop educational materials specific to the species in need of conservation and to raise the awareness of

watershed residents of the extent of the issue in the Prettyboy Reservoir watershed. The strategy further focuses on the preservation of areas that contain species of concern to afford them protection, while promoting habitat restoration to expand the available habitat. The ultimate goal is to provide the opportunity for these species to expand their populations.

### **3.6 Goal 5: Promote Ecological and Economic Sustainability of Forest**

Prettyboy Reservoir watershed has a relatively large amount of forest cover, particularly around the reservoir. This forest provides habitat for wildlife and promotes water quality, since forest is the least polluting land cover. Forest is a multiple-use resource that, besides providing for wildlife and water quality, has recreational uses and economic uses. Baltimore County is engaged in an endeavor called the Montreal Process that seeks to promote the multiple uses of forest county-wide. The process has resulted in what is called the Forest Sustainability Program. This program will be implemented throughout the county. One component of the Forest Sustainability program is the Rural Residential Program that works with large lot residential landowners to convert existing herbaceous cover to forest. In many cases, only an acre or less is maintained as lawn immediately around the house. The balance of the acreage is rough cut once or twice a year. The program provides for planting of the additional acreage by Baltimore County staff, with long-term care and maintenance by the landowner after education and training by county staff.

The quality of the forest within Prettyboy Reservoir watershed has been compromised in a variety of ways. The restoration strategy will focus on expansion of the forest cover and improvement of existing forest. The expansion of the forest cover is also part of the strategy for improvement of water quality, with a focus on riparian buffers and highly erodible land. Education will be a large part of the strategy regarding forest, with an emphasis on the private landowner. The education will revolve around two components, management of forest and timber harvesting. The management of forest will seek to improve the existing quality of the forest from a forest health perspective. This in turn will improve the terrestrial habitat for wildlife. The timber harvesting will seek to educate the private forest owner on stand improvement and techniques of environmentally sensitive harvesting of the timber.

In addition to educational programs and the implementation of the Forest Sustainability program, the WRAS Implementation Committee will seek funding for the preservation of existing forest and the planting of additional forest acreage.

### **3.7 Goal 6: Promote Environmentally Sensitive Farming**

Farming is the largest economic sector in the Prettyboy Reservoir watershed. It represents a large part of the heritage of the rural community in northern Baltimore County and Carroll County. This goal recognizes the heritage and economic benefits of farming, while at the same time, attempting to integrate environmental sensitivity into the agricultural activities. Many of the other goals in this document cannot be met without the implementation of farming practices that improve environmental quality.

The strategy for this goal is to reach out to the agricultural community regarding the other goals contained within this WRAS. The aim is to engage the farmers in the implementation of agricultural best management practices that help in achieving the other goals and at the same time do not compromise the economic productivity of agriculture. The implementation of best management practices often will result in an economic gain for the farmer through the use of less fertilizer, the maintenance of soil conditions conducive to crop growth, or the better use of manure. Often, the implementation may be economically neutral, with the exception of the installation of the practice. In order to assist the agricultural community in the installation of best management practices, funding mechanisms beyond the existing Maryland Water Quality Cost Share (MACS) program will be sought. In order to assist the small landholder, the Baltimore County Soil Conservation District has instituted a pilot program to provide cost-share funds for those operations that fall below the threshold for MACS funding.

A further strategy for this goal is to continue the highly successful agricultural preservation programs overseen by Baltimore County and Carroll County and to seek alternate sources of preservation funding to preserve the rural heritage of the Prettyboy Reservoir watershed.

### **3.8 Goal 7: Promote Environmentally Sensitive Development**

While the current zoning is restrictive within both the Baltimore County and the Carroll County portions of the Prettyboy Reservoir watershed, additional growth will occur, mainly in the form of large-lot subdivisions. The strategy for this goal is to ensure that what development does occur is built in an environmentally sensitive fashion. The existing development regulations are restrictive in requiring forest buffers along streams, forest conservation, and stormwater management. These regulations will become more restrictive with the institution of the new Environmentally Sensitive Site Design criteria currently under development by Maryland Department of the Environment.

The Builders for the Bay process that recently was held in Baltimore County identified a number of measures that would result in more environmentally sensitive development. Implementation of these measures is currently being evaluated for feasibility, with a progress workshop to be held in the spring of 2008. One of the measures was to develop watershed-based stormwater criteria, based on the presence of coldwater fisheries. The brook trout populations are sensitive to increases in impervious area, which “overlay” criteria would mitigate. The development of stormwater criteria for the protection of coldwater fisheries is expected to take three years, with input from stakeholders. Carroll County is currently undergoing a Builders for the Bay process that could result in more environmentally sensitive development in that county.

The final strategy for this goal is to support any downzoning requests that will result in less large-lot development within the Prettyboy Reservoir watershed. Baltimore County has repeatedly downzoned portions of the land within the reservoir watersheds through the Comprehensive Zoning process that occurs every four years. In order to facilitate this downzoning, additional rural zoning categories have been developed that further reduce the allowable residential densities. These new categories have been used to great effect in the reservoir watersheds.

### **3.9 Goal 8: Inter-governmental Commitments**

The function of the Inter-governmental Commitments goal is to recognize and take advantage of those cooperative efforts that are already occurring. This goal sets up a Prettyboy Reservoir WRAS Implementation Committee to oversee implementation progress, prepare joint grant proposals for funding, to evaluate the success of the action strategy, and to provide adaptive management changes to the strategy if needed. The goal recognizes the existing management framework associated with the 2005 Reservoir Agreement and the 2005 Reservoir Action Strategy. In addition, the USGS study, currently underway, on the development of a collaborative monitoring program for the reservoirs is specifically mentioned.

The overall objective of this goal is to provide continuing input and support for meeting the other goals within this WRAS.

## Chapter 4

### Subwatershed Strategies

#### 4.1 Overview

This chapter provides a brief overview of the subwatershed prioritization process developed by the Prettyboy Reservoir WRAS Steering Committee (full discussion in Appendix F, Chapter 5). The chapter will also review the restoration strategies to be used for each of the nineteen subwatersheds, based on the existing conditions within each subwatershed. While the subwatershed discussions will be presented in the order of restoration priority, in order to achieve the WRAS goals, all subwatersheds eventually must be addressed.

Each subwatershed will be presented including a statistical summary of the main characteristics of the subwatershed, a map of the land use, a brief discussion of the subwatershed's current condition, and the strategies to be used in the subwatershed to achieve the goals.

#### 4.2 Subwatershed Prioritization Process

While realizing that most of the actions will have to occur on a watershed-wide basis, and that many restoration opportunities will be dependent on the willingness of the landowner(s) to participate, the Prettyboy Steering Committee felt that it was necessary to prioritize the subwatersheds for restoration and preservation. Restoration in the context of this WRAS document is the implementation of actions to improve the environmental conditions of the Prettyboy Reservoir watershed. Preservation includes actions that protect resources that are currently of high quality. Separate restoration and preservation scoring mechanisms were developed. The prioritization is described in full in the *Prettyboy Reservoir Watershed Characterization Report*, (Chapter 5, Section 5.4). In general, the prioritization schemes for both restoration and preservation included physical/chemical factors, biological factors, and land use factors. The resulting scores were used to develop the rankings which are displayed in Table 4-1. These rankings were used to divide the subwatersheds into four categories of very high, high, medium, and low for restoration priority and for preservation priority. The results of this categorization process are displayed in Figures 4-1 and 4-2.

Table 4-1: Subwatershed Restoration and Preservation Ranks

<b>Subwatershed</b>	<b>Restoration Rank</b>	<b>Preservation Rank</b>
Gunpowder Falls	<b>1</b>	<b>2</b>
Muddy Creek	<b>2</b>	<b>8</b>
Prettyboy Direct Drainage 3	<b>3</b>	<b>1</b>
Georges Run	<b>4</b>	<b>12</b>
South Branch	<b>5</b>	<b>16</b>
Murphy Run	<b>6</b>	<b>18</b>
Peggys Run	<b>7</b>	<b>15</b>
Grave Run	<b>8</b>	<b>10</b>
South Branch Gunpowder Falls	<b>9</b>	<b>13</b>
Silver Run	<b>10</b>	<b>6</b>
Walker Run	<b>11</b>	<b>3</b>
Prettyboy Direct Drainage 1	<b>12</b>	<b>5</b>
Prettyboy Branch	<b>13</b>	<b>19</b>
Prettyboy Direct Drainage 2	<b>14</b>	<b>7</b>
Prettyboy Direct Drainage 4	<b>15</b>	<b>4</b>
Indian Run	<b>16</b>	<b>17</b>
Compass Run	<b>17</b>	<b>14</b>
Poplar Run	<b>18</b>	<b>9</b>
Frog Hollow	<b>19</b>	<b>11</b>

Activities already have been initiated within a number of subwatersheds prior to the development of the prioritization scheme. Specifically, the Baltimore County Soil Conservation District has initiated a pilot implementation tracking program with the assistance of Baltimore County Department of Environmental Protection and Resource Management in the Prettyboy Branch, Walker Run, and Peggys Run subwatersheds. This tracking program is focused on agricultural best management practices that are in place in these subwatersheds, regardless of whether they are cost-share funded or not.

Trout Unlimited, the Prettyboy Watershed Alliance, and the York County Watershed Alliance have begun contacting landowners and identifying restoration projects in the Walker Run and Silver Run subwatersheds. These activities are intended to help achieve the goals regarding aquatic biological integrity, specifically the maintenance and expansion of brook trout populations.

Since it is anticipated that all nineteen subwatersheds will eventually need to be addressed from a restoration perspective, each subwatershed’s condition and the main strategies to be implemented within that subwatershed are presented. The subwatersheds are presented in the order of the restoration ranking. A land use map and subwatershed facts are presented, followed by a general discussion of the subwatershed’s condition. The primary strategies for the restoration of the subwatershed are then presented.

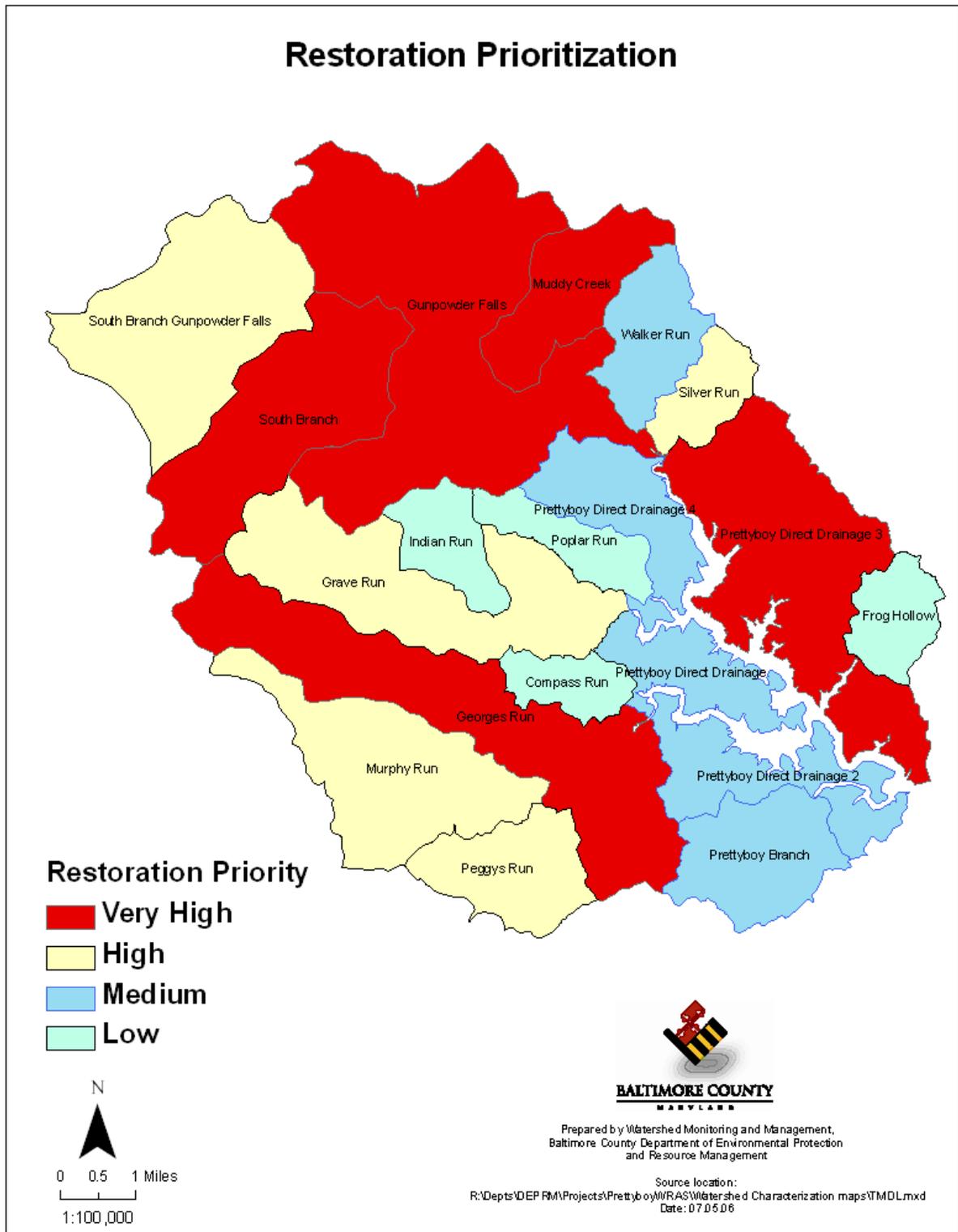


Figure 4-1: Subwatershed Restoration Priority

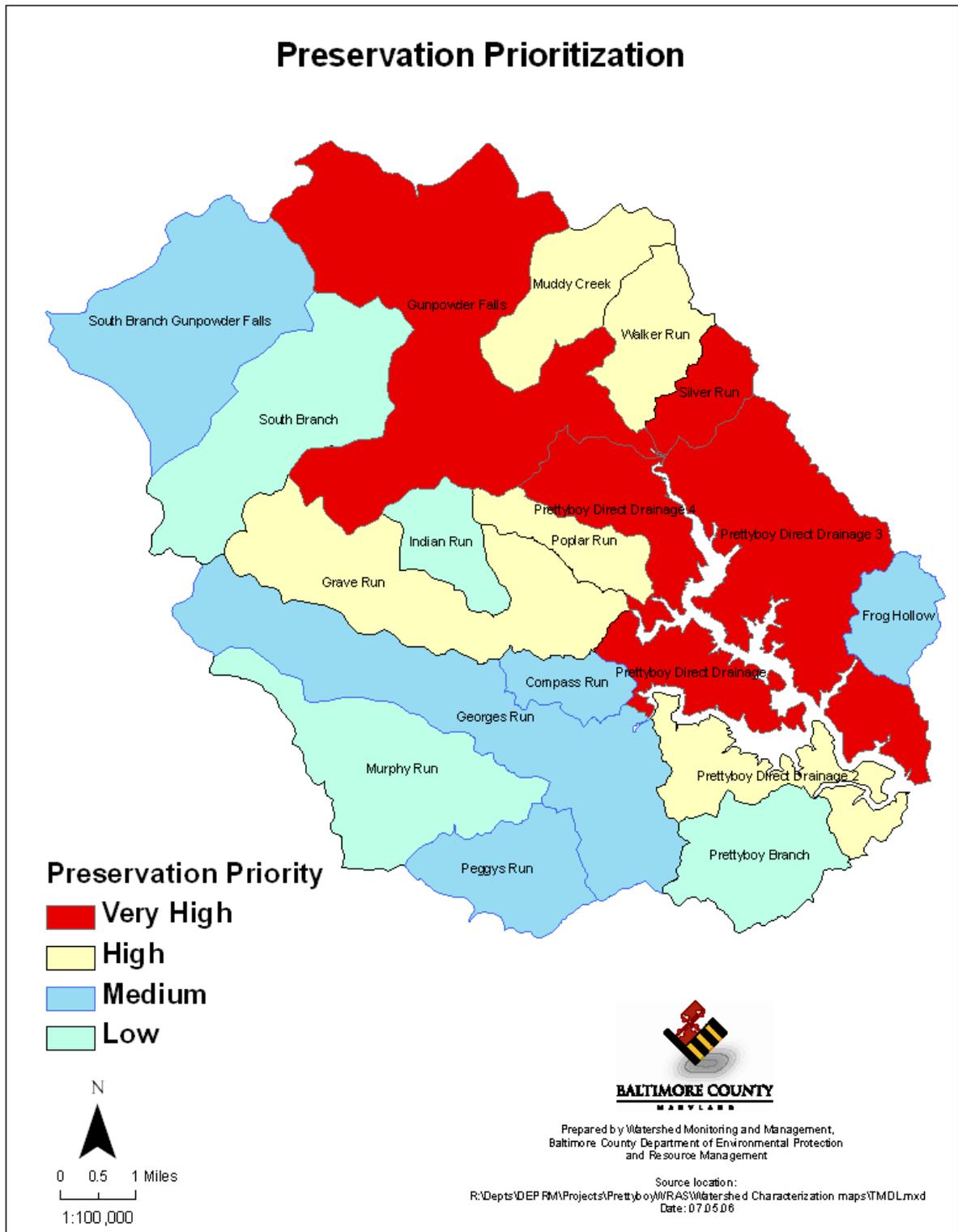


Figure 4-2: Subwatershed Preservation Priority

### 4.3 Gunpowder Falls

#### GUNPOWDER FALLS

##### **WRAS Priority**

**Restoration: Very High**  
**Preservation: Very High**

##### **Quick Subwatershed Facts**

Size: 8,035 acres (762 ac in Baltimore County, 4,328 in Carroll, 2,945 in York)  
 Stream miles: 36.2

##### **Land Cover**

- 11% Developed
- 38% Croplands
- 13% Pasture
- 37% Forest
- 2.4% Impervious Cover

##### **Stream Characteristics**

- Unforested buffer, acres: 262.3 (47%)

##### **Biological Condition**

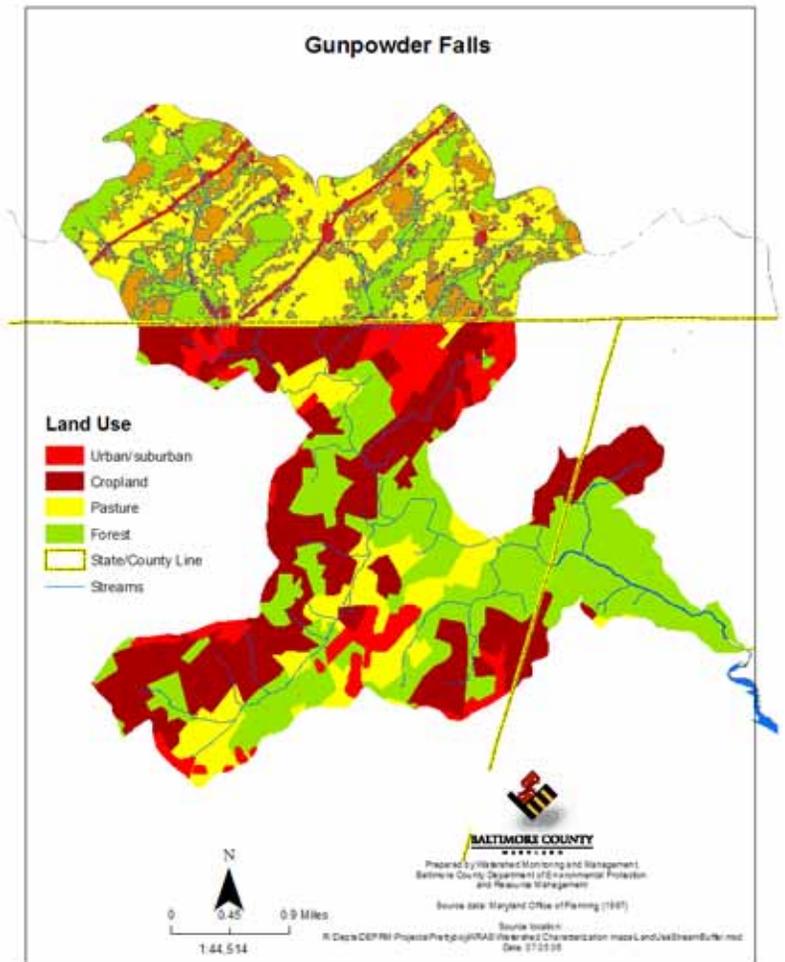
- Aquatic Conservation Target 2
- Brook Trout: Abundant; highest priority
- Ecologically Significant Area Designation: 4,686 ac. (58%)

##### **Soil Erosion Hazard on agricultural lands, acres (% of area)**

- High: 627 ac. (24%)
- Medium: 1,303 ac. (51%)
- Low: 627 ac. (24%)

##### **Protected Land**

- Public Land: 566 ac
- Agricultural Easements: 1,065 ac.



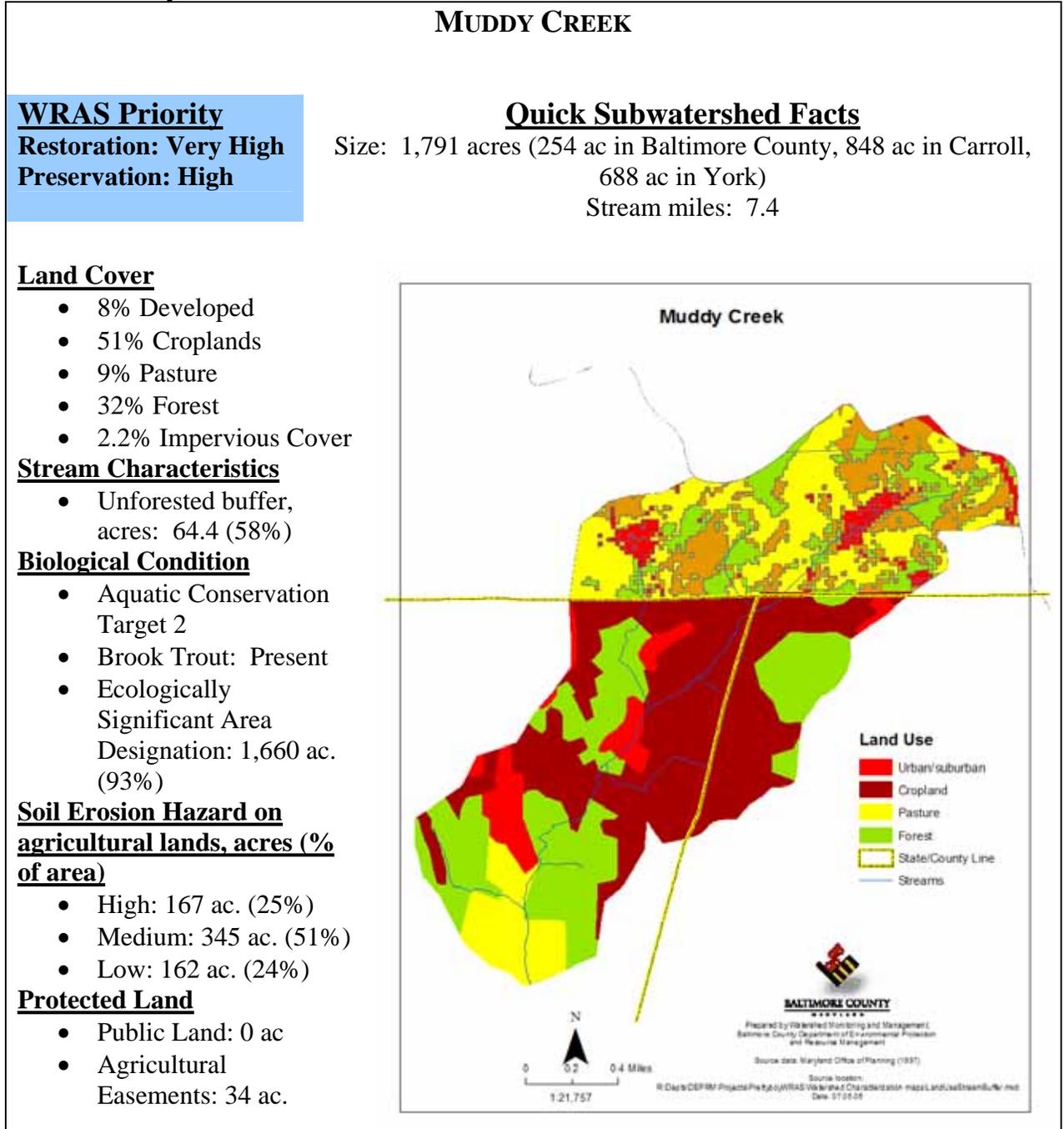
**Conditions:** The Gunpowder Falls subwatershed is located in the northern portion of the Prettyboy Reservoir watershed and discharges directly into the Prettyboy Reservoir. Along with the four subwatersheds that flow into the Gunpowder Falls subwatershed, the drainage area constitutes over a third (37%) of the land surface contributing flows to the reservoir. The headwaters originate in York County, but the subwatershed is located predominately in Carroll County with a small portion in Baltimore County. Agriculture accounts for the majority of land use (51%), followed by forest cover (37%). The forest cover in the subwatershed is close to the average for the Prettyboy Reservoir watershed as a whole. The zoning for Gunpowder Falls is primarily for agricultural conservation.

(75% Carroll County, 93% York County). Carroll County has the largest acreage zoned for development (1,052 acres), but the majority falls in the rural residential conservation category (1 unit/3 acres). Most of the rural residential conservation zoning is located along the mainstem of the Gunpowder Falls, with much of it undeveloped at this time. The portion that is in Baltimore County is zoned rural residential (RC7, RC8). The bulk of this land (75%) is owned by Baltimore City and is close to the reservoir. There is currently no rural residential development in the remaining portion of the subwatershed located in Baltimore County. There are three rural Priority Funding Areas (PFAs) within the Carroll County portion of the subwatershed (Lineboro, Alesia, and Millers). These PFAs are rural villages serving the surrounding agricultural community. They account for the 17 acres zoned for commercial operations.

The biological condition in the Gunpowder Falls, is considered fair to good and it is not listed as impaired for biology. A number of tributaries to Gunpowder Falls support good populations of brook trout, although there is limited data for the majority of the drainage area.

Strategy: The primary strategy for the Gunpowder Falls subwatershed is to focus on those agricultural BMPs that will result in phosphorus load reductions in order to meet Total Maximum Daily Load reduction requirements. The Carroll Soil Conservation District currently works with the Gunpowder Falls farmers to explore opportunities for installation of best management practices, along lines of those practices identified in Appendix A. Emphasis can be placed on working with the agriculture community in this subwatershed to implement best management practices on highly erodible land (640 acres), particularly the 43 acres of highly erodible land within the riparian buffer. One-hundred and five acres of the un-forested riparian buffer are in pasture. These acres present an opportunity for fencing and reforestation. The rural residential areas have nineteen acres of un-forested riparian buffer that is suitable for reforestation. Riparian buffer reforestation will not only reduce phosphorus loads, but also will improve aquatic habitat and further protect the quality of the biotic community. There is also the possibility for reforestation on large lot residential subdivisions within Carroll County. Educational outreach will focus on both the agricultural BMPs and the opportunities for environmental enhancement on large lot subdivisions.

## 4.4 Muddy Creek



**Conditions:** Muddy Creek is located in the north central portion of the Prettyboy Reservoir watershed and discharges into the mainstem of Gunpowder Falls. The headwaters originate in York County, with approximately 47% of the subwatershed in Carroll County and a smaller portion in Baltimore County. Agriculture accounts for the majority of land use (60%), followed by forest cover (32%). The forest cover in the subwatershed is slightly below average for the Prettyboy Reservoir watershed as a whole.

The zoning for Muddy Creek is primarily for agricultural conservation in all three Counties, with 100% agricultural conservation in York and Baltimore Counties and 94% in Carroll County. Only 50 acres, mainly along the southern edge of the subwatershed, in Carroll County is zoned for rural residential development (1unit/3 acres).

Muddy Creek has a population of brook trout, although it is limited in total population size. Within the existing populations of brook trout in the Prettyboy watershed, the population within Muddy Creek has the lowest number of adult trout per kilometer of stream. The limited biological monitoring data indicate that the aquatic biological integrity is good.

Strategy: Although the primary strategy for the Muddy Creek subwatershed is to focus on those agricultural BMPs that will result in phosphorus load reductions and protect the aquatic biological integrity of the streams, there are opportunities for addressing large-lot residential development. The Carroll Soil Conservation District and the Baltimore County Soil Conservation Districts are already working with the Muddy Creek farmers to explore opportunities for installation of best management practices, along lines of those practices identified in Appendix A. Emphasis will be placed on working with the agriculture community in this subwatershed to install best management practices on highly erodible land (167 acres), particularly the 33 acres of highly erodible land within the riparian buffer. Thirteen acres of the unforested riparian buffer are in pasture. These acres can be assessed for the possibility of fencing and reforestation. The rural residential areas have six acres of unforested riparian buffer that is suitable for reforestation. Riparian buffer reforestation will not only reduce the phosphorus loads, but will also improve aquatic habitat and further protect the quality of the biotic community. There is also the possibility for reforestation on large-lot residential subdivisions within Carroll County and the one large-lot subdivision in York County. The educational outreach will focus on both the agricultural BMPs and the opportunities for environmental enhancement on large-lot subdivisions.

An emphasis will be placed on protecting the existing brook trout population and on improvement of in-stream habitat to expand the existing population size. Additional monitoring will be performed to establish the baseline population, with monitoring in future years intended to determine the trends in population size and extent after the implementation of best management practices.

## 4.5 Prettyboy Direct Drainage 3

### PRETTYBOY DIRECT DRAINAGE 3

#### **WRAS Priority**

**Restoration: Very High**

**Preservation: Very High**

#### **Land Cover**

- 6% Developed
- 23% Croplands
- 4% Pasture
- 66% Forest
- 1.7% Impervious Cover

#### **Water Quality (Relative Yields)**

- Phosphorous: Very High
- Nitrogen: Very High

#### **Stream Characteristics**

- Unforested buffer, acres: 110.3 (16.9%)

#### **Biological Condition**

- Aquatic Conservation Target 1
- Brook Trout: Abundant; Highest Priority
- Ecologically Significant Area Designation: 870 ac. (18%)

#### **Soil Erosion Hazard on agricultural lands, acres (% of area)**

- High: 224 ac. (17%)
- Medium: 606 ac. (45%)
- Low: 509 ac. (38%)

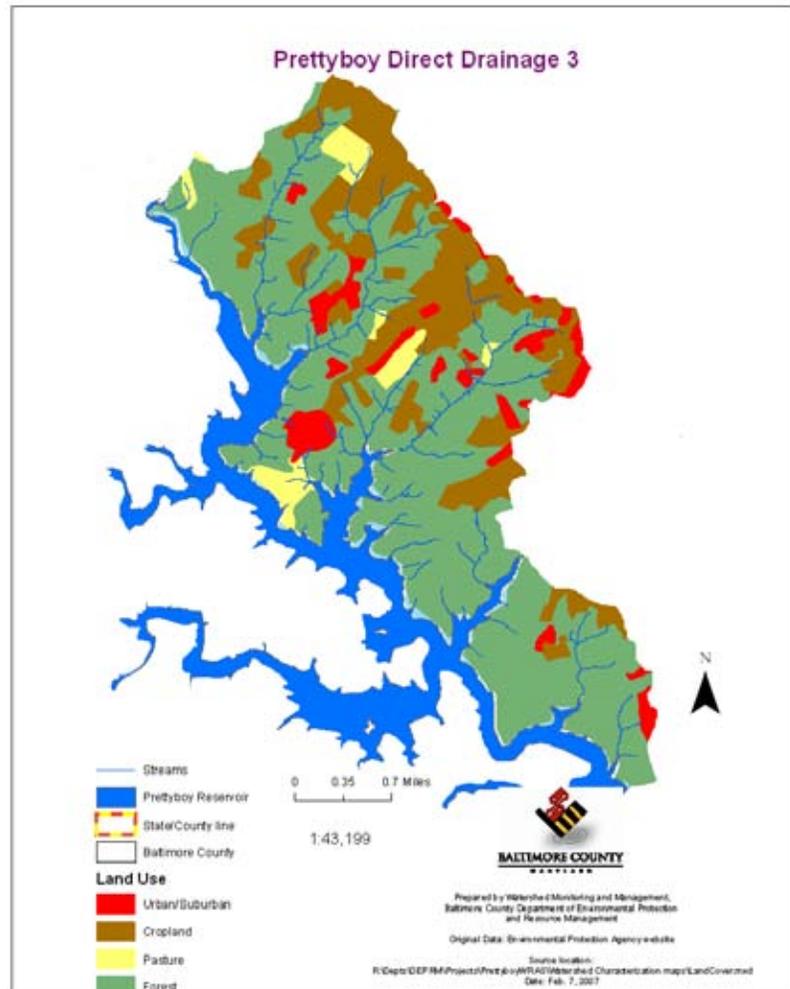
#### **Protected Land**

- Public Land: 1,776 ac
- Agricultural Easements: 732 ac.

#### **Quick Subwatershed Facts**

Size: 4,906 acres (4,906 ac in Baltimore County)

Stream miles: 39.6



Conditions: Prettyboy Direct Drainage 3 extends along the northern shore of the reservoir, reaching to the northern watershed boundary. This subwatershed is located entirely within Baltimore County. Over one-third (36%) of the subwatershed is owned by Baltimore City for reservoir protection. The majority of the land cover is forest (66%), followed by agriculture (27%); rural residential development accounts for only 6% of the land cover. The forest cover in the subwatershed is well above the average for the Prettyboy Reservoir watershed as a whole. There are 29 separate streams that drain directly into the reservoir in the subwatershed. While many of these are first-order or second-order streams, there are four stream systems that are third-order.

Approximately one-third (31%) of the acreage in the subwatershed is zoned for agricultural conservation. The balance is rural residential of varying densities (RC7 (37%), RC8 (26%), RC4 (5%) RC5 (0.5%), and a small amount of commercial (7 acres), that is located along Middletown Road. The RC7 zoning (1 unit/25 acres) is located adjacent to the reservoir and on land that is mainly owned by Baltimore City. The RC8 zoning is mainly located along the stream systems, and the RC2 is on the ridges between the stream systems. The RC4 (1 unit/ 5 acres) zoning is scattered in several locations. The controversial proposed development called Shelly Fields is located on the ridge line within this subwatershed.

A least three unnamed tributaries within the Prettyboy Direct Drainage 3 have good populations of brook trout. Many of the stream systems have not been surveyed for brook trout populations due to the remote location of the streams. While this subwatershed is located within a 12-digit watershed that is listed as biologically impaired, the limited biological monitoring data indicate that the subwatershed's aquatic biological integrity is good.

Strategy: The strategy for this subwatershed will focus on the existing large-lot subdivisions and the potential for future development within the subwatershed. The existing large-lot subdivisions provide an opportunity for the reforestation of 18 acres of riparian forest buffer and additional reforestation acreage on large-lots devoid of forest. The approach will be through educational programs that highlight the high quality of the existing aquatic resources, and the protective nature of forested riparian buffers and additional forest cover. New development will be subjected to the existing Baltimore County development regulations that are protective of streams and forest. The *Maryland 2000 Stormwater Design Manual* no longer provides exemptions for stormwater management on large-lot subdivisions. The trend is for implementation of stormwater best management practices that disperse stormwater flow throughout the site and quantity management that is protective of the stream channel. New stormwater management regulations that incorporate Environmental Site Design are expected to be required by Maryland Department of the Environment in the near future and will be adopted by Baltimore County. In addition, Baltimore County recently completed a Builders for the Bay process that identified improvements in the Baltimore County regulations that would be more protective of the environment. Those recommendations are currently under review.

The agricultural strategy will be to focus on implementation of best management practices as indicated in Appendix A. Due to the presence of brook trout populations, the farming community will be educated on the environmental benefits of riparian buffer

reforestation, in the hopes that many of the 420 acres of unforested buffer on agricultural land will be reforested.

Additional biological monitoring is planned to determine the extent and size of the brook trout populations and to provide additional information on the overall aquatic biological integrity of the subwatershed.

#### 4.6 Georges Run

### GEORGES RUN

#### **WRAS Priority**

**Restoration: Very High**  
**Preservation: Medium**

#### **Quick Subwatershed Facts**

Size: 5,357 acres (2, 874 ac in Baltimore County, 2,483 ac in Carroll)  
Stream miles: 41.1

#### **Land Cover**

- 16% Developed
- 50% Croplands
- 12% Pasture
- 22% Forest
- 3.2 % Impervious Cover

#### **Stream Characteristics**

- Unforested buffer, acres: 402.5 (55.3%)

#### **Biological Condition**

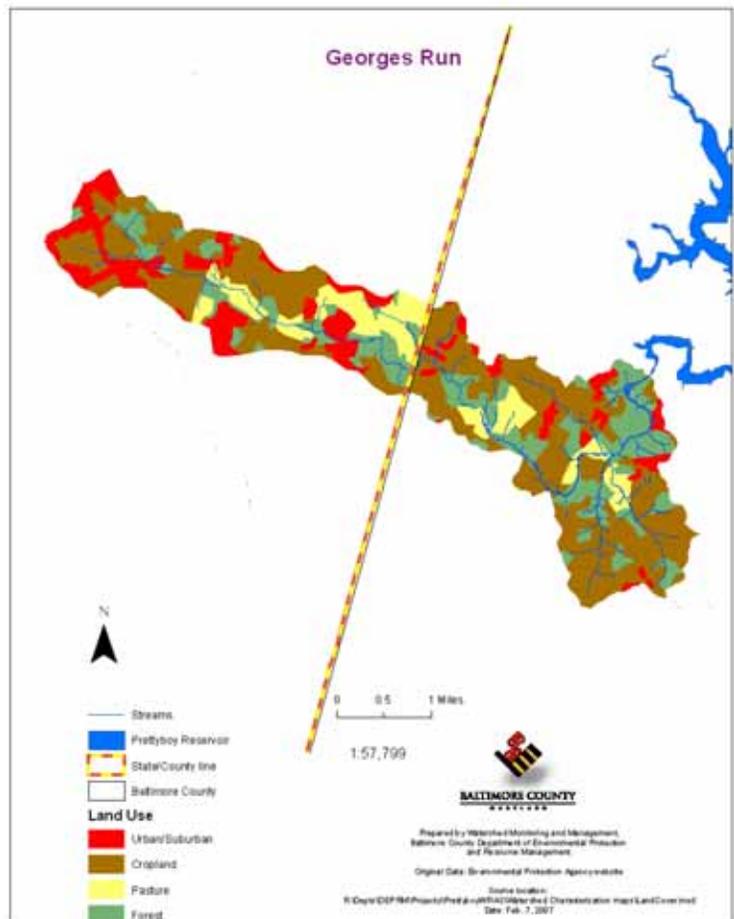
- Aquatic Conservation Target 3
- Brook Trout: Absent/No Data
- Ecologically Significant Area Designation: 2,182 ac. (41%)

#### **Soil Erosion Hazard on agricultural lands, acres (% of area)**

- High: 534 ac. (16%)
- Medium: 1775 ac. (53%)
- Low: 1019 ac. (31%)

#### **Protected Land**

- Public Land: 213 ac.
- Agricultural Easements: 423 ac.



**Conditions:** Georges Run is located in the south central portion of the Prettyboy watershed, extending from its headwaters in the town of Manchester to the point where it discharges into the Prettyboy reservoir in Baltimore County. This subwatershed is about

evenly split between Carroll and Baltimore Counties. The majority of the land cover is agriculture (62%), followed by forest (22%), with a significant amount of developed land (16%). The headwaters within the town of Manchester have higher and medium-density residential land use. Below the town of Manchester, large-lot subdivisions interspersed with agricultural operations are found. The extent of forest cover in the subwatershed is well below the average for the Prettyboy Reservoir watershed as a whole.

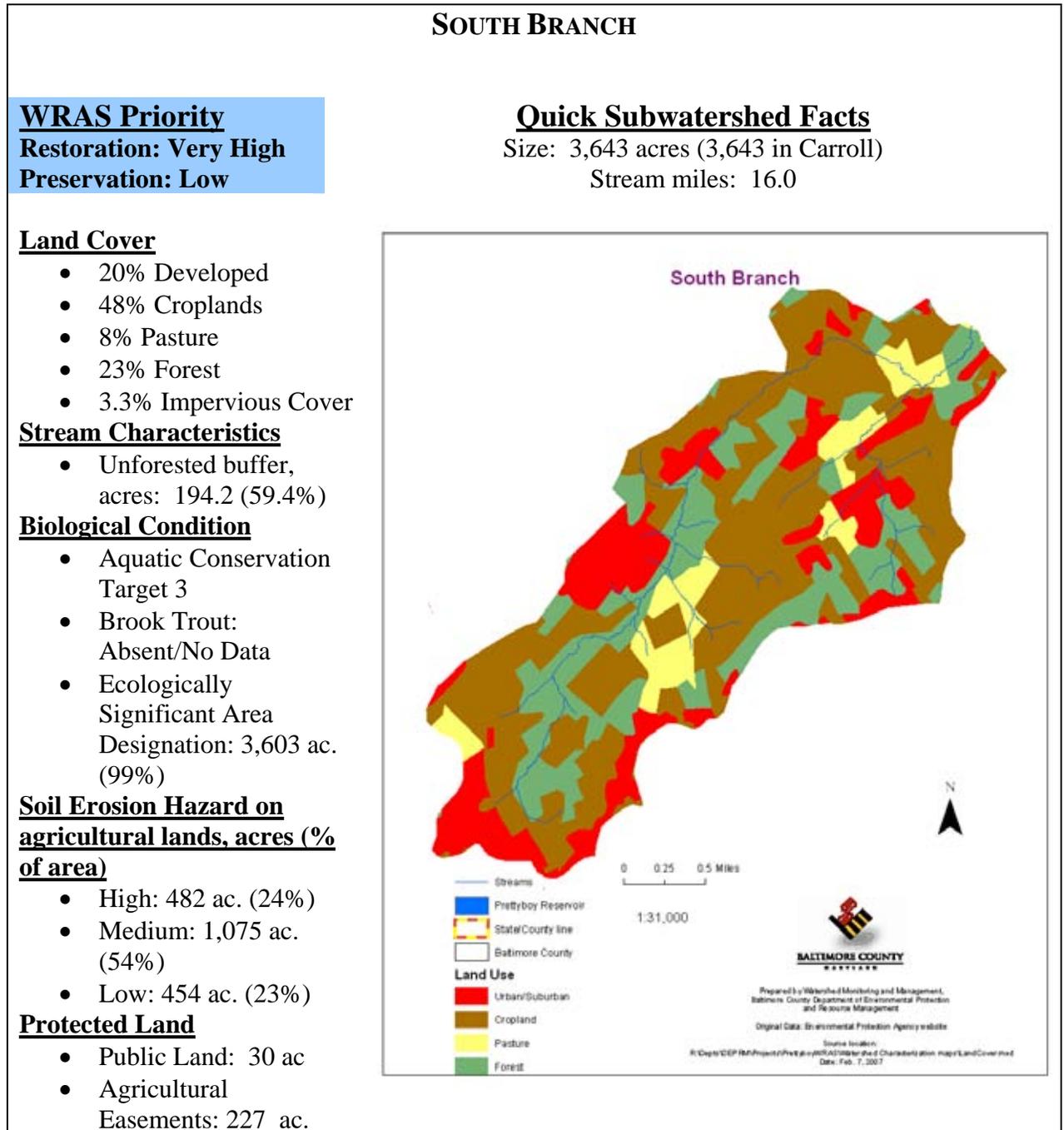
Approximately two-thirds (71%) of the acreage in the subwatershed is zoned for agricultural conservation; the balance is mainly rural residential, with the exception of the acreage within the town limits of Manchester. Within Baltimore County 88% of the land is zoned for agricultural conservation. The only the portion of the land within the subwatershed immediately prior to reservoir is currently zoned for rural residential, with 219 acres of RC7 and 116 acres of RC8. Most of the RC7 is owned by Baltimore City and the RC8 has been already developed. The bulk of future residential development would therefore occur in Carroll County.

It is in a 12-digit subwatershed that is listed as biologically impaired. Both the Maryland Biological Stream Survey and the Baltimore County Random Point program have found the results to mainly indicated poor biological integrity. Only 40% of the riparian buffer is forested. The town of Manchester waste water treatment plant discharges to the headwaters of Georges Run. It uses spray irrigation during the growing season that utilizes plant uptake and land treatment to reduce nutrients and bacteria.

Strategy: The strategy for this subwatershed will focus on both agricultural BMPs and existing large-lot subdivisions activities. The existing large-lot subdivisions provide an opportunity for the reforestation of 36 acres of riparian forest buffer and additional reforestation acreage on large lots devoid of forest. The approach will be through educational programs that highlight the benefits of riparian forest buffers in restoring water quality and aquatic resources, and the protective nature of forested riparian buffers and additional forest cover. The agricultural strategy will be to focus on implementation of best management practices as indicated in Appendix A. One-hundred and eighteen acres of unforested buffer occurs in pasture. An emphasis will be placed on fencing and reforestation of the riparian buffer on pastureland. The Carroll Soil Conservation and Baltimore County Soil Conservation Districts will take to the lead on working with the farmers.

Two subwatersheds discharge into Georges Run (Murphy Run and Peggys Run). The drainage areas of these three subwatersheds comprise ~20% of the land area in the Prettyboy watershed. A US Geological Survey gage was installed at the base of the drainage area in 2000. This gage provides an opportunity to monitor storm events, in order to determine annual loads and trends over time.

## 4.7 South Branch



**Conditions:** The South Branch subwatershed is located in the western portion of the Prettyboy Reservoir watershed and discharges to Gunpowder Falls. The subwatershed is entirely within in Carroll County. The southern portion of the subwatershed falls within the town of Manchester – Priority Funding Area, while a small portion of the northern end of the subwatershed falls in the village of Lineboro PFA. The South Branch is zoned mainly for agricultural conservation (88%) and much of the remainder is Conservation

Residential (6%, 1 unit/3 acres). General business zoning accounts for only 17 acres, while 187 acres are zoned for density residential, varying from 1 unit/¼ acre (6 acres), to 1 unit/one-half acre (94 acres), to 1 unit/1 acre (87 acres). All of this zoning is located adjacent to the Manchester – Priority Funding Area. Twenty percent of the acreage within the South Branch subwatershed is classified as developed. While much of this development is located in the southern portion of the subwatershed, the balance is scattered throughout the drainage area. Fifty-four percent of the drainage area is in agricultural use, with only 23% in forest cover. Only 39% of the riparian buffer is forested.

The subwatershed is part of a larger 12-digit subwatershed that is listed for biological impairment. However, the one Maryland Biological Stream Survey sample located in the South Branch indicates good biological integrity for both benthic macroinvertebrates and fish.

Strategy: The primary strategy for South Branch is to focus on agricultural and suburban BMPs to improve water quality. These actions include outreach to and education of subwatershed residents on how their actions can result in the improvement of water quality. For the residential community, the primary message will be on lawn fertilizer reduction, septic system maintenance, and the planting of additional trees where possible. The Baltimore County handbook *From My Backyard to Our Bay* will be one tool used in the outreach to the residents of South Branch. The handbook was created through a collaborative effort between Baltimore County Soil Conservation District, the Baltimore County Office of the Maryland Cooperative Extension and Baltimore County Department of Environmental Protection and Resource Management. The Carroll Soil Conservation District will work with the South Branch farmers to explore opportunities for installation of best management practices.

Of special concern in the South Branch is the limited amount of riparian forest. Opportunities to reforest the 32 acres of riparian buffer that are currently unforested in large lot-developments will be explored. The Carroll Soil Conservation District can educate the farming community on the environmental benefits of reforestation of agricultural forest buffers, along with other best management practices listed in Appendix A. There are 52 acres of unforest riparian buffer in pasture, that have offer a possibility for reforestation.

## 4.8 Murphy Run

### MURPHY RUN

**WRAS Priority**  
**Restoration: High**  
**Preservation: Low**

#### Quick Subwatershed Facts

Size: 3,333 acres (798 ac in Baltimore County, 2,536 ac in Carroll)  
 Stream miles: 20.0

#### Land Cover

- 30% Developed
- 43% Croplands
- 5% Pasture
- 22% Forest
- 4.2% Impervious Cover

#### Stream Characteristics

- Unforested buffer, acres: 203 (53%)

#### Biological Condition

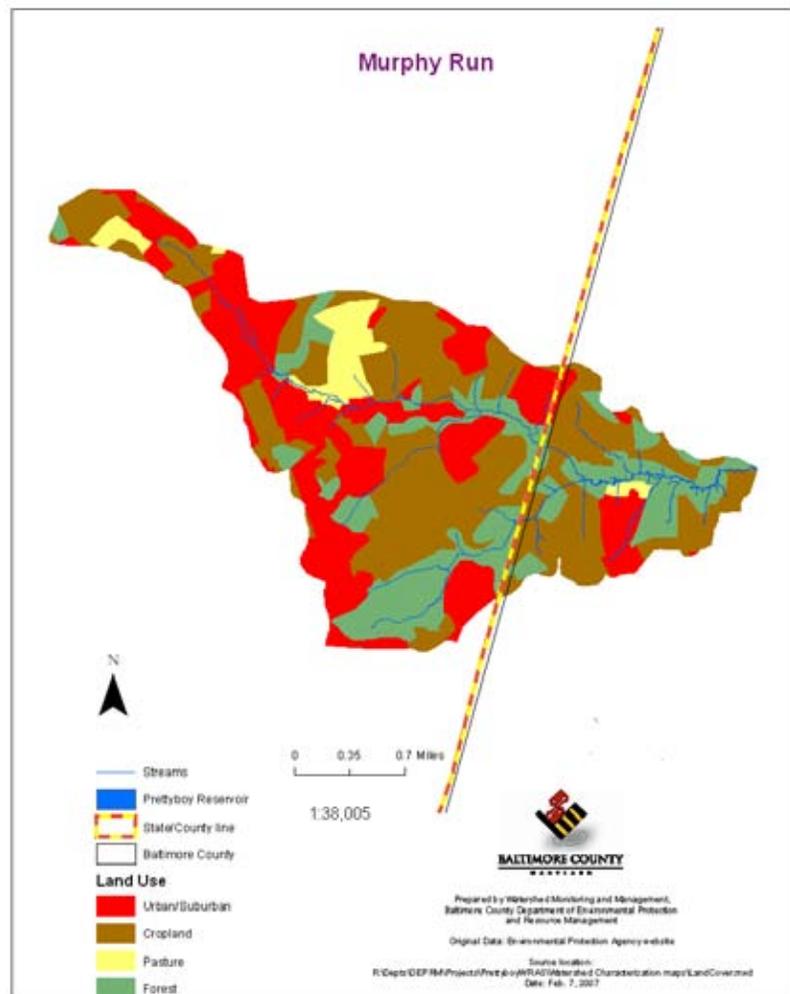
- Aquatic Conservation Target 3
- Brook Trout: Absent/No Data
- Ecologically Significant Area Designation: 2,195 ac. (66%)

#### Soil Erosion Hazard on agricultural lands, acres (% of area)

- High: 205 ac. (13%)
- Medium: 775 ac. (50%)
- Low: 585 ac. (37%)

#### Protected Land

- Public Land: 95 ac
- Agricultural Easements: 65 ac.



**Conditions:** Murphy Run is located in the south central portion of the Prettyboy watershed, extending from its headwaters in the town of Manchester to the point where it discharges into Georges Run in Baltimore County. The southern portion of this subwatershed lies along the Route 30 corridor between Hampstead and Manchester. Three-quarters of this subwatershed lies in Carroll County with the balance in Baltimore County. Murphy Run has the highest percentage of developed land (30%) of any

subwatershed within the Prettyboy watershed. Consequently, it has the highest percentage (4.2%) of impervious surface, compared to other Prettyboy subwatersheds, and the majority of the existing stormwater management facilities are in the subwatershed. Agriculture, however, still accounts for the majority of the land use (48%). Forest cover amounts to only 22% of the land cover, and only 47% of the riparian buffer is forested.

All of the Murphy Run acreage in Baltimore County is zoned for agricultural conservation. Within Carroll County only 11% of the acreage is zoned for agricultural conservation and 24% is zoned for rural residential (1 unit/3 acres). The balance is zoned for higher density residential and commercial land use. Future development within this subwatershed would occur in Carroll County associated with the towns of Manchester and Hampstead Priority Funding Areas.

The stream corridor assessment indicated a relatively high number of problems, mainly associated with pipe outfalls and inadequate riparian buffer. Stream erosion was noted as being a problem for 11,500 feet of stream channel, but it was of moderate severity. It is in a 12-digit subwatershed that is listed as biologically impaired. There is limited biological data for Murphy Run, but the two Maryland Biological Stream Survey samples would indicate that Murphy Run has fair to good biological integrity.

Strategy: The strategy for this subwatershed will focus primarily on developed lands, although the agricultural BMPs will be pursued as well. The existing large-lot subdivisions provide an opportunity for the reforestation of 53 acres of riparian forest buffer and additional reforestation acreage on large-lots devoid of forest. There is an additional 28 acres of unforested buffer associated with more densely developed land that may also be suitable for reforestation. The approach will be through educational programs that highlight the benefits of riparian forest buffers in restoring water quality and aquatic resources, and the protective nature of forested riparian buffers and additional forest cover. The agricultural strategy will be to focus on implementation of best management practices as indicated in Appendix A. Twenty-one acres of unforested buffer occurs in pasture. An emphasis will be placed on fencing and reforestation of the riparian buffer on pastureland. The Carroll Soil Conservation District and Baltimore County Soil Conservation District will take to the lead on working with the farmers.

## Peggys Run

### PEGGYS RUN

#### **WRAS Priority**

**Restoration: High**

**Preservation: Medium**

#### **Quick Subwatershed Facts**

Size: 1,679 acres (1,640 ac in Baltimore County, 39 ac in Carroll)

Stream miles: 13.3

#### **Land Cover**

- 5% Developed
- 72% Croplands
- 8% Pasture
- 13% Forest
- 2.4% Impervious Cover

#### **Stream Characteristics**

- Unforested buffer, acres: 167.5 (72%)

#### **Biological Condition**

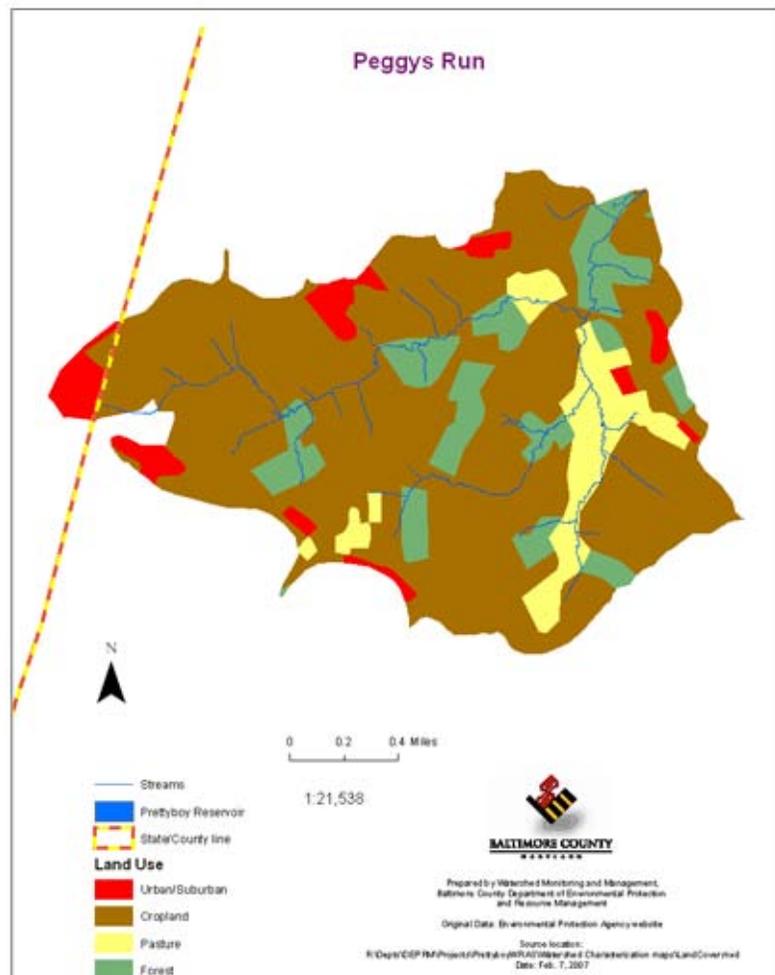
- Aquatic Conservation Target 3
- Brook Trout: Absent/No Data
- Ecologically Significant Area Designation: 757 ac. (45%)

#### **Soil Erosion Hazard on agricultural lands, acres (% of area)**

- High: 161 ac. (12%)
- Medium: 617 ac. (46%)
- Low: 570 ac. (42%)

#### **Protected Land**

- Public Land: 0 ac
- Agricultural Easements: 582 ac.



**Conditions:** Peggys Run is located in the south central portion of the Prettyboy Reservoir watershed and discharges to Georges Run. The headwaters originate in Carroll County, but the subwatershed is located predominately in Baltimore County. The zoning for Peggys Run in Baltimore County is entirely agricultural conservation. The 37 acres in Carroll County is part of the town of Hampstead and is included within the priority funding area for growth. Most of the 37 acres in Carroll County have already been developed, and there are historic residential developments within the Baltimore County

portion of the subwatershed. These areas account for only 5% of the subwatershed drainage area. Peggys Run has the higher percentage (80%) of agricultural land use than any other subwatershed within Baltimore County. This is reflective of the fact that the soils within Peggys Run have the highest percentage (81%) of the prime farmland designation. Most of the agricultural land use is in cropland. Peggys Run forest cover (13%) is well below the average for Prettyboy Reservoir watershed. This lack of forest cover is also reflected in the amount of unforested riparian buffer (167 acres, 72%). In contrast, the aquatic biological data indicates that the community is in a fair to good condition, with only one Baltimore County sample that indicated a poor condition. All of the samples are in the lower portion of the watershed where more forest cover exists. Peggys Run has the highest per acre phosphorus loads (1.92 pounds/acre, Table E-2) of any of the subwatershed within the Prettyboy Reservoir watershed. Forty-three percent of the 1,349 acres of agricultural land is under conservation easements.

Strategy: The primary strategy for Peggys Run is to focus on those agricultural BMPs that will result in phosphorus load reductions. The Baltimore County Soil Conservation District will work with the Peggys Run farmers to explore opportunities for installation of best management practices, along lines of those practices identified in Appendix A. Emphasis will be placed on working with the agriculture community in this subwatershed to install BMPs on highly erodible land (160 acres), particularly the 45 acres of highly erodible land within the riparian buffer. Fifteen acres of the unforested riparian buffer are in pasture. These acres will be assessed for the possibility of fencing and reforestation.

A total of 11,350 linear feet of stream erosion was recorded during the Stream Corridor Assessment. This erosion was noted as being moderate in severity, correctability, and for access. The stream erosion will be further assessed to determine applicability of stream restoration for the reduction of phosphorus and the improvement of aquatic habitat. The lack of a forested riparian buffer was noted during the stream corridor assessment also.

## 4.9 Grave Run

### GRAVE RUN

#### **WRAS Priority**

**Restoration: High**

**Preservation: High**

#### **Quick Subwatershed Facts**

Size: 3,896 acres (1,243 ac in Baltimore County, 2,653 ac in Carroll)

Stream miles: 22.0

#### **Land Cover**

- 12% Developed
- 32% Croplands
- 20% Pasture
- 36% Forest
- 2.4 % Impervious Cover

#### **Stream Characteristics**

- Unforested buffer, acres: 170 (42%)

#### **Biological Condition**

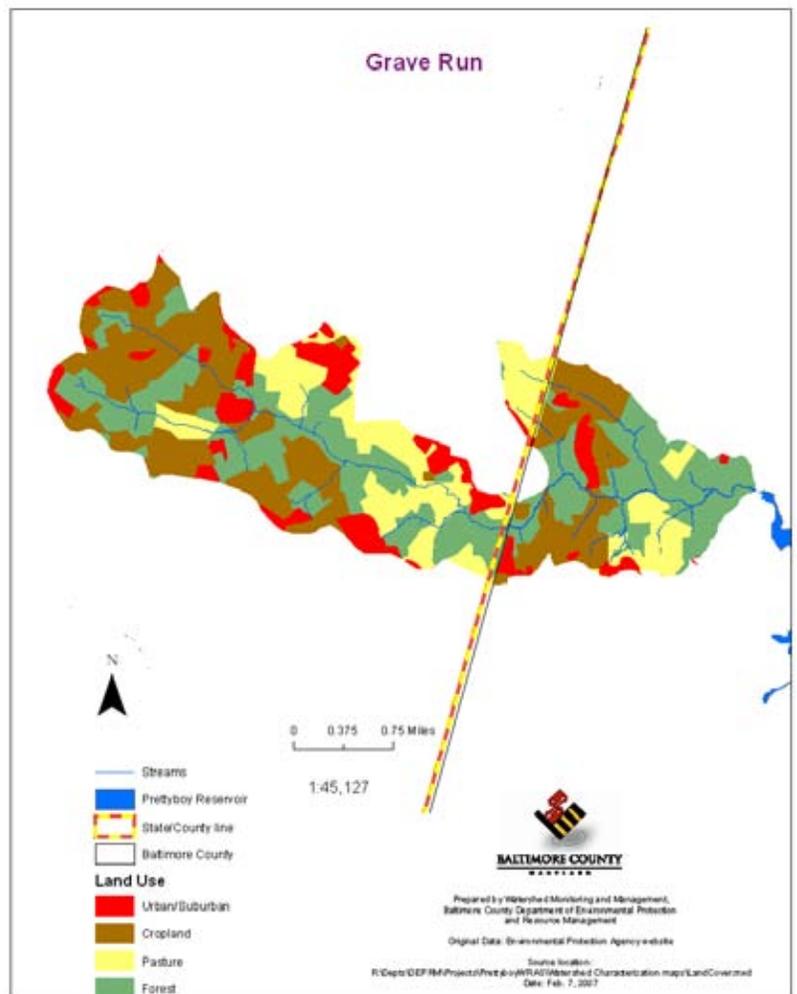
- Aquatic Conservation Target 2
- Brook Trout: Absent/No Data
- Ecologically Significant Area Designation: 1,554 ac. (40%)

#### **Soil Erosion Hazard on agricultural lands, acres (% of area)**

- High: 312 ac. (15%)
- Medium: 1,163 ac. (58%)
- Low: 545 ac. (27%)

#### **Protected Land**

- Public Land: 103 ac.
- Agricultural Easements: 681 ac.



**Conditions:** Grave Run is located in the central portion of the Prettyboy Reservoir watershed, extending from its headwaters in the town of Manchester to the point where it discharges into the Prettyboy Reservoir in Baltimore County. Approximately two-thirds of this subwatershed is in Carroll County, with the balance in Baltimore County. The majority of the land cover is agriculture (52%) followed by forest (36%). Developed land accounts for only 12% of the land cover. The small portion of the headwaters that is within the town of Manchester has higher and medium-density residential land use.

Below the town of Manchester, large-lot subdivisions interspersed with agricultural operations are found. The extent of forest cover in the subwatershed is close to the average for the Prettyboy Reservoir watershed as a whole.

Approximately two-thirds (68%) of the acreage in the subwatershed is zoned for agricultural conservation, and the balance is mainly rural residential, with the exception of the acreage within the limits of the Manchester PFA. Within Baltimore County, 42% of the land is zoned for agricultural conservation and the balance is zoned for rural residential. The land immediately prior to the reservoir is zoned for rural residential, with 54 acres of RC7 and 672 acres of RC8. Most of the RC7 is owned by Baltimore City. Some of the RC8 has been already developed, but much has not.

The stream corridor survey noted only a few problems, and the amount of stream erosion noted was less than in other subwatersheds. Both the Maryland Biological Stream Survey and the Baltimore County Random Point program have found the results for Grave Run to indicated fair to good biological integrity. This is in agreement with the fact that the 12-digit subwatershed that contains Grave Run is not listed as biologically impaired.

Strategy: The strategy for this subwatershed will be to maintain the existing good aquatic biology integrity. Restoration activities will focus on both agricultural BMPs and existing large-lot subdivisions activities. Only 6 acres of unforested buffers are available for reforestation in the existing large-lot subdivisions. The focus for these large-lot subdivisions will be on education on lawn fertilizer reductions, septic system maintenance, and reforestation where possible. The agricultural strategy will be to focus on implementation of BMPs as indicated in Appendix A. Seventy-one acres of the unforested buffer occurs in pasture. An emphasis will be placed on fencing and reforestation of the riparian buffer on pastureland if conditions warrant. The Carroll Soil Conservation District and Baltimore County Soil Conservation District will take the lead on working with the farmers.

Indian Run discharges into Grave Run. The drainage areas of these two subwatersheds comprise ~10% of the land area in the Prettyboy watershed. A US Geological Survey gage was installed at the base of the drainage area in 2000. This gage provides an opportunity to monitor storm events, in order to determine annual loads and trends over time.

## South Branch Gunpowder Falls

### SOUTH BRANCH GUNPOWDER FALLS

#### **WRAS Priority**

**Restoration: Very High**

**Preservation: Low**

#### **Quick Subwatershed Facts**

Size: 4,193 acres (3,355 ac in Carroll, 837 ac in York)

Stream miles: 9.6

#### **Land Cover**

- 12% Developed
- 48% Croplands
- 12% Pasture
- 28% Forest
- 2.7% Impervious Cover

#### **Stream Characteristics**

- Unforested buffer, acres: 236.0 (72.7%)

#### **Biological Condition**

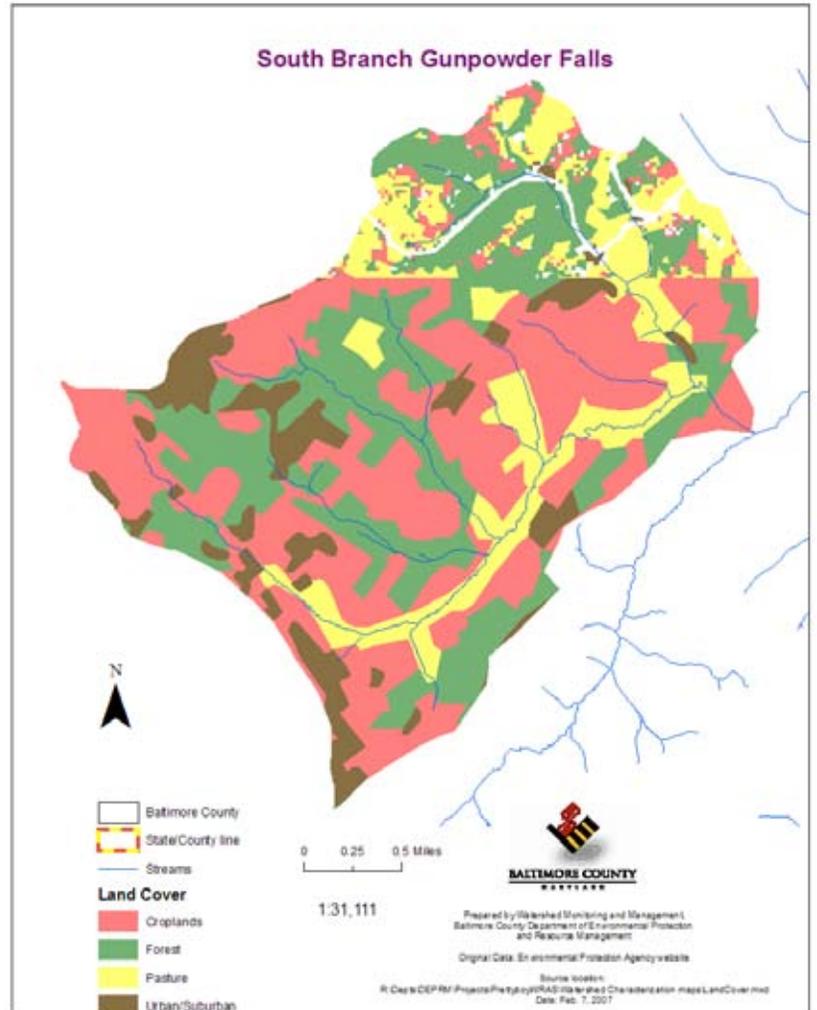
- Aquatic Conservation Target 3
- Brook Trout: Absent/No Data
- Ecologically Significant Area Designation: 4,046 ac. (96%)

#### **Soil Erosion Hazard on agricultural lands, acres (% of area)**

- High: 280 ac. (14%)
- Medium: 1,290 ac. (65%)
- Low: 412 ac. (21%)

#### **Protected Land**

- Public Land: 1 ac
- Agricultural Easements: 316 ac.



**Conditions:** The South Branch Gunpowder Falls subwatershed is located in the western most portion of the Prettyboy Reservoir watershed and discharges to Gunpowder Falls. The headwaters originate in Carroll County, but a tributary originates in York County. Eighty percent of the drainage area is in Carroll County, with the remaining 20% in York County. The South Branch Gunpowder Falls is zoned mainly for agricultural conservation (87% over all, 94% within Carroll County). Within Carroll County, only

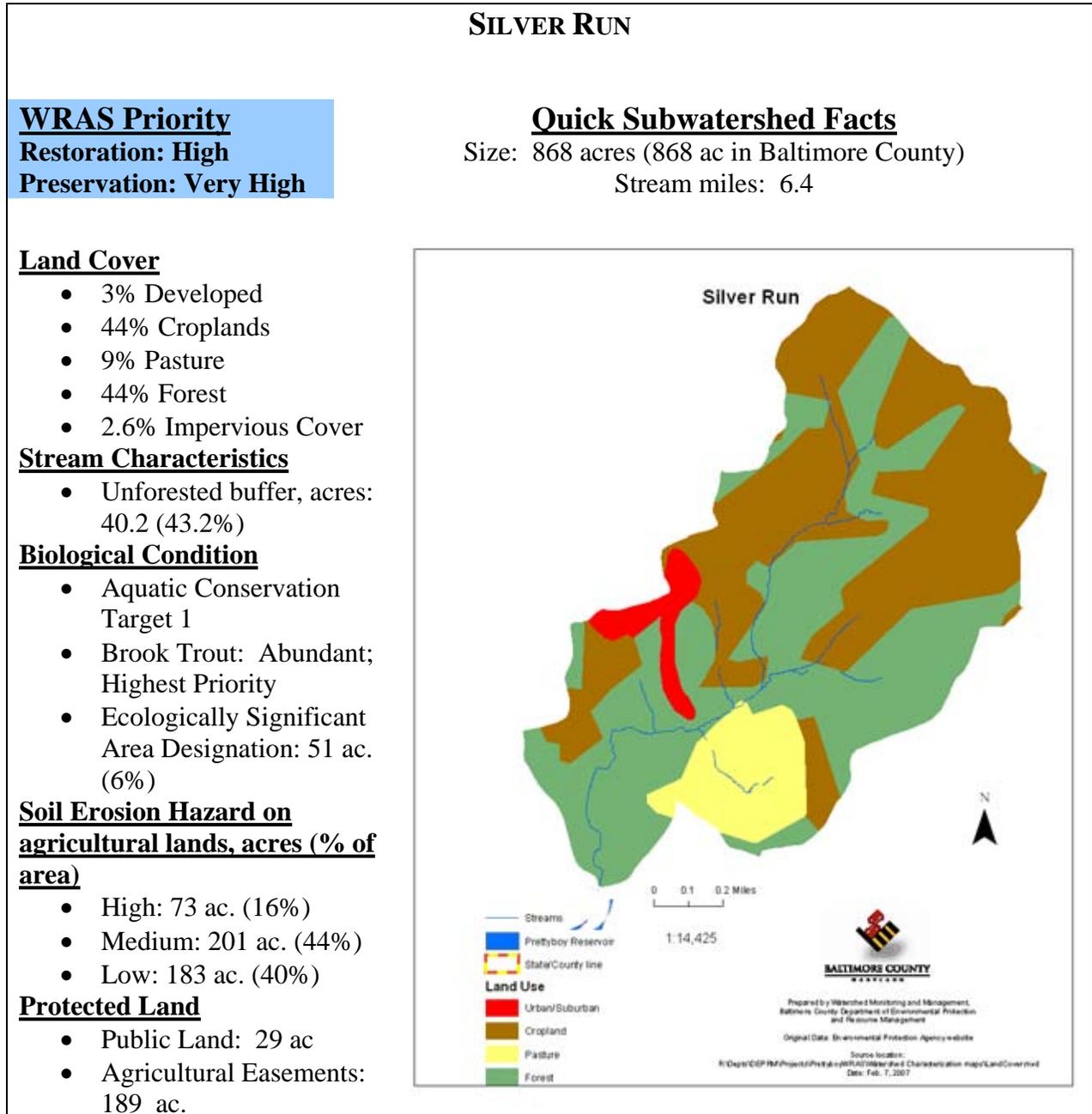
134 acres is zoned other than agricultural conservation. These acres are zoned for the most part as high-density residential and commercial and are associated with the village of Melrose, identified as a rural Priority Funding Area in the southern portion of the subwatershed. York County has 131 acres zoned for rural residential (mostly built) and 221 for conservation. Sixty percent of the subwatershed is classified as agricultural use, with 28% in forest cover. Twelve percent of the acreage within the South Branch Gunpowder Falls subwatershed is classified as developed. While much of this development is located in the southern portion of the subwatershed, the balance is scattered throughout the drainage area. Only 27% of the riparian buffer is forested.

The subwatershed is part of a larger 12-digit subwatershed that is listed for biological impairment. Data from the one Maryland Biological Stream Survey station and one of the three Stream Wader sites within the subwatershed would indicate poor aquatic biological integrity, but this is a limited data set.

Strategy: The primary strategy for South Branch Gunpowder Falls is to focus on agricultural and suburban BMPs to improve water quality. These actions include outreach to and education of subwatershed residents on how their actions can result in the improvement of water quality. For the residential community, the primary message will be on lawn fertilizer reduction, septic system maintenance, and the planting of additional trees where possible. The Baltimore County handbook *From My Backyard to Our Bay* will be one tool used in the outreach to the residents of South Branch. The handbook was created through a collaborative effort between Baltimore County Soil Conservation District, the Baltimore County Office of the Maryland Cooperative Extension and Baltimore County Department of Environmental Protection and Resource Management. The Carroll Soil Conservation District will work with South Branch Gunpowder Falls farmers to explore opportunities for installation of BMPs.

Of special concern in the South Branch Gunpowder Falls is the limited amount of riparian forest. Opportunities to reforest the 11 acres of riparian buffer that are currently unforested in large-lot developments will be explored. The Carroll Soil Conservation District will pursue, where appropriate, reforestation of agricultural forest buffers, particularly the 127 acres of unforested riparian buffer in pasture.

## 4.10 Silver Run



**Conditions:** Silver Run is located in the north central portion of the Prettyboy Reservoir watershed and discharges to Gunpowder Falls prior to the reservoir. The subwatershed is entirely within in Baltimore County. The zoning for Silver Run is mainly rural residential (65% - RC8, 6% RC4, and 4% - RC7). The remaining 25% is zoned for agricultural preservation and is located mainly in the headwaters. RC4 has an allowable density of 1 dwelling/5 acres, the RC7 allows 1 dwelling/25 acres and the RC8 zoning works on a sliding scale, based on the size of the parcel, with maximum density of 1

unit/10 acres. Based on the existing development in the subwatershed, Silver Run has moderate potential for impacts from future development. The residential development is located along the western border of the subwatershed, with a scattering throughout the rest of the drainage area. Many of the residential lots are mainly forested and away from streams, presenting few opportunities for reforestation of large lots and no opportunity for reforestation of the riparian buffer in the developed area. There are 32 acres of unforested riparian buffer in cropland and 8 acres in pasture. Forty-four percent of the watershed is forested, which is above the average for Prettyboy Reservoir as a whole.

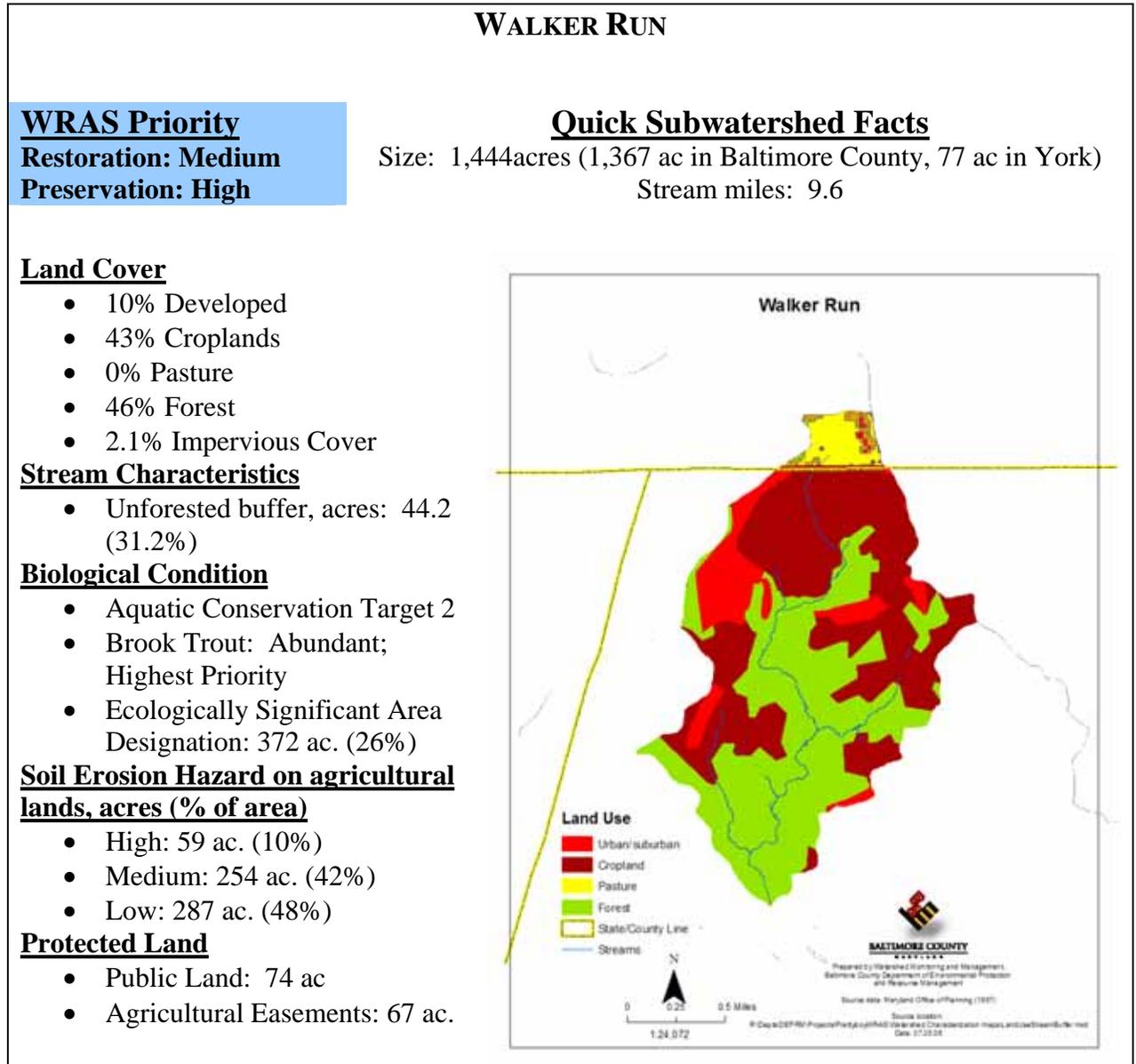
Silver Run has a good population of brook trout, but only 6% of the subwatershed falls within a designated ecologically significant area. Brook trout are especially sensitive to impacts associated with impervious cover and temperature. Trout Unlimited and the Prettyboy Watershed Alliance have been active within the subwatershed, in terms of seeking opportunities for the restoration and protection of trout habitat.

Stream erosion was not recorded during the Stream Corridor Assessment, but 2,000 linear feet of inadequate buffer were noted. Silver Run had the fewest problems noted among the subwatersheds that were assessed during the stream corridor assessment.

**Strategy:** The primary strategy for Silver Run is to focus on the protection and restoration of the existing brook trout population through a variety of actions. These actions include outreach to and education of subwatershed residents on how their actions can impact the existing resource. For the residential community, the primary message will be on lawn fertilizer reduction, septic system maintenance, and the planting of additional trees where possible. The Baltimore County handbook *From My Backyard to Our Bay* will be one tool used in the outreach to the residents of Silver Run. The handbook was created through a collaborative effort between Baltimore County Soil Conservation District, the Baltimore County Office of the Maryland Cooperative Extension and Baltimore County Department of Environmental Protection and Resource Management. The Baltimore County Soil Conservation District will work with Silver Run farmers to explore opportunities for installation of BMPs. Since brook trout are sensitive to temperature increases, emphasis will be placed on working with the agriculture community in this subwatershed to increase the acres of buffer reforestation, with the first focus on the 8 unforested acres in pasture. Prettyboy Watershed Alliance and Trout Unlimited will continue to work with landowners to seek restoration and protection of trout habitat.

Baltimore County will pursue the Builders for the Bay recommendations to provide additional environmental protection for any new development within Silver Run. One recommendation was to develop watershed stormwater criteria for the better protection of coldwater fisheries resources. Given the potential for moderate development within this subwatershed, application of greater protective measures may be necessary to provide adequate protection for the existing brook trout resource. Baltimore County will pursue the development of additional protective criteria for cold water fisheries within the next three years. The development of the criteria will be in conjunction with a stakeholder group. In addition, Baltimore County will implement the Environmental Site Design criteria currently being developed by Maryland Department of the Environment – Stormwater Program, when those criteria become available.

## 4.11 Walker Run



**Conditions:** Walker Run is located in the north central portion of the Prettyboy Reservoir watershed and discharges to Gunpowder Falls prior to the reservoir. The headwaters originate in York County, but the subwatershed is located predominately in Baltimore County. The zoning for Walker Run is mainly agricultural conservation (60%) in Baltimore County and 100% agricultural conservation in York County. Thirty percent is zoned RC 8 and is located along the stream valley. This zoning classification uses a sliding residential density scale based on the size of the parcel, with a density range of 1 unit/10 acres to 1 unit/25 acres. Therefore, the impacts from future development are minimized in this subwatershed. The residential development is located along the western border of the subwatershed, with a scattering throughout the rest of the drainage area. The lots are mainly forested and away from streams, presenting few opportunities

for reforestation of large-lots and no opportunity for reforestation of the riparian buffer in the developed area. There are 87 acres of unforested riparian buffer in cropland and none in pasture. Forty-six percent of the watershed is forested, which is above the average for Prettyboy Reservoir as a whole.

Walker Run has a good population of brook trout and 26% of the subwatershed falls within a designated ecologically significant area. Brook trout are especially sensitive to impacts associated with impervious cover and temperature. Trout Unlimited, the Prettyboy Watershed Alliance, and the York County Watershed Alliance have been active within the subwatershed, in terms of seeking opportunities for the restoration and protection of trout habitat.

Strategy: The primary strategy for Walker Run is to focus on the protection and restoration of the existing brook trout population through a variety of actions. These actions include outreach to and education of subwatershed residents on how their actions can impact the existing resource. For the residential community, the primary message will be on lawn fertilizer reduction, septic system maintenance, and the planting of additional trees where possible. The Baltimore County handbook *From My Backyard to Our Bay* will be one tool used in the outreach to the residents of Walker Run. The handbook was created through a collaborative effort between Baltimore County Soil Conservation District, the Baltimore County Office of the Maryland Cooperative Extension and Baltimore County Department of Environmental Protection and Resource Management. The Baltimore County Soil Conservation District will work with Walker Run farmers to explore opportunities for installation of BMPs. Since brook trout are sensitive to temperature increases, emphasis will be placed on working with the agriculture community in this subwatershed to increase the acres of buffer reforestation, where appropriate. In addition to seeking riparian buffer reforestation opportunities, the five agricultural ponds within the Walker Run subwatershed will be assessed, with the concurrence of the owner, for potential temperature impacts. Three of these ponds have already been assessed. If temperature impacts are noted, remediation will be explored.

A total of 5,500 linear feet of stream erosion was recorded during the Stream Corridor Assessment. This erosion was noted as being moderate in severity, correctability, and for access. The major stream erosion length was in a forested buffer area. The stream erosion will be further assessed to determine its impact on brook trout populations.

## 4.12 Prettyboy Direct Drainage 1

### PRETTYBOY DIRECT DRAINAGE 1

#### **WRAS Priority**

**Restoration: Medium**

**Preservation: Very High**

#### **Quick Subwatershed Facts**

Size: 1,300 acres (1,300 ac in Baltimore County)

Stream miles: 12.8

#### **Land Cover**

- 3% Developed
- 1% Croplands
- 2% Pasture
- 94% Forest
- 1.8% Impervious Cover

#### **Stream Characteristics**

- Unforested buffer, acres: 11.4 (9.1%)

#### **Biological Condition**

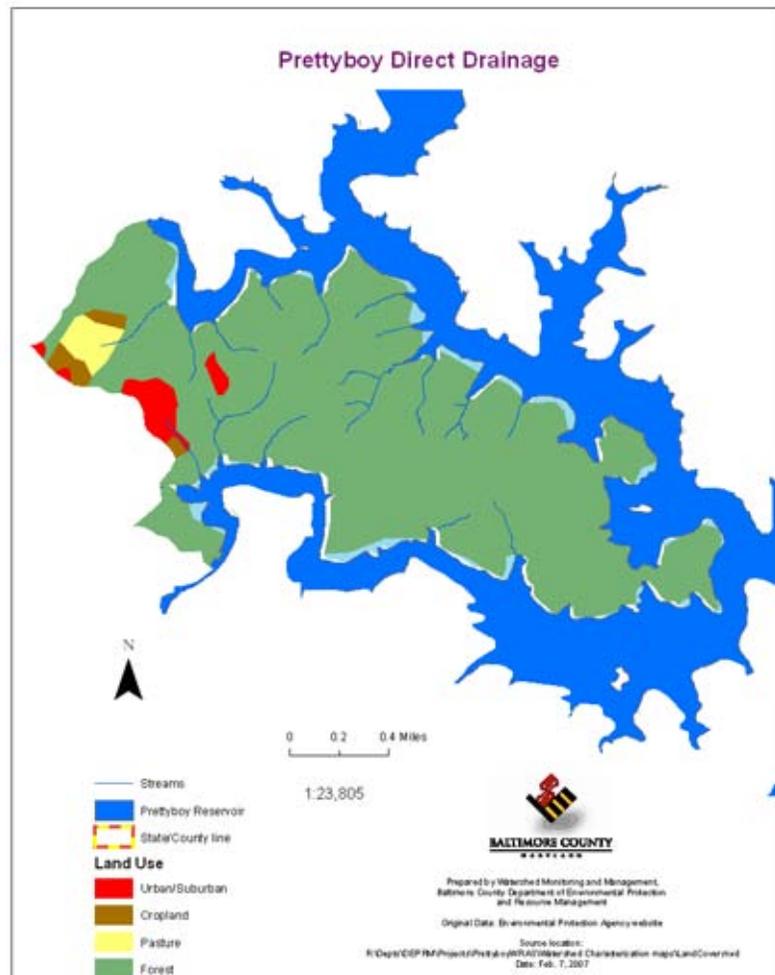
- Aquatic Conservation Target 1
- Brook Trout: Absent/No Data
- Ecologically Significant Area Designation: 1 ac. (.1%)

#### **Soil Erosion Hazard on agricultural lands, acres (% of area)**

- High: 22 ac. (54%)
- Medium: 17 ac. (43%)
- Low: 1 ac. (4%)

#### **Protected Land**

- Public Land: 1,088 ac
- Agricultural Easements: 0 ac.



**Conditions:** Prettyboy Direct Drainage 1 is situated on the peninsula that separates the two main arms of reservoir itself that receive drainage from Graves Run and Georges Run. This subwatershed is located entirely within Baltimore County. The streams are all 1<sup>st</sup> and 2<sup>nd</sup> order streams that drain directly to the reservoir. Ninety-four percent of the drainage area is under forest cover, and 84% of the drainage area is owned by Baltimore City. The remaining 6% of the land cover is evenly divided between agriculture uses and developed lands. These areas are located in the western most portion of the

subwatershed. The zoning for Prettyboy Direct Drainage 1 is primarily RC7 (1 unit/25 acres, 89 %) with the balance zoned RC8 (1 unit/10acres to 1 unit/25 acres). Due to the public ownership of the land and the restrictive zoning impacts, due to future development are limited. Only two residential lots present an opportunity for reforestation. Eleven acres of unforested riparian buffer were identified.

Due mainly to the remote nature of the streams, there is no data on the biological condition of the streams. The condition of the forest on the Baltimore City reservoir lands was detailed in the comprehensive Forest Resource Conservation Plan conducted by Maryland Department of Natural Resources, Forest Service (2003). This plan indicated potential impacts related to deer browse, the even-age nature of the tree stands, the internal road system, and human related trespass activities (dumping, damage to trees, disturbance of the soil, grading and filling, installation of fences, and construction of sheds, tree houses, and stream obstructions).

Strategy: The primary strategy for Prettyboy Direct Drainage 1 is to maintain the existing forest cover within the subwatershed. In order to address the shortage of information on the biological condition of the 15 separate stream systems within this subwatershed, during the first five years of implementation, the streams will be assessed for benthic macroinvertebrate, fish assemblage (including brook trout presence/absence), and habitat condition. In addition, stream corridor assessments will be conducted. The two residential landowners will be approached regarding possible reforestation on their property, including areas of unforested riparian buffer.

### 4.13 Prettyboy Branch

#### PRETTYBOY BRANCH

**WRAS Priority**  
**Restoration: Medium**  
**Preservation: Low**

#### Quick Subwatershed Facts

Size: 1,927 acres (1,927 ac in Baltimore County)  
 Stream miles: 23.4

#### Land Cover

- 8% Residential
- 56% Croplands
- 14% Pasture
- 21% Forest
- 1.0 % Impervious Cover

#### Stream Characteristics

- Unforested buffer, acres: 208.2 (60.3%)

#### Biological Condition

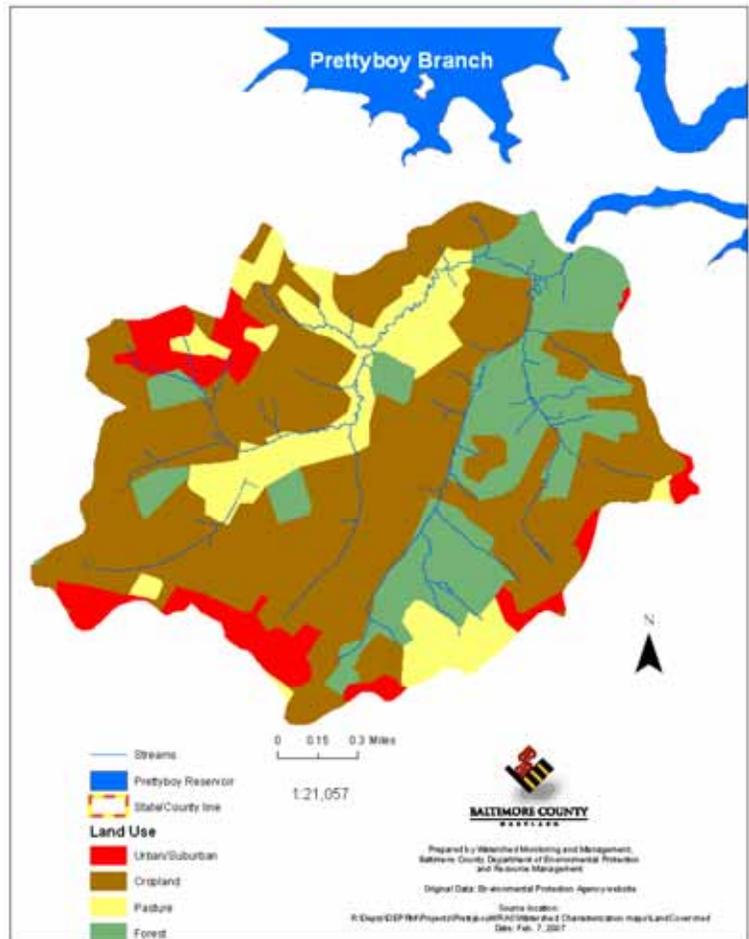
- Aquatic Conservation Target 1
- Brook Trout: Absent/No Data
- Ecologically Significant Area Designation: 5 ac. (.2%)

#### Soil Erosion Hazard on agricultural lands, acres (% of area)

- High: 150 ac. (11%)
- Medium: 750 ac. (55%)
- Low: 453 ac. (34%)

#### Protected Land

- Public Land: 87 ac
- Agricultural Easements: 623 ac.



**Conditions:** Prettyboy Branch is located in the southeastern most portion of the Prettyboy Reservoir watershed, lies totally within Baltimore County boundaries, and discharges directly to the reservoir. The majority of land cover is agriculture (70%), with suburban development limited to along Mount Carmel Road and the northwestern portion of the subwatershed. Ninety-one percent of the land is zoned for Agricultural Conservation, with the remainder primarily in RC8, with a density of one unit per 10 acres to 1 unit per 25 acres. The 120 acres of RC8 zoning is along Tracys Store Road,

adjacent to the City-owned land surrounding the reservoir and is currently in agricultural production and forest. Based on the size of the parcels, only five residential lots could be developed; therefore, future impacts due to development in the Prettyboy Branch is limited. The forest cover within the watershed is limited and well below the average for the Prettyboy Reservoir watershed. In addition, over half of the riparian buffer is unforested (60%). Prettyboy Branch is in a DNR 12-digit watershed (2130806-0313) that is listed for biological impairment. A review of the biological data indicates that the impairment listing is due to the biological scores within Prettyboy Branch. The chemical data indicate that Prettyboy Branch has very high yields of nitrogen and phosphorus. The stream corridor assessment indicated that the main problem within Prettyboy Branch is inadequate forested riparian buffer (32,700 linear feet lacking buffer protection). In addition, the stream corridor assessment found 6,200 linear feet of erosion, rated as moderate severity.

Strategy: The primary strategy for Prettyboy Branch is to focus on the restoration of aquatic biological conditions. Improvement in the biological condition should result in the removal of the entire DNR 12-digit subwatershed from the 303(d) list of impaired waters (biological). Reforestation of the riparian buffer will be aggressively pursued, starting with the unforested buffer associated with the large-lot subdivision in the northwest edge of the subwatershed. The second level of focus will be on fencing and reforestation of the riparian buffer on pastureland and those agricultural riparian buffer areas that have high erosion potential, where farmers are willing.

To address the high levels of phosphorus within the subwatershed, several approaches will be used. For the residential community, the primary message will be on lawn fertilizer reduction, septic system maintenance, and the planting of additional trees where possible. The Baltimore County handbook *From My Backyard to Our Bay* will be one tool used in the outreach to the residents of Prettyboy Branch. The handbook was created through a collaborative effort between Baltimore County Soil Conservation District, the Baltimore County Office of the Maryland Cooperative Extension and Baltimore County Department of Environmental Protection and Resource Management. The Baltimore County Soil Conservation District will work with Prettyboy Branch farmers to explore opportunities for installation of BMPs. Installation of BMPs to address highly erodible agricultural land will be recommended to the farmers, especially for the 13 acres that are in the riparian buffer.

There are a number of small agriculture operations within the Prettyboy Branch subwatershed that fall beneath the qualifications for participation in the Maryland Agricultural Water Quality Cost Share Program (MACS) for best management practice installation. The Baltimore County Soil Conservation District has developed a pilot program to address this gap in financial assistance called the Small Agricultural Operations program. A total of \$25,000 has been allocated to the pilot program, with a limitation of \$5,000 per operation. Prettyboy Branch is one of the subwatersheds that is targeted for assistance. The cost share formula is the same as for the MACS program. Depending on the success of the pilot program, the Baltimore SCD will seek additional funding to expand the program in the future.

Currently, 46% of the agricultural land within the Prettyboy Branch is in agricultural easement. The County will seek to expand the participation of Prettyboy Branch farmers

in the Baltimore County agricultural easement program, in order to conserve the farmlands.

Prettyboy Branch, along with Walker Run and Peggys Run, has been targeted in a pilot program to develop tracking of BMPs. The data typically used by Maryland Department of Agriculture to determine the extent of implementation of BMPs is based on participation in the MACS program. This may underestimate the actual installation and use of BMPs on agricultural land, as it does not account for those BMPs that are used without cost-share money. This effort will include working with farmers in the three subwatersheds to determine what is being implemented and conducting windshield surveys of BMPs. The ultimate goal is to develop a BMP tracking mechanism that accounts for all of the BMPs applied, while at the same time maintaining the privacy of the individual farmer.

## 4.14 Prettyboy Direct Drainage 2

### PRETTYBOY DIRECT DRAINAGE 2

#### **WRAS Priority**

**Restoration: Medium**

**Preservation: Very High**

#### **Quick Subwatershed Facts**

Size: 1,821 acres (1,821 ac in Baltimore County)

Stream miles: 19.0

#### **Land Cover**

- 10% Developed
- 24% Croplands
- 1% Pasture
- 66% Forest
- 1.7% Impervious Cover

#### **Stream Characteristics**

- Unforested buffer, acres: 60.6 (25.7%)

#### **Biological Condition**

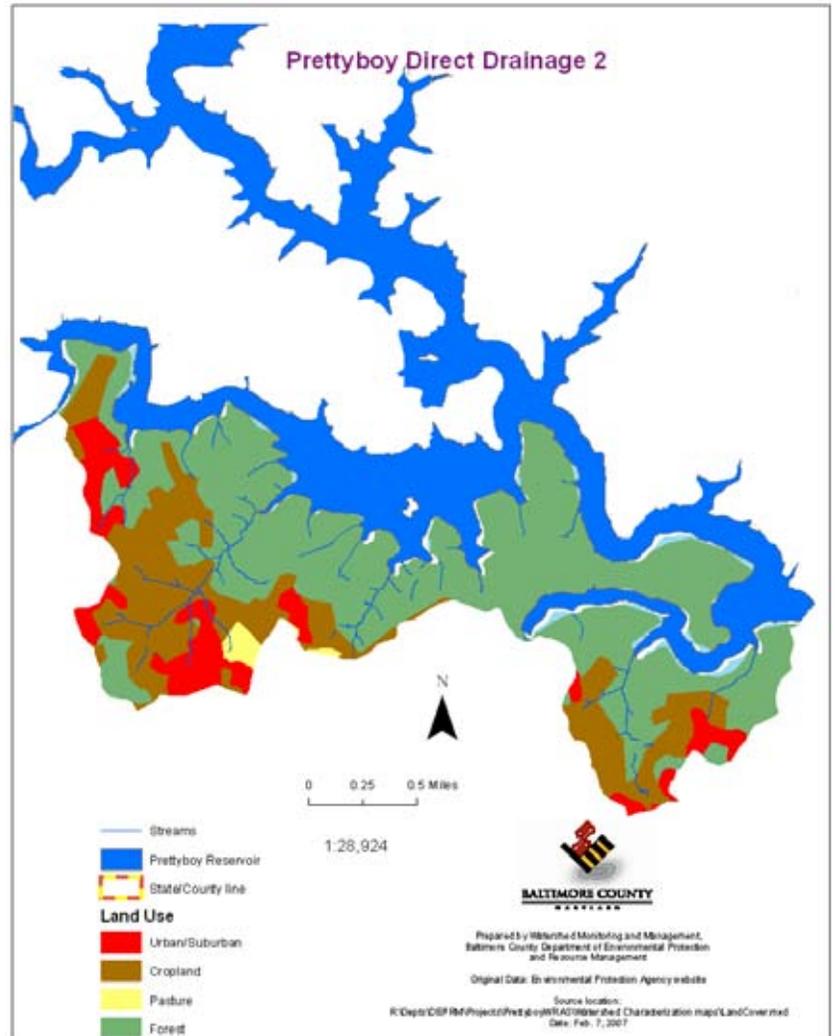
- Aquatic Conservation Target 1
- Brook Trout: Absent/No Data
- Ecologically Significant Area Designation: 57 ac. (3%)

#### **Soil Erosion Hazard on agricultural lands, acres (% of area)**

- High: 93 ac. (21%)
- Medium: 217 ac. (49%)
- Low: 137 ac. (30%)

#### **Protected Land**

- Public Land: 914 ac
- Agricultural Easements: 22 ac.



**Conditions:** Prettyboy Direct Drainage 2 is situated along the southern edge of Prettyboy Reservoir. This subwatershed is located entirely within Baltimore County. There are 19 separate stream systems, the majority of which are first or second-order streams. There are 4 stream systems that are larger 2<sup>nd</sup> order streams or 3<sup>rd</sup> order streams. Sixty-six percent of the drainage area is under forest cover, and 50% of the drainage area is owned by Baltimore City. Agriculture accounts for 25% of the land cover with developed lands accounting for the remaining 10%. Most of the agriculture and developed lands are in the

west-central portion of the subwatershed, in the headwaters of the largest stream system. The zoning for Prettyboy Direct Drainage 2 is primarily RC7 (64%, 1 unit/25 acres), followed by agricultural conservation (26%) with the balance zoned RC8 (20%, 1 unit/10 acres to 1 unit/25 acres). The RC7-zoned land is adjacent to the reservoir and is mainly owned by the City of Baltimore. Much of the RC8 zoned land has already been developed. Due to the public ownership of the land, and the restrictive zoning impacts due to future development are limited.

Due mainly to the remote nature of the streams, there is no data on the biological condition of the streams. The analysis of the riparian buffers indicated that 18 acres of unforested buffer exist in the developed areas, and 2 acres in pasture land. The condition of the forest on the Baltimore City reservoir lands was detailed in the comprehensive Forest Resource Conservation Plan conducted by Maryland Department of Natural Resources, Forest Service (2003). This plan indicates a number of impacts and potential impacts related to deer browse, the even-age nature of the tree stands, the internal road system, and human-related trespass activities (dumping, damage to trees, disturbance of the soil, grading and filling, installation of fences, and construction of sheds, tree houses, and stream obstructions).

Strategy: The primary strategy for Prettyboy Direct Drainage 2 is the preservation of existing forest within the subwatershed. In order to address the shortage of information about the biological condition of the 19 separate stream systems within this subwatershed, they will be monitored during the first five years of the implementation. The streams will be assessed for benthic macroinvertebrates, fish assemblage (including brook trout presence/absence), and habitat condition. In addition, stream corridor assessments will be conducted. The large-lot subdivisions provide an opportunity for reforestation of the riparian buffer and expansion of forest cover by reforestation. Outreach to the residential landowners will be conducted by the Prettyboy Watershed Alliance, to educate them on the benefits of forest cover in protecting high-quality waters. In addition, education on proper use of fertilizer and septic systems will be made available. The Baltimore County handbook *From My Backyard to Our Bay* will be one tool used in the outreach to the residents of Prettyboy Direct Drainage 2. The handbook was created through a collaborative effort between Baltimore County Soil Conservation District, the Baltimore County Office of the Maryland Cooperative Extension and Baltimore County Department of Environmental Protection and Resource Management. The Baltimore County Soil Conservation District will work with the farmers in Prettyboy Direct Drainage 2 to implement the agricultural BMPs detailed in Appendix A.

## 4.15 Prettyboy Direct Drainage 4

### PRETTYBOY DIRECT DRAINAGE 4

#### **WRAS Priority**

**Restoration: Medium**

**Preservation: Very High**

#### **Quick Subwatershed Facts**

Size: 1,711 acres (1,703 ac in Baltimore County, 8 ac in Carroll)

Stream miles: 15.6

#### **Land Cover**

- 9% Developed
- 23% Croplands
- 8% Pasture
- 58% Forest
- 1.8% Impervious Cover

#### **Stream Characteristics**

- Unforested buffer, acres: 76.4 (36.6%)

#### **Biological Condition**

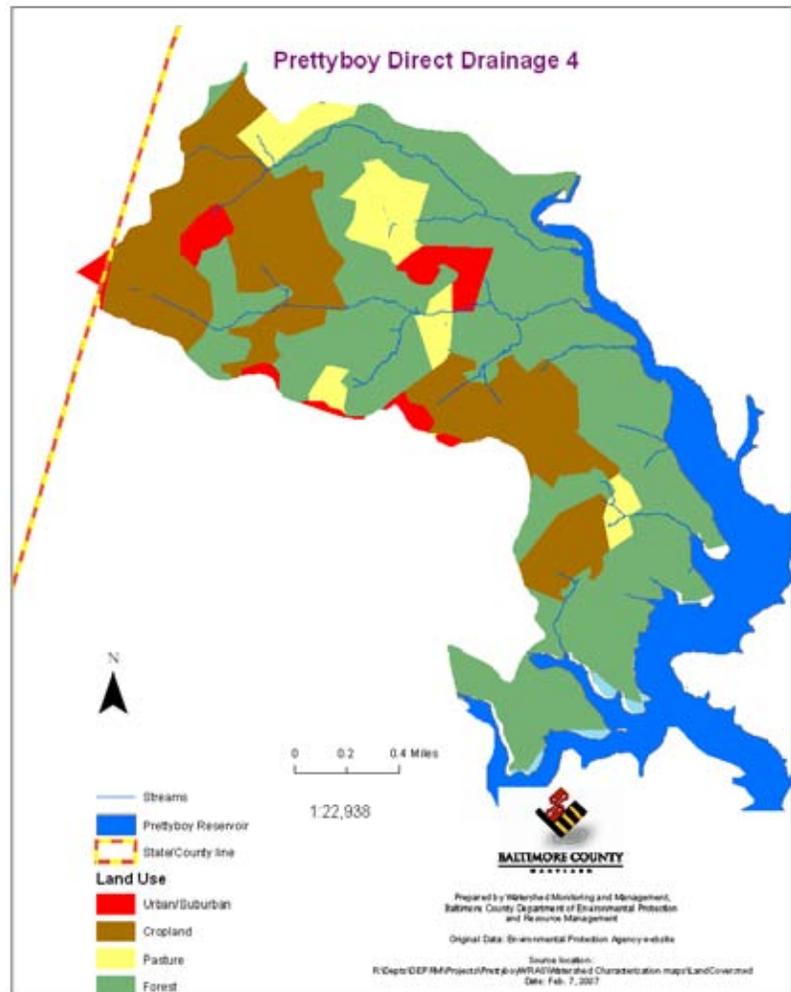
- Aquatic Conservation Target 1
- Brook Trout: Relatively Abundant
- Ecologically Significant Area Designation: 7 ac. (.1%)

#### **Soil Erosion Hazard on agricultural lands, acres (% of area)**

- High: 100 ac. (16%)
- Medium: 324 ac. (50%)
- Low: 218 ac. (24%)

#### **Protected Land**

- Public Land: 568 ac
- Agricultural Easements: 191 ac.



**Conditions:** Prettyboy Direct Drainage 4 is situated along the western edge of the Prettyboy Reservoir. This subwatershed is located entirely within Baltimore County, with the exception of 8 acres in Carroll County. There are 9 separate stream systems, two of which are 3<sup>rd</sup>-order streams. Fifty-eight percent of the drainage area is under forest cover, and one-third of the drainage area is owned by Baltimore City. Agriculture accounts for 31% of the land cover, with developed lands accounting for the remaining

9%. The zoning for Prettyboy Direct Drainage 4 is primarily agricultural conservation (47%), followed by rural residential RC7 (36%, 1 unit/25 acres), with the balance zoned RC8 (17%, 1 unit/10acres to 1 unit/25 acres). The RC7-zoned land is adjacent to the reservoir and mainly owned by the City of Baltimore. The RC8-zoned land extends along the main stream system within the subwatershed. Some of this RC8 zoned land has already been developed. Due to the public ownership of the land and the restrictive zoning, impacts due to future development are limited.

Brook trout have been found in the largest stream system in Prettyboy Direct Drainage 4, with what appears to be a healthy population. Maryland Biological Stream Survey data indicates that the aquatic biological integrity within this subwatershed is good. The analysis of the riparian buffers indicated that 4 acres of unforested buffer exist in the developed areas, and 19 acres in the pasture lands. The condition of the forest on the Baltimore City reservoir lands was detailed in the comprehensive Forest Resource Conservation Plan conducted by Maryland Department of Natural Resources, Forest Service. This plan indicated a number of impacts and potential impacts related to deer browse, the even age nature of the tree stands, the internal road system, and human related trespass activities (dumping, damage to trees, disturbance of the soil, grading and filling, installation of fences, and construction of sheds, tree houses, and stream obstructions).

Strategy: The primary strategy for Prettyboy Direct Drainage 4 is the preservation of existing forest. In order to address the shortage of information about the biological condition of all of the 9 separate stream systems within this subwatershed, they will be monitored during the first five years of implementation. The streams will be assessed for benthic macroinvertebrates, fish assemblage (including brook trout presence/absence), and habitat condition. In addition, stream corridor assessments will be conducted. The large-lot subdivisions provide an opportunity for reforestation of the riparian buffer and expansion of forest cover by reforestation. Outreach to the residential landowners will be conducted by the Prettyboy Watershed Alliance, to educate them on the benefits of forest cover in protecting high-quality waters. In addition, education on proper use of fertilizer and septic systems will be made available. The Baltimore County handbook *From My Backyard to Our Bay* will be one tool used in the outreach to the residents of Prettyboy Direct Drainage 4. The handbook was created through a collaborative effort between Baltimore County Soil Conservation District, the Baltimore County Office of the Maryland Cooperative Extension and Baltimore County Department of Environmental Protection and Resource Management. The Baltimore County Soil Conservation District will work with the farmers in Prettyboy Direct Drainage 4 to implement the agricultural BMPs detailed in Appendix A.

## 4.16 Indian Run

### INDIAN RUN

#### **WRAS Priority**

**Restoration: Low**

**Preservation: Low**

#### **Quick Subwatershed Facts**

Size: 1,012 acres (40 ac in Baltimore County, 972 ac in Carroll)

Stream miles: 4.1

#### **Land Cover**

- 10% developed
- 1% Croplands
- 61% Pasture
- 28% Forest
- 2.4% Impervious Cover

#### **Stream Characteristics**

- Unforested buffer, acres: 32.5 (32.4%)

#### **Biological Condition**

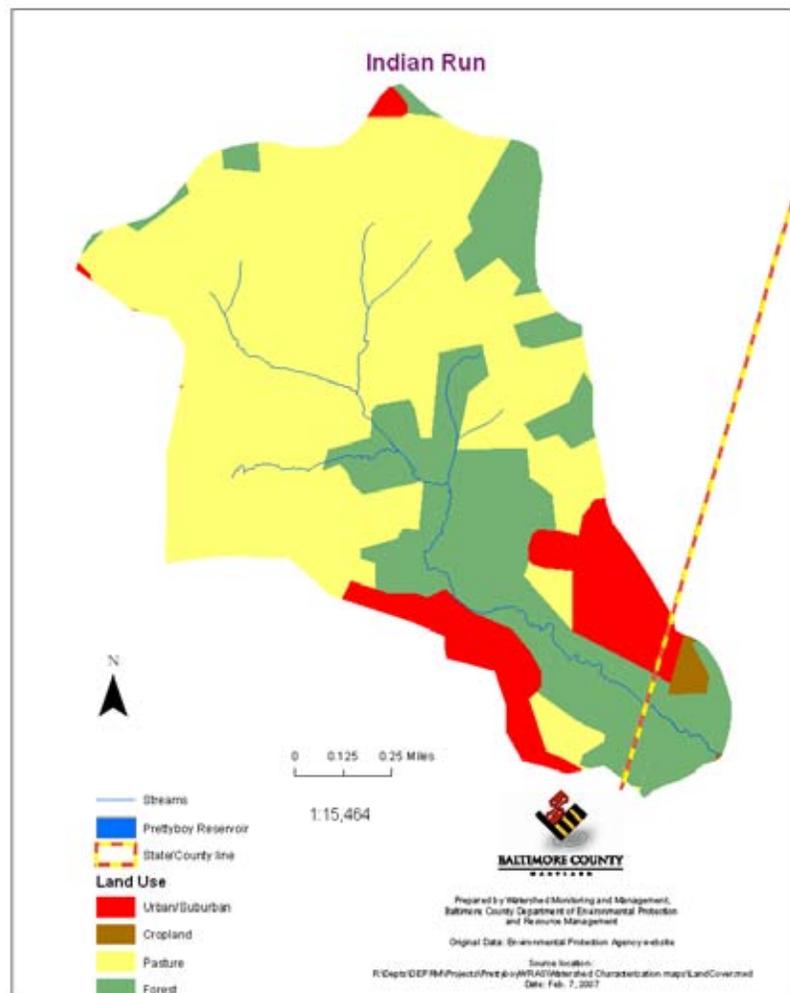
- Aquatic Conservation Target 2
- Brook Trout: Relatively Abundant
- Ecologically Significant Area Designation: 246 ac. (24%)

#### **Soil Erosion Hazard on agricultural lands, acres (% of area)**

- High: 61 ac. (10%)
- Medium: 341 ac. (55%)
- Low: 219 ac. (35%)

#### **Protected Land**

- Public Land: 0 ac
- Agricultural Easements: 362 ac.



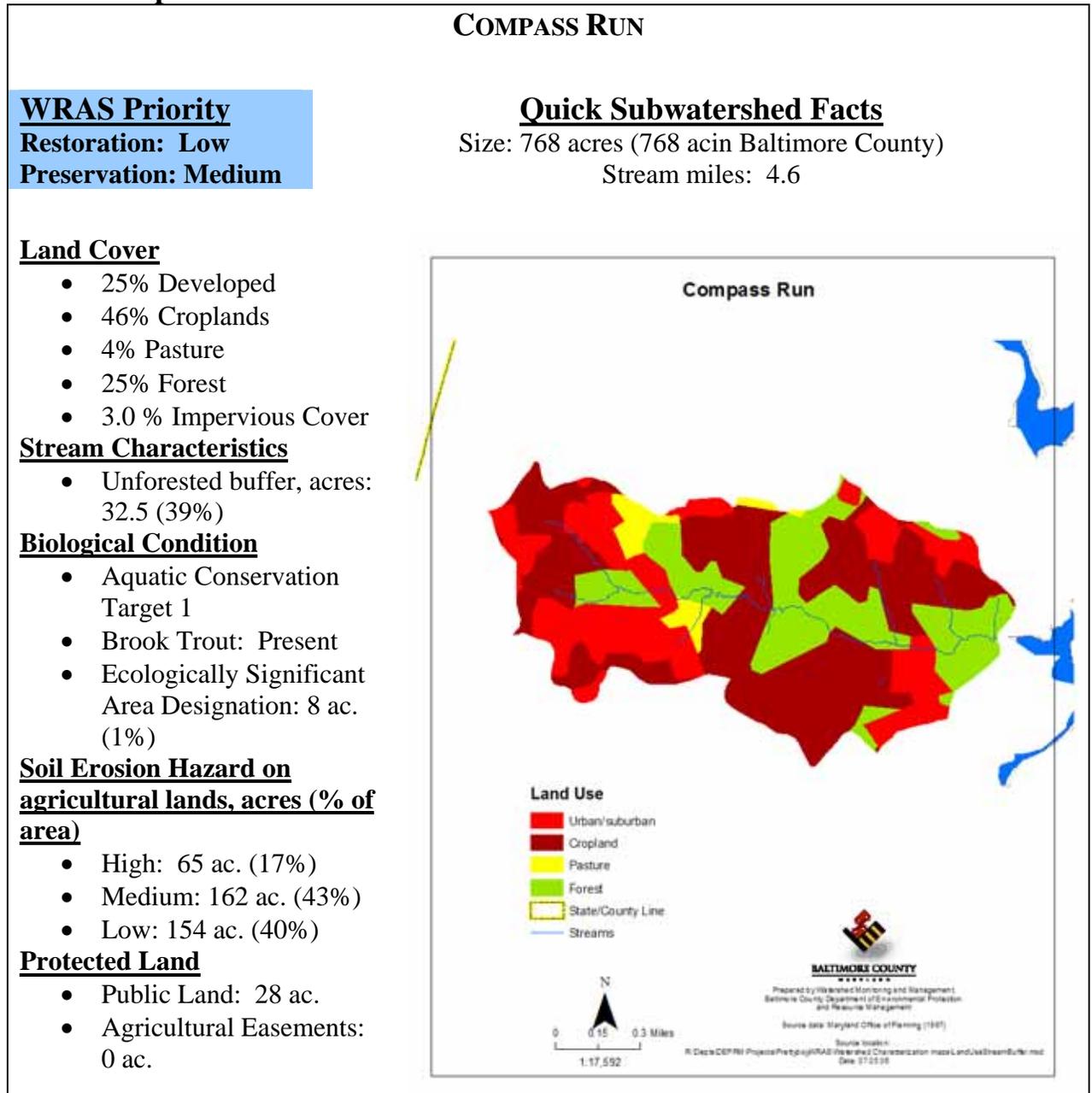
**Conditions:** Indian Run is situated in the central portion of the Prettyboy watershed, west of the reservoir. Indian Run flows into Grave Run. This subwatershed is located mainly within Carroll County, with the exception of 40 acres in Baltimore County. Agriculture accounts for 62% of the land cover, developed lands represent 10% of the drainage area, and the remaining 28% is in forest cover. Much of the agricultural classification for this subwatershed is shown by the Maryland Department of Planning data to be pasture. However, an inspection of aerial photography indicates that the actual land use is

cropland. The zoning for Indian Run is primarily agricultural conservation, with only 38 acres zoned as rural residential in Carroll County, located along the lower mainstem.

Few problems were noted during the Stream Corridor Assessment of Indian Run. There was no channel erosion identified. Pipe outfall issues were the main problems identified. There is no biological data for Indian Run. The synoptic survey noted orthophosphorus concentrations as baseline and nitrate concentrations as high.

Strategy: The primary strategy for Indian Run is the implementation of agricultural BMPs as detailed in Appendix A. All but one agricultural field lie in Carroll County. Carroll Soil Conservation District will take the lead on outreach to farmers in Indian Run, in an effort to increase implementation of agricultural BMPs. There are two large-lot subdivisions in Indian Run that provide an opportunity for reforestation of the riparian buffer (1 acre) and expansion of forest cover by reforestation on the lots. Outreach to the residential landowners will be conducted by the Prettyboy Watershed Alliance, to educate them on the benefits of forest cover in protecting high-quality waters. In addition, education on proper use of fertilizer and septic systems will be made available. The Baltimore County handbook *From My Backyard to Our Bay* will be one tool used in the outreach to the residents of Indian Run. The handbook was created through a collaborative effort between Baltimore County Soil Conservation District, the Baltimore County Office of the Maryland Cooperative Extension and Baltimore County Department of Environmental Protection and Resource Management.

## 4.17 Compass Run



**Conditions:** Compass Run is situated in the central portion of the Prettyboy Reservoir watershed west of the reservoir and flows directly into the reservoir. This subwatershed is located entirely in Baltimore County. Agriculture accounts for 50% of the land cover, developed lands represent 25% of the drainage area, and the remaining 25% is in forest cover. The developed lands occur in the headwater regions and along the ridges to the north and south of the stream. The zoning for Compass Run is primarily agricultural conservation (64%). The remaining zoning is divided between RC8 (33%) and a small amount of RC7 (3%). The RC7-zoned land is located adjacent to the reservoir and is

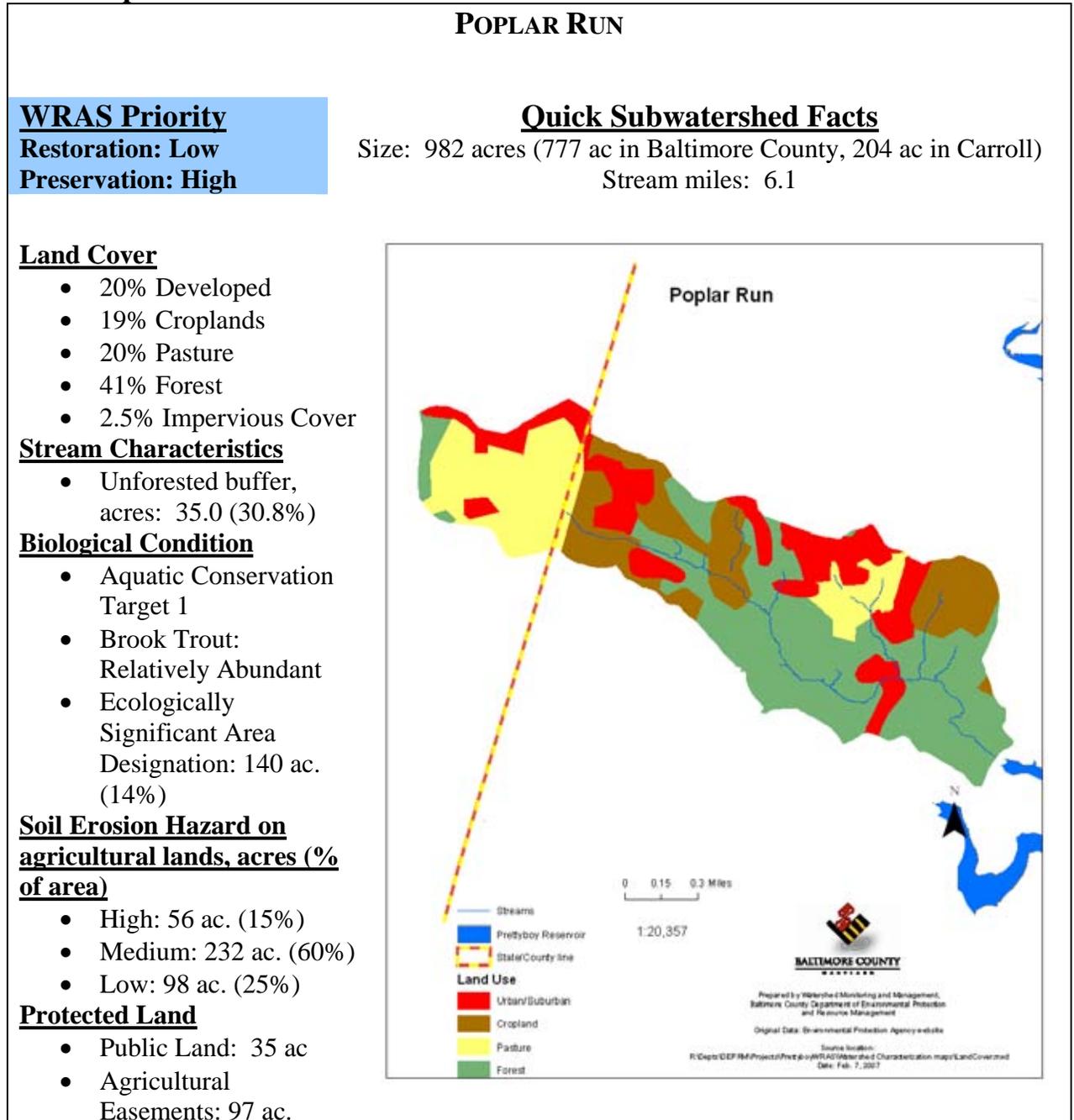
owned by Baltimore City, while the RC8 is located in the northeastern portion of the subwatershed and along the mainstem. While a fair amount of the RC8-zoned land has already been developed, there are parcels remaining that are currently in agricultural usage.

Few problems were noted during the Stream Corridor Assessment of Compass Run (2,250 feet of moderate stream erosion and 4,450 linear feet of inadequate buffer). The Stream Stability Assessment noted only ~500 feet of stream channel that lacked vertical stability and had the potential for additional erosion. The synoptic survey noted orthophosphorus concentrations as baseline and nitrate concentrations as moderate. Brook trout have been found in Compass Run in moderate abundance, while both the Maryland Biological Stream Survey results and Baltimore County Random Point Program results indicate good aquatic biological integrity.

Strategy: The primary strategy for Compass Run is to focus on the protection and restoration of the existing brook trout population through a variety of actions. These actions include outreach to and education of subwatershed residents on how their actions can impact the existing resource. For the residential community, the primary message will be on lawn fertilizer reduction, septic system maintenance, and the planting of additional trees where possible. The Baltimore County handbook *From My Backyard to Our Bay* will be one tool used in the outreach to the residents of Compass Run. The handbook was created through a collaborative effort between Baltimore County Soil Conservation District, the Baltimore County Office of the Maryland Cooperative Extension and Baltimore County Department of Environmental Protection and Resource Management. Nine acres of unforested riparian buffer associated with large-lot subdivisions occur in Compass Run. These acres and additional acreage available on large residential lots represent an opportunity to enhance the forest resources within the subwatershed. The Baltimore County Soil Conservation District will work with Compass Run farmers to explore opportunities for installation of BMPs. Since brook trout are sensitive to temperature increases, emphasis will be placed on working with the agriculture community in this subwatershed to increase the acres of buffer reforestation, with the first focus on the 3 unforested acres now in pasture.

Baltimore County will pursue the Builders for the Bay recommendations to provide additional environmental protection related to any new development within Silver Run. One recommendation was to develop watershed stormwater criteria that provide better protection of coldwater fisheries resources. Given the potential for moderate development within this subwatershed, application of greater protective measures may be necessary to provide adequate protection for the existing brook trout resource. Baltimore County will pursue the development of additional protective criteria for cold water fisheries within the next three years. The development of the criteria will be in conjunction with a stakeholder group. In addition, Baltimore County will implement the Environmental Site Design criteria currently being developed by Maryland Department of the Environment – Stormwater Program, when those criteria become available.

## 4.18 Poplar Run



**Conditions:** Poplar Run is situated in the central portion of the Prettyboy watershed west of the reservoir and flows directly into the reservoir. The headwaters of this subwatershed are located Carroll County and represent 20% of the drainage area, while the balance of the subwatershed is in Baltimore County. Agriculture accounts for 39% of the land cover, developed lands represent 20% of the drainage area, and the remaining 41% is in forest cover. The developed lands occur scattered throughout the subwatershed

and consist of large-lot rural residential land use. The zoning for Poplar Run is primarily agricultural conservation (52%). The remaining zoning is divided between RC8 (44%) and a small amount of RC7 (4%). The RC7 zoned land is located adjacent to the reservoir and is owned by Baltimore City, while the RC8 is located along the mainstem and almost the entire southern half of the subwatershed in Baltimore County. While a fair amount of the RC8-zoned land has already been developed, there are parcels remaining that are currently in agricultural usage.

Poplar Run had only four problems were noted during the Stream Corridor Assessment (one erosion problem of 700 feet of moderate stream erosion, two inadequate buffers for a total of 900 linear feet, and one fish blockage). The synoptic survey noted orthophosphorus concentrations as baseline and nitrate concentrations as moderate. Brook trout have been found in Poplar Run in moderate abundance, while both the Maryland Biological Stream Survey results and Baltimore County Random Point Program results indicate good aquatic biological integrity.

Strategy: The primary strategy for Poplar Run is to focus on the protection and restoration of the existing brook trout population through a variety of actions. These actions include outreach to and education of subwatershed residents on how their actions can impact the existing resource. For the residential community, the primary message will be on lawn fertilizer reduction, septic system maintenance, and the planting of additional trees where possible. The Baltimore County handbook *From My Backyard to Our Bay* will be one tool used in the outreach to the residents of Poplar Run. The handbook was created through a collaborative effort between Baltimore County Soil Conservation District, the Baltimore County Office of the Maryland Cooperative Extension and Baltimore County Department of Environmental Protection and Resource Management. Eight acres of unforested riparian buffer associated with large-lot subdivisions occur in Poplar Run. These acres and additional acreage available on large residential lots represent an opportunity to enhance the forest resources within the subwatershed. The Baltimore County Soil Conservation and the Carroll Soil Conservation District will work with Poplar Run farmers to explore opportunities for installation of BMPs. Since brook trout are sensitive to temperature increases, emphasis will be placed on working with the agriculture community in this subwatershed to increase the acres of buffer reforestation, with the first focus on the 10 unforested acres in pasture.

Baltimore County will pursue the Builders for the Bay recommendations to provide additional environmental protection related to any new development within Poplar Run. One recommendation was to develop watershed stormwater criteria that provide better protection of coldwater fisheries resources. Given the potential for moderate development within this subwatershed, application of greater protective measures may be necessary to provide adequate protection for the existing brook trout resource. Baltimore County will pursue the development of additional protective criteria for cold water fisheries within the next three years. The development of the criteria will be in conjunction with a stakeholder group. In addition, Baltimore County will implement the Environmental Site Design criteria currently being developed by Maryland Department of the Environment – Stormwater Program, when those criteria become available.

## 4.19 Frog Hollow

### FROG HOLLOW

#### **WRAS Priority**

**Restoration: Low**

**Preservation: Medium**

#### **Quick Subwatershed Facts**

Size: 975 acres (975 ac in Baltimore County)

Stream miles: 7.9

#### **Land Cover**

- 19% Developed
- 26% Croplands
- 6% Pasture
- 48% Forest
- 2.3 % Impervious Cover

#### **Stream Characteristics**

- Unforested buffer, acres: 28.6 (21.4%)

#### **Biological Condition**

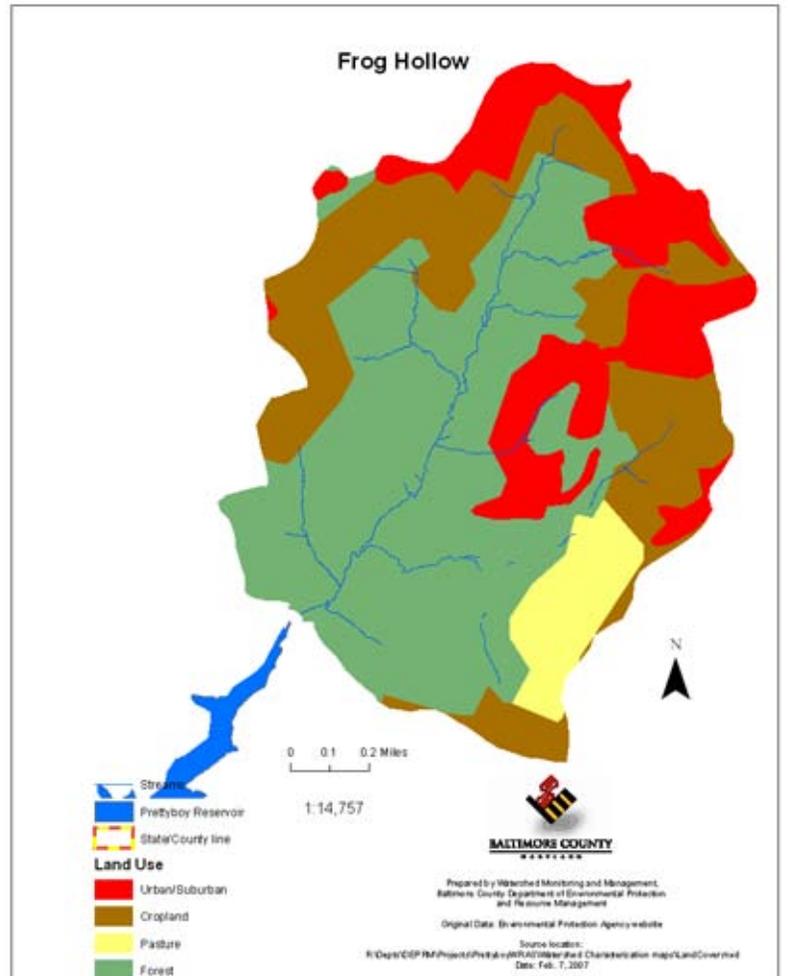
- Aquatic Conservation Target 1
- Brook Trout: Present
- Ecologically Significant Area Designation: 0 ac. (0%)

#### **Soil Erosion Hazard on agricultural lands, acres (% of area)**

- High: 26 ac. (8%)
- Medium: 119 ac. (37%)
- Low: 168 ac. (54%)

#### **Protected Land**

- Public Land: 59 ac
- Agricultural Easements: 0



**Conditions:** Frog Hollow is situated in the easternmost portion of the Prettyboy watershed north of the reservoir and flows directly into the reservoir. This subwatershed is located entirely in Baltimore County. Forest is the dominant land cover at 48%, followed by agriculture at 32% of the land area, with developed lands representing 19% of the drainage area. The developed lands are located primarily on the northern and eastern fringes of the subwatershed and consist of large-lot rural residential land use. The zoning for Frog Hollow is primarily various types of rural residential (RC8 – 36%, RC4 – 35%, RC7 – 7%) for a total of 78% rural residential. The remaining zoning is

agricultural conservation (22%) and a small amount of ML (4 acres). The RC7-zoned land is located adjacent to the reservoir and is owned by Baltimore City, while the RC8 is located along the mainstem. The RC4 occupies most of the northern portion of the subwatershed, while the agricultural conservation zoning is split into two areas (one to the southeast and one to the west) within the subwatershed. While there has been development along the northern and eastern fringe of the subwatershed, the bulk of the land zoned for large-lot residential development has not been developed.

The Frog Hollow Stream Stability Assessment found that 61% of the stream channel assessed lacked channel stability. The synoptic survey noted orthophosphorus concentrations as baseline and nitrate concentrations as high. Brook trout have been found in Frog Hollow in low abundance, while the results for the single Maryland Biological Stream Survey station indicate good aquatic biological integrity.

Strategy: The primary strategy for Frog Hollow is to focus on the protection and restoration of the existing brook trout population through a variety of actions. These actions include outreach to and education of subwatershed residents on how their actions can impact the existing resource. For the residential community, the primary message will be on lawn fertilizer reduction, septic system maintenance, and the planting of additional trees where possible. The Baltimore County handbook *From My Backyard to Our Bay* will be one tool used in the outreach to the residents of Frog Hollow. The handbook was created through a collaborative effort between Baltimore County Soil Conservation District, the Baltimore County Office of the Maryland Cooperative Extension and Baltimore County Department of Environmental Protection and Resource Management. Eight acres of unforested riparian buffer associated with large-lot subdivisions occur in Frog Hollow. These acres and additional acreage available on large residential lots represent an opportunity to enhance the forest resources within the subwatershed. The Baltimore County Soil Conservation will work with Frog Hollow farmers to explore opportunities for installation of BMPs. Since brook trout are sensitive to temperature increases, emphasis will be placed on working with the agriculture community in this subwatershed to increase the acres of buffer reforestation, with the first focus on the 1 unforested acre now in pasture. Baltimore County has identified Frog Hollow for a stream restoration project to be funded in part through the Baltimore County Department of Environmental Protection and Resource Management capital budget in future years.

Baltimore County will pursue the Builders for the Bay recommendations to provide additional environmental protection related to any new development within Frog Hollow. One recommendation was to develop watershed stormwater criteria that provide better protection of coldwater fisheries resources. Given the potential for moderate development within this subwatershed, application of greater protective measures may be necessary to provide adequate protection for the existing brook trout resource. Baltimore County will pursue the development of additional protective criteria for cold water fisheries within the next three years. The development of the criteria will be in conjunction with a stakeholder group. In addition, Baltimore County will implement the Environmental Site Design criteria currently being developed by Maryland Department of the Environment – Stormwater Program, when those criteria become available.

## **Chapter 5**

### **Evaluation**

#### **5.1 Interim Measurable Milestones**

The Prettyboy WRAS 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 Prettyboy WRAS Implementation Committee (an outgrowth of the Prettyboy 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 Prettyboy WRAS Steering Committee anticipates using an adaptive management approach for meeting the goals and objectives detailed in this report. Each year the progress and success of each action 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 WRAS goals. Based on the evaluation, the action strategy may be changed to facilitate meeting the goals and objectives.

#### **5.2 Criteria for Load Reduction**

The Prettyboy WRAS 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 reduction goal. These reduction efficiencies are detailed in Appendix D. The current load reduction scenario for phosphorus is presented in Appendix E, Table E-4. 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 phosphorus load reductions in the Prettyboy Reservoir watershed.

The Prettyboy WRAS Implementation Committee will, in the future, also work on developing an implementation-tracking tool that accounts for all restoration activities. Currently, the agricultural BMPs are felt to be under-represented, as only those BMPs that are cost shared are tracked.

### **5.3 Monitoring**

A number of monitoring activities are proposed for assessing the effectiveness of restoration activities in meeting the WRAS goals and objectives. These activities fall under three basic categories: chemical monitoring, biological monitoring, and habitat monitoring.

#### ***Chemical Monitoring***

*Annual Load and Pollutant Trend Monitoring:* The US Geological Survey is currently assessing the in-lake and watershed monitoring being conducted by Baltimore City, Baltimore County, and Carroll County in relation to key management questions regarding the three reservoirs located in Baltimore and Carroll Counties. The assessment and recommendations for a monitoring program are anticipated to be completed by the end of 2008. Based on staffing requirements and funding levels, the recommendations will be implemented. It is anticipated that wet-weather monitoring at the US Geological Survey gage locations will be recommended.

Wet-weather data collected at the US Geological Survey gages will provide improved annual loading estimates, and (over time) reveal trends in the pollutant loads. The data can also be compared to the Hydrologic Simulation Program Fortran (HSPF) model load estimates. There was insufficient data to calibrate the watershed model accurately for the Prettyboy Reservoir watershed. Calibration was achieved through the calibration runs for Loch Raven Reservoir watershed.

*Pollutant Source Monitoring:* The Prettyboy WRAS Steering Committee has some question as to the accuracy of the HSPF model in determining the sources of phosphorus, specifically, the role of landscape sources versus stream-channel sources. The scale of the HSPF model precludes an accurate representation of stream-channel scour. Phosphorus loads that are being attributed to agricultural or developed land runoff may actually be derived from the stream channels. Having an accurate depiction of the load sources will help identify the types of BMPs that will be most effective and also address the concerns of farmers regarding an accurate accounting of agricultural loads. Within two years, a monitoring design will be completed for determining the pollutant load sources. During the process of the monitoring design, input from the agricultural community will be solicited, to ensure their concurrence. Monitoring will commence in year three.

*Baseflow (Dry Weather) Monitoring:* Baltimore County will continue its Baseflow Monitoring Program. This program will monitor sites within the Prettyboy Reservoir watershed in even-numbered years. Currently, five sites are monitored three to eight times during the designated years.

*Reservoir Monitoring:* Baltimore City has conducted growing-season in-lake monitoring for three decades. This monitoring will continue, with the likelihood of changes based on the US Geological Survey assessment and recommendations.

#### ***Biological Monitoring***

*Brook Trout Monitoring:* In order to assess the status and extent of the brook trout populations within the Prettyboy Reservoir watershed, Baltimore County (in partnership with Maryland Department of Natural Resources) will develop a monitoring plan. Both Baltimore County and DNR will provide staffing to conduct the monitoring. The monitoring will seek to monitor stream systems that have not been previously assessed and to periodically monitor stream systems that have known brook trout populations. This monitoring will assist in determining the effectiveness of the restoration measures that are implemented to improve brook trout habitat.

*Baltimore County Probabilistic Monitoring:* Baltimore County conducts a probabilistic monitoring program for benthic macroinvertebrates to determine the health of its watersheds. The Gunpowder Basin, including the Prettyboy Reservoir watershed, is monitored in even-numbered years. The sites are randomly selected and then monitored using Maryland Biological Stream Survey protocols. The data provides a higher-density supplement for the MBSS-collected biological data. Two sites within the Prettyboy Reservoir watershed are “sentinel sites” and are monitored at the same location every two years to help determine trends in the biological community over time. In addition, a Baltimore County reference site is located within the Prettyboy Reservoir watershed and is monitored on an annual basis.

### ***Habitat Monitoring***

*Stream Corridor Assessments:* The unassessed streams in the Baltimore County portion of the Prettyboy Reservoir watershed will have a stream corridor assessment performed. This monitoring activity will be completed during the first five years of implementation. These additional stream corridor assessments will assist in targeting future restoration activities.

*Stream Watch Program:* The Prettyboy Watershed Alliance will continue its Stream Watch Program, which is designed to engage citizens in stream stewardship. The program was created through funding by Baltimore County to be utilized by watershed associations throughout the county. Baltimore County continues to provide funding to the Prettyboy Watershed Alliance to conduct a Stream Watch Program. The program is designed to allow citizens to conduct stream monitoring activities at a number of levels, depending on amount of effort the citizens want to expend. Among the activities are monitoring of stream conditions, stream sampling, and identification of restoration options.

*Targeted Habitat Surveys:* The targeted habitat surveys will specifically assess fish habitat; and identify locations for habitat improvement, using Maryland Biological Stream Survey methodologies. These targeted surveys will be conducted in brook trout streams or in streams with the potential to support brook trout, for the express purpose of identifying habitat improvement projects to benefit the brook trout populations. One hundred stream reaches will be surveyed within five years.

## Appendix A

### Watershed Restoration Action 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
- Educational 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 Managment	1
Baltimore County Soil Conservation District	2
Carroll County Government	3
Carroll County Soil Conservation District	4
Baltimore City Government	5
Reservoir Technical Group	6
Prettyboy Watershed Alliance	7
Gunpowder Valley Conservancy	8
Trout Unlimited	9
Maryland Department of Natural Resources	10
Prettyboy WRAS Implementation Committee	11

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 Prettyboy WRAS Implementation Committee will aggressively pursue grant opportunities as they become available, subject to staff capacity to manage the grants and availability of matching funds.

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

**Table A-2: Recommended Actions to Meet the Prettyboy Watershed Restoration Action Strategy Goals and Objectives**

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
<b>Restoration Actions</b>							
1 2 5 6	1 3 4 1	<u>Riparian buffer reforestation:</u> Reforest 44,000 linear feet (200 acres) of developed land riparian buffer (200 feet wide); Reforest 80,000 lf (367 arces) of pasture land forest buffer (200 feet wide); Reforest 254,000 lf (410 acres) of cropland forest buffer (70 feet wide)	Water quality improvement, stream temperature moderation, increased terrestrial and aquatic habitat	20 years	3.5 miles (50 acres) per year	\$1,500/acre	1, 2, 4, 7, 8, 9
1 2	1 3	Baltimore County and Carroll County shall continue to require riparian buffers for all new development and redevelopment.	Preserves existing riparian forest buffer	On-going	Acres preserved	Existing Staff	1, 3
1	1	Install 1,000 acres of herbaceous riparian buffers	Water quality improvement	20 years	50 acres per year	\$33/ acre	2, 4
1	1	Restore 4,600 feet of eroded stream	Water quality and aquatic habitat improvement	5 years	Restoration completed	\$300/ linear foot	1
1	1	Reforest 1,800 acres of pervious urban/suburban land	Water quality improvement, increased terrestrial wildlife habitat	20 years	Reforestation of 90 acres per year	\$1,500/acre	1, 7, 8, 9
1	1	Assure that all agricultural operations have a Nutrient Management Plan	Improved water quality, economic savings for farm operations	5 years	100% of agricultural operations have a Nutrient Management Plan	NA	MDA
1 6	1 1	Retire 1,000 acres of highly erodible agricultural land and reforest	Water quality improvement, increased terrestrial habitat	20 years	50 acres of erodible land reforested	\$1,500/acre	2, 4
1	1	Install 5 animal waste structures to manage manure	Water quality improvement	20 years	1 structure installed every 4 years	\$20,000 /structure	2, 4
1 6	1 1	Plant 2,200 acres of cover crops annually	Water quality improvement	20 years	2,200 acres of cover crops planted annually	\$35/acre	2, 4

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
1	1	Install stream fencing on pasture with off stream watering for 2,400 acres of pasture	Water quality improvement and improved aquatic habitat	20 years	120 acres treated per year	\$2.60 lf cattle; \$6.00 lf horses	2, 4
1 6	1 1	Install off stream watering without fence on 1,200 acres of pasture	Water quality improvement and improved aquatic habitat	20 years	60 acres treated per year	\$500/off stream watering site	2, 4
1	1	Install 20 rooftop runoff structures on agricultural facilities.	Water quality improvement	20 years	1 structure per year	\$500/structure	2, 4
1	1	Implement continuous no-till on 8,500 acres of cropland	Water quality improvement	20 years	400 acres per year	No cost change in practice	2, 4
1	1	Implement conservation plans on 8,000 acres of cropland	Water quality improvement	20 years	400 acres per year	\$30/acre	2, 4
1	1	Implement conservation plans on 2,400 acres of pasture	Water quality improvement	20 Years	120 acres treated per year	\$30/acre	2, 4
1 8	1 6	Investigate the feasibility of planting riparian buffers on publicly owned land.	Provides water quality and enhances terrestrial and aquatic habitat	10 years	Public land riparian buffers planted	\$1,500/acre	1, 3
1 8	1 6	Investigate the feasibility of retrofitting pre-existing developed public acreage with stormwater management within 10 years.	Provides water quality	10 years	Stormwater retrofits installed	Unknown	1, 3
1	2	Review and comment on the Bacteria TMDL when developed by Maryland Department of the Environment.	Assures understanding of the TMDL	When developed by MDE	Comments produced	Existing Staff	1, 2, 3, 4, 5, 6, 7, 8
1	2	Based on the TMDL reduction requirement, identify sources and associated actions for bacteria reduction.	Assures that the actions needed to address the bacterial impairment are identified	Within 2 years of the development of the TMDL	Actions incorporated into PB WRAS	Existing Staff	1, 2, 3, 4, 5, 6, 7, 8
2	1	Based on the results from probabilistic monitoring and the survey of 100 stream reaches, identify and prioritize locations for habitat enhancement and preservation.	Improves aquatic biological integrity and enhances fish populations	10 years	Habitat improvement projects completed	Unknown	1, 7, 8, 9, 10, 11

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
2	2	Identify property owners who have streams in need of improvement of in-stream habitat within one year of the completion of the WRAS, using the stream corridor assessments and the stream stability assessments.	Targets habitat restoration efforts based on existing information	1 year	List of property owners	Existing staff	1
2	2	Contact property owners with the highest-ranked projects to solicit their participation in or permission to complete the in-stream habitat projects.	Refines those projects that can be done based on landowner approval	2 year	Letters sent and responses tallied	Existing staff	11
2	2	Based on the responses from above, contact 10 property owners with the highest-ranked properties, regarding preservation opportunities and/or habitat improvement projects related to maintaining aquatic biodiversity.	Secures the preservation of high-quality aquatic habitat	3 year	10 projects completed or sites preserved	Unknown	11
2	4	Participate in the Baltimore County Builders for the Bay Committee to explore greater protections for known brook trout streams.	Participation of stakeholders that might be affected by changes in development requirements	3 years	Greater protection for brook trout	Existing Staff	1, 2, 7, 8, 9, 10
2	4	Enhance or restore brook trout populations where suitable habitat exists or is created.	Expands brook trout populations	20 years	Increased brook trout populations	Unknown	9, 10
2	5	With Baltimore City and DNR, assess opportunities to improve recreational fishing in Prettyboy Reservoir watershed.	Provides recreational opportunities	5 years	Assessment Memo	Existing Staff	1, 5, 9, 10
3	3	A minimum of 5 habitat restoration or stream clean-up projects will be conducted by citizen volunteers per year.	Watershed education, improved water quality and habitat	20 years	5 projects per year	\$1,000 /project	7, 8
4	1	Identify, secure funding, and implement 1 site-specific activities per year to address species in need of conservation based on the DNR Natural Heritage Program.	Improved habitat, increased populations of species in need of conservation	20 years	1 project per year	\$5,000/ Project	11, 10
4	3	Investigate ways to conserve properties containing populations of species of concern within 10 years of the completion of the Prettyboy WRAS.	Protection of species in need of conservation	10 years	Acres of land conserved	Varies depending on easement costs	1, 3, 10

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
5	1	Identify woodlot owners within one year of the completion of the WRAS	Improved forest habitat	1 year	List of woodlot owners	Existing staff	1
5	2	Acquire funding through existing programs (eg. Rural Legacy Program) or new programs (developed by the State or Federal Governments) for the preservation of an additional 1,000 acres of existing forest (50 acres/year).	Additional forest preserved	20 years	50 acres of forest preserved per year	Existing staff, varies depending on easement costs	11
5	3	Organize 1 exotic invasive species removal activity addressing 10 acres per year.	Improved forest habitat	20 years	Exotic species removed from 10 acres per year	\$500	7, 8
5	5	Arrange at least 10 small-scale timber harvesting projects using low-impact techniques on the properties of small woodlot owners over a 20-year period.	Forest habitat improvement	20 years	1 low-impact harvest every two years	Existing staff	7, 8
5	6	Help citizens develop 5 forest management plans each year that emphasize water quality and wildlife habitat.	Forest habitat and water quality improvement	20 years	5 forest management plans per year	Existing staff	7, 8
5	6	Engage 20 landowners in the creation of 10 acres of upland forest habitat on their properties, annually.	Expanded forest habitat	20 years	10 acres of new forest per year.	Existing Staff	1, 7, 8
5	7	<b>Baltimore County and Carroll County will continue to enforce forest conservation, floodplain management, and riparian buffer requirements for all new development and re-development</b>	Protection of existing forest during development process	20 years	Acres of forest protected	Existing staff	1, 3
6	2	Complete four habitat restoration/ enhancement projects per year on farms, using residential-property-owner labor over a eight-year period.	Improved habitat, improved water quality, watershed education	8 years	1 project every two years	\$1,000/project	2, 4, 7, 8
6	3	Secure funding for the implementation of the BMPs on agricultural land.	Provides the funds necessary for increased implementation	20 year	Grants awarded	Existing staff	11
6	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

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

<b>Goal</b>	<b>Objective</b>	<b>Action</b>	<b>Benefits</b>	<b>Timeline</b>	<b>Performance Measure</b>	<b>Cost</b>	<b>Respon. Party(s)</b>
6	4	Baltimore County will seek to preserve high-value agriculture land within the Prettyboy watershed.	Assures continued agricultural operations	20 years	Acres preserved	Existing staff, Cost of easements variable	1
6	4	Carroll County will seek to preserve agricultural land within the Prettyboy watershed.	Assures continued agricultural operations	20 years	Acres preserved	Existing Staff, Cost of easements variable	3
7	1	Implement the recommendations detailed by the Baltimore County Builders for the Bay within three years.	Reduces impact of new development	3 years	Recommendations Implemented	Existing Staff	1
7	1	Carroll County will continue with the on-going Builders for the Bay process.	Reduces impact of new development	1 year	B4B Report produced	\$115,000	3
7	2	Support any down-zoning requests in Baltimore County during the next Comprehensive Rezoning Process, based on the identification of sensitive natural resources in the Prettyboy WRAS.	Reduces suburban growth and impacts associated with development	1 year and every 4 years	Rezoning recommendations	Existing staff	1, 6
8	1	Prettyboy WRAS Implementation Committee - 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	Annual	2 meeting per year	Existing staff	11
8	1	Coordinate restoration activities between and among Baltimore County, Baltimore City, Carroll County, MDE, DNR, and the Prettyboy Watershed Alliance.	Assures continued progress in implementation and adaptive management	On-going		Existing staff	11
8	1	Encourage increased participation by local governments (the towns of Hampstead and Manchester, and York County)	Expands participation of local governments	On-going	Participation of local governments	Existing staff	3, 11
8	3	Participate in the committee to be organized by the Reservoir Program to address salt issues in the reservoir drainage areas. This will include the appropriate road maintenance personnel from the State, Baltimore County, and Carroll County.	Addresses the issue of increasing chloride and sodium concentrations in the reservoirs	On-going	Committee set up	Existing staff	1, 3, 6

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
8	3	Modify deicing programs to reduce salt usage in the Prettyboy Reservoir watershed, based on the recommendations of the committee above	Reduces the chloride and sodium input to the reservoir	When recommendations are made	Changes in deicing practices	Existing staff	1, 3
8	4	Designated County, City and State personnel should attend the bi-monthly Reservoir Technical Group meetings.	Provides coordination between local government and state agencies on issues related to the reservoir	On-going	Attendance at meetings	Existing staff	1, 2, 3, 4, 5
8	5	Participate on the Baltimore County Deer Management Plan Workgroup	Addresses the issue of forest degradation by deer browse	Periodic	Attendance at meetings	Existing staff	1, 5, 7, 8
8	5	Request a bi-annual report on deer management efforts to be presented at the Prettyboy WRAS Implementation Committee meeting.	Compiles data on progress in deer management	Every 2 years	Report produced	Existing staff	11
<b>Education</b>							
1	1	Conduct education on urban nutrient management.	Improve water quality	5 years	Modified nutrient application on 2,300 acres	\$5,000/year, Existing staff	11
1	4	<b>Identify and prioritize target groups (Community Associations, religious organizations, etc.) and needed presentation materials.</b>	Watershed education to targeted groups	1 years	List of target groups and presentation materials to be developed	Existing staff	11
1	4	Develop outreach material and presentations appropriate for each target group, based on the prioritized stewardship practices.	Watershed education to targeted groups	2 years	Outreach material developed	Existing staff	11
1	4	Give 2 presentations per year to educate the various community groups on water quality issues.	Watershed education	20 years	2 presentations per year	Existing staff \$500/event	11
2	3	Develop educational materials on the benefits of forested riparian buffers for distribution at all educational gatherings and events.	Watershed education and acceptance of forested riparian buffers	2 years	Educational materials developed	Existing Staff	11

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
4	2	Develop outreach and educational materials regarding species in need of conservation within one year of the completion of the Prettyboy WRAS.	Watershed education	2 years	Outreach materials developed	Existing Staff	11
4	2	Conduct 1 outreach and education program regarding species of concern annually after the development of the educational materials.	Watershed education	3-20 years	1 program per year	Existing staff \$500/ event	11
5	1	<b>Assemble resources for small woodlot owners (i.e.: list of small portable sawmill operators, information on invasive control, etc.).</b>	Improved forest habitat	1 year	Packet of information of forest-related resources	Existing staff	11
5	1	Hold 1 Small Woodlot Owners Association meetings per year to education woodlot owners on their options.	Forest education	20 years	1 educational meeting per year	Existing staff \$500/ event	11
5	4	Educate landowners on the value of forested riparian areas through an annual workshop and mailings.	Watershed education	20 years	1 workshop per year.	Existing Staff \$500/ event	11
5	5	Develop a demonstration project to promote low-impact timber harvesting techniques.	Forest management education	2 years	1 demo. timber harvesting	Existing staff \$500/ event	11
5	5	Hold an annual workshop on low-impact timber harvesting techniques and demonstrate the benefits.	Forest management education	20 years	1 workshop per year	Existing staff \$500/ event	11
6	2	Encourage mutual education between watershed residents and agricultural property owners regarding water quality issues pertaining to agricultural properties and residential properties by hosting six outreach and discussion sessions for the exchange of information over a six-year period.	Assures watershed residents, businesses, and farmers are all informed of water quality issues and what is being done to address them.	6 years	Annual outreach and discussion session	Existing staff \$500/ event	11
<b>Monitoring</b>							

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
1	1	Develop a BMP tracking process for both the urban and agricultural sectors, along with the BMPs implemented by the counties and citizen groups.	Provides an accounting of progress made	2 years	Tracking mechanism developed	Existing staff	1, 2, 3, 4
1	3	Conduct Stream Corridor Assessments on the remaining un-assessed streams in Baltimore County within five years of the conclusion of the Prettyboy WRAS.	Provides data for targeting remedial actions	5 Years	All stream assessed	Existing staff	1
2	1	Using MBSS methodology, survey 100 stream reaches in the watershed to identify areas for fish habitat enhancement. Complete the survey within five years of the completion of the Prettyboy WRAS.	Provides detailed information for the identification of fish habitat enhancement projects	5 years	100 reaches surveyed	Existing staff	1, 7, 9, 10
2	1	Baltimore County shall continue its program of probabilistic biological monitoring.	Provides data on the biological health of streams	Even number years	Stations monitored and report produced	Existing staff, \$4,500/station	1
2	4	With DNR, identify and monitor the brook trout population trends in the Prettyboy watershed	Establishes the locations of brook trout populations and over time trends in population	20 years	Data related to brook trout population trends	Existing staff	1, 9, 10
3	1	Localize the area of biological impairment, through enhanced monitoring, within 2 years.	Targets restoration efforts to localized impaired areas	2 years	Targeted implementation	Existing staff	1, 7, 9, 10
3	2	A citizen-based monitoring program will be implemented to enhance the ability to identify sources of water quality and habitat degradation. The program will assess water quality and habitat degradation along 100 stream reaches in the watershed within 2 years.	Watershed education, additional data for the identification of sources of impairment, and potential restoration locations	2 years	Citizen based monitoring on 100 stream reaches	Existing staff	7
8	2	Participate in the USGS Study of existing water quality monitoring by local governments.	Provides a framework for monitoring	2 years	Completed USGS Study	Existing staff	1, 3, 5
8	2	Seek funding, if necessary to adequately carry out the recommended monitoring program.	Provides the funds to implement recommended monitoring	4 years	Cost estimate to conduct monitoring	Existing staff	1, 3, 5

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
8	2	Carry out coordinated monitoring program and prepare periodic data reports.	Compiles data on water quality and biological conditions and trends	Biennial	Biennial Report	Existing Staff	1, 3, 5
<b>Funding</b>							
1	2	Investigate funding for implementation of BMPs and actions for the reduction of bacteria to achieve delisting of the watershed within 10 years of the TMDL.	Assures that the actions identified to address bacteria are implemented	Complete implementation within 10 years of the TMDL	Watershed delisted for bacteria	Unknown	1, 2, 3, 4, 11
1	5	Establish a committee to explore tax credits or other tax incentives to landowners who install specific water practices on either already developed or agricultural use land. Use 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	1 years	Establishment of the committee	Existing staff	11
1	4	Assist in the submittal of 2 funding proposals per year for private water quality improvements.	Water quality improvement, watershed education	20 years	2 proposals per year	Existing staff	11
2	4	<b>Seek grant funding for preservation easements of forested land in subwatersheds containing brook trout to maintain sustainable brook trout populations.</b>	Provides protection for brook trout	20 years	Acres of forested land preserved to protect brook trout	Existing staff	11
3	2	The Counties and Baltimore City will implement the monitoring program recommended by the USGS study, subject to funding availability.	Improved monitoring to track water quality trends over time	3 years	Water quality data generated	Unknown	1, 3, 5
3	1	Secure funding and implement restoration projects to delist the biological impairment within 8 years.	Improved aquatic biological integrity	8 years	Delisted subwatershed for biological impairment	Existing staff	9, 11
5	2	Explore the development of additional funding options that may be linked to either the Green Infrastructure Program or the Sustainable Forest Initiative.	Funding for forest related best management practice implementation	5 years	Additional funding for impementation	Existing staff	11

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

Goal	Objective	Action	Benefits	Timeline	Performance Measure	Cost	Respon. Party(s)
6	3	The SCDs will seek funding for one additional staff member to provide planning/technical assistance to farmers and to help them obtain cost-share grants for BMPs.	Provides the additional staffing for increased implementation of agricultural BMPs	1 year	New staff hired	\$80,000 per year	2, 4, 11
3	1	Secure funding and implement restoration projects to delist the biological impairment within 8 years.	Improved aquatic biological integrity	8 years	Delisted subwatershed for biological impairment	Existing staff	9, 11
8	1	Seek opportunities for shared funding through grants. Submit a minimum of 3 grant proposals yearly.	Provides funding for implementation	Annual	3 grant proposals per year	Existing staff	11
<b>Reporting</b>							
1	5	Compile the committee findings of incentive options in a report, no later than two years after the completion of the Prettyboy WRAS.	Provide incentive for landowners to install best management practices to address water quality and habitat	2 years	Report on incentive options	Existing staff	11
1 8	6 4	Assist the Baltimore Metropolitan Council in the preparation of periodic progress reports by providing the implementation tracking information developed by the Prettyboy WRAS Implementation Committee.	Watershed education, progress reporting	Periodic	Completed report by RTG	Existing staff	11
3	2	A water quality monitoring report will be produced biennially.	Summarizes the state of the watershed	Every 2 years	Report produced	Existing staff	11
8	1	Prepare an annual watershed restoration/preservation progress report.	Tracks progress	Annual	1 report per year	Existing Staff	11

## Appendix B

### US Environmental Protection Agency

#### A Through I Criteria for Watershed Planning

This appendix will provide information on how the development of the Prettyboy Reservoir Watershed Restoration Action Strategy 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. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X number of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).*

Prettyboy Reservoir watershed is listed by the Maryland Department of the Environment (MDE) as being impaired by nutrients, bacteria, methyl-mercury in fish tissue, and three of five subwatersheds are listed as being biologically impaired. MDE has prepared Total Maximum Daily Loads (TMDL) for nutrients and methyl-mercury. The TMDL for methyl-mercury identifies the source as air bourn mercury from power plant emissions outside of the Prettyboy WRAS planning area. The TMDL for nutrients identified phosphorus as the limiting nutrient for improvements in the reservoir water quality. The model broke down the pollutant sources between point sources (wastewater treatment plant discharges and urban stormwater), non-point sources (agricultural sources and forest), and stream channel scour. The agricultural sources were divided into various agricultural operation categories. The TMDL document is included in Volume 2 – Appendix L as support for the phosphorus load reductions necessary to achieve water quality standards within the Prettyboy Reservoir. This TMDL was approved by EPA in March 2007.

In order to refine the estimates of phosphorus loads by subwatershed, an analysis was conducted based on the per-acre loading rates developed in the TMDL model. This data is presented in Appendix E. Additional information was collected to refine specific sources of impairment. This information is included as appendices in Volume 2 of this report, including:

- Appendix F – Prettyboy Reservoir Watershed Characterization Report (DEPRM 2007)
- Appendix G – Report on Nutrient Synoptic Survey in the Prettyboy Watershed, Baltimore and Carroll Counties Maryland, April, 2005 as part of a Watershed Restoration Action Strategy (MDE 2006)
- Appendix H – Aquatic Conservation Targets: prioritization of stream in need of restoration and protection and the assessment of stream conditions in 2005 Watershed Action Strategy (WRAS) watersheds: Deer Creek, Prettyboy Reservoir, Port Tobacco River, Miles River and Assawoman Bay (Kilian, etal. 2006)
- Appendix I – Stream Corridor Assessment Survey for the Prettyboy Reservoir Watershed, Baltimore County, Maryland (MDE 2006)
- Appendix J – Stream Corridor Assessment Survey for the Prettyboy Reservoir Watershed, Carroll County, Maryland (DEPRM 2006)
- Appendix K – Prettyboy Reservoir Stream Stability Assessment (Compass Run & Frog Hollow Subwatersheds) (Parsons, Brinkerhoff 2006)

While TMDLs for the three subwatersheds listed as biologically impaired have not been developed, the Prettyboy Reservoir (WRAS) will address those impairments in hopes of removing the impairment listings prior to TMDL development. Based on the information collected and summarized in Appendix F – Chapter 4, and Appendix H, the impairments are localized and therefore more easily corrected. The data specifically associated with stream condition in Appendices I, J, and K assist in the identification of factors in the biological impairment of the streams.

Bacteria are not specifically addressed, however, actions taken to improve water quality by the reduction of phosphorus will also improve water quality degradation related to bacteria. The WRAS specifically sets up the process for modification of the action strategy at the point in time when the bacteria TMDL is developed.

***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. Supporting information on the achievement of the phosphorus reduction goal is provided in Appendix E. The analysis of the potential restoration options is provided in the Appendix F (Characterization Report). Within the body of the Watershed Restoration Action Strategy, Chapter 4 details the restoration strategy to be applied to each subwatershed.

***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 organizations that will work on each action item.

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

The educational activities to enhance public understanding and encourage participation in restoration implementation planning and the installation of best management practices are detailed in Appendix A. In addition, the documentation of subwatershed conditions and strategies in Chapter 4 is designed to serve as a two-page information sheet for each subwatershed, allowing the specific targeting of educational information to the residents of the 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.

***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.

For goals relating to aquatic biology, the monitoring of the biological community will determine if the water quality standards for the biological community are being met. This data will be supplied to the State Agencies for consideration of delisting of biological impairment.

Brook trout will be monitored to determine extent and population trends over time. While target population sizes and the extent of the population have not been set, this information will provide a guide on the success of the restoration implementation.

## Appendix C

### Cost Analysis and a Listing of Potential Funding Sources

This Appendix provides an analysis of the potential cost of implementation of the Prettyboy Reservoir Watershed Restoration Action Strategy 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.

Table C-1 presents the cost analysis. The cost analysis is based on the actions detailed in Appendix A and the phosphorus load reductions in Appendix E. 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 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 phosphorus removal – extended costs/pounds of 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 \$12,000,000.00.

Table C-2 presents the potential funding sources for implementation of the Prettyboy Reservoir WRAS. It presents the funding source, applicant eligibility, eligible projects, funding amount, cost share requirements, and grant cycle.

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

Table C-1: Estimated Cost for Prettyboy Watershed Restoration Action Strategy Implementation (Exclusive of Existing Staffing)

BMP or Action	Acres/ linear feet/no	# TP Removal	Unit Cost	Extended Cost	Cost/# of Phosphorus Removal	Cost Over 20 Years	Comments
Suburban Riparian Forest Buffers	202	242.1	\$1,500	\$303,000	\$1,252	\$303,000	One time cost
Suburban Reforestation	1,850	227.6	\$1,500	\$2,775,000	\$12,192	\$2,775,000	One time cost
Stream Restoration	4,600	16.1	\$300	\$1,380,000	\$85,714	\$1,380,000	One time cost
Urban Nutrient Management	2,314	168	\$2.25	\$5,400	\$32	\$108,000	Annual cost
Riparian Forest Buffers 100' – pasture	367		\$1,500	\$550,500		\$550,500	One time cost
Riparian Buffer Fencing for Above	40,000	596	\$3.20 lf cattle	\$128,000	\$1,541	\$128,000	One time cost
	40,000		\$6.00 lf horse	\$240,000		\$240,000	
Riparian Forest Buffers 35' - crop	408	1,239.7	\$1,500	\$612,000	\$494	\$612,000	One time cost
Riparian Grass Buffer – Crop	1,021	3,653.4	\$33	\$33,700	\$9	\$33,700	One time cost
Tree Planting (highly Erodible soils)	1,100	2,018.6	\$1,500	\$1,650,000	\$817	\$1,650,000	One time cost
Off Stream Watering with Fencing	2,440	600.1					One time cost
	40,000		\$2.60 lf cattle	\$104,000	\$573	\$104,000	
	40,000		\$6.00 lf horse	\$240,000		\$240,000	
Cover Crops	2,212	287	\$35	\$77,420	\$270	\$1,554,800	Annual Cost
Nutrient Management Plans	27,000	6,634.1	\$5	\$135,000	\$20	\$135,000	90% complete
Waste Storage Structures	3	303	\$20,000	\$60,000	\$198	\$60,000	One time cost
Rooftop Runoff Structure	20	260	\$2,000	\$40,000	\$154	\$40,000	One time cost
Continuous No-Till Above Fall Line	6,900	6,895.2	0	0	0	0	Change in practice
Conservation Plans on Conventional Till	775	621	\$30	\$23,250	\$37	\$23,250	One time cost
Conservation Plans on Conservation Till and Hay	600	603	\$30	\$18,000	\$30	\$18,000	One time cost
Conservation Plans on Pasture	2,440	200	\$30	\$73,200	\$366	\$73,200	One time cost
Off Stream Watering without Fencing	1,450 (1 water structur e per 25 acres)	300	\$500	\$25,000	\$83	\$25,000	One time cost
A minimum of 5 habitat restoration or stream clean-up projects will be conducted by citizen volunteers per year.	5	NA	\$1,000	\$5,000	NA	\$100,000	Annual Cost

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

BMP or Action	Acres/ linear feet/no	# TP Removal	Unit Cost	Extended Cost	Cost/# of Phosphorus Removal	Cost Over 20 Years	Comments
Identify, secure funding, and implement 1 site-specific activities per year to address species in need of conservation based on the DNR Natural Heritage Program.	1	NA	\$5,000	\$5,000	NA	\$100,000	Annual Cost
Organize 1 exotic invasive species removal activities addressing 10 acres per year.	1	NA	\$500	\$500	NA	\$10,000	Annual Cost
Complete four habitat restoration/ enhancement projects per year on farms, using residential-property-owner labor over a eight-year period.	4	NA	\$1,000	\$4,000	NA	\$32,000	Annual Costs over Eight year period
Give 2 presentations per year to educate the various community groups on water quality issues.	2	NA	\$500	\$1,000	NA	\$20,000	Annual Cost
Conduct 1 outreach and education program regarding species of concern annually after the development of the educational materials.	1	NA	\$500	\$500	NA	\$9,000	18 years
Hold 1 Small Woodlot Owners Association meetings per year to education woodlot owners on their options.	1	NA	\$500	\$500	NA	\$10,000	Annual cost
Educate landowners on the value of forested riparian areas through an annual workshop and mailings.	1	NA	\$500	\$500	NA	\$10,000	Annual cost
Develop a demonstration project to promote low-impact timber harvesting techniques.	1	NA	\$500	\$500	NA	\$500	Only one in plan
Hold an annual workshop on low-impact timber harvesting techniques and demonstrate the benefits.	1	NA	\$500	\$500	NA	\$10,000	Annual cost

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

<b>BMP or Action</b>	<b>Acres/ linear feet/no</b>	<b># TP Removal</b>	<b>Unit Cost</b>	<b>Extended Cost</b>	<b>Cost/# of Phosphorus Removal</b>	<b>Cost Over 20 Years</b>	<b>Comments</b>
The SCDs will seek funding for one additional staff member to provide planning/technical assistance to farmers and to help them obtain cost-share grants for BMPs.	1	NA	\$80,000	\$80,000	NA	1,600,000	Annual cost for one staff person plus overhead
Encourage mutual education between watershed residents and agricultural property owners regarding water quality issues pertaining to agricultural properties and residential properties by hosting six outreach and discussion sessions for the exchange of information over a six-year period.	1	NA	\$500	\$500	NA	\$10,000	Annual cost
<b>Estimated Total Cost Over 20 Year Period</b>						<b>\$11,964,950</b>	

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

Table C-2: Prettyboy WRAS – Potential Funding Sources

<b>Funding Source Name (Managing Agency)</b>	<b>Applicant Eligibility</b>	<b>Eligible Projects</b>	<b>FUNDING AMOUNT</b>	<b>COST SHARE? / IN-KIND</b>	<b>Project Period</b>
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
Maryland Center for Agro-Ecology Grant Program (Funds from U.S. Dept. of Agriculture) (Maryland Center for Agro-Ecology, Inc.)	Public and Private Sectors	Research Projects: Sustaining agriculture and forestry; Using land use tools to address land use issues more effectively; Environmental improvements in agriculture and forestry through sustainability indicators and new practices	\$30,000 to \$177,000	50% for State agencies	1 year?
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
Eastern Brook Trout Joint Venture Grant Program (FWS)	Looks like everybody	Habitat conservation and improvement projects and related design and monitoring	\$10,000 to \$75,000	100% 1:1	1-5 years
Fish Partnership Grant Program (NFWF)	Local non-profits B.A.S.S. Clubs Ed. Institutions Local government	Enhancement & restoration of habitat; Training workshops and roundtable	\$10,000 to \$30,000	100% 1:1	18 months
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 (?)

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

<b>Funding Source Name (Managing Agency)</b>	<b>Applicant Eligibility</b>	<b>Eligible Projects</b>	<b>FUNDING AMOUNT</b>	<b>COST SHARE? / IN-KIND</b>	<b>Project Period</b>
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 Initiative Grant Program (Chesapeake Bay Trust)	Non-Profit 501(c) 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)	Strengthen an organization through management operations, technology, governance, fundraising, and communications	\$15,000 per year	0% YES	3 Years
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
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
Kodak American Greenways Awards	Non-profit 501(c)3 State Governments	Have demonstrated community support and are important to local greenway development efforts;	\$500 to \$2,500	(?)%	None Specified

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

Funding Source Name (Managing Agency)	Applicant Eligibility	Eligible Projects	FUNDING AMOUNT	COST SHARE? / IN-KIND	Project Period
Program (Eastman Kodak Company)	Local Governments	Are likely to be completed and have tangible results		YES	
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 <a href="#">Chesapeake 2000 Agreement</a>	\$5,000 to \$50,000	(?)%	None Specified
Margaret Rosch Jones Award (MET)	Non-profit 501(c) Organizations involved in environmental education	Encourage education about growth management; Stimulate a better understanding of environmental issues	Up to \$2,000	0%	Annual
Bill James Environmental Grant (MET)			Up to \$1,000		
Buffer Incentive Program (DNR)	Private Landowner with 1-50 acres of open land within 300' of a stream, river, pond, or non-tidal wetland	Establish and maintain streamside forested buffers around the Bay and its Tributaries; Include plantings of seedlings whereby there is at least a 65% survival rate after 1 year	\$300 to \$15,000 (Varies with # of acres)	0%	Open enrollment
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	(?)%	Annual
Environmental Quality Incentives Program (NRCS)	Individual/Family Farmers and Ranchers	Establish grass waterways, filter strips; Involve manure management, nutrient management, Integrated pest management, and Wildlife Habitat Management	\$10,000 to \$50,000	75%  YES	Open enrollment

NRCS- Natural Resources Conservation Service  
MDE- Maryland Department of the Environment  
MET- Maryland Environmental Trust  
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**

<b>Agricultural BMPs</b>	<b>How Credited</b>	<b>TN Reduction Efficiency</b>	<b>TP Reduction Efficiency</b>	<b>SED Reduction Efficiency</b>
Riparian Forest Buffers and Wetland Restoration - Agriculture <sup>1</sup> :	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%

<sup>1</sup> 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.

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

<b><i>Agricultural BMPs (continued)</i></b>	<b><i>How Credited</i></b>	<b><i>TN Reduction Efficiency</i></b>	<b><i>TP Reduction Efficiency</i></b>	<b><i>SED Reduction Efficiency</i></b>
Conservation Plans - Agriculture <sup>1</sup> (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 <sup>1</sup> :	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%

<sup>1</sup> 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.

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

<b><i>Agricultural BMPs (continued)</i></b>	<b><i>How Credited</i></b>	<b><i>TN Reduction Efficiency</i></b>	<b><i>TP Reduction Efficiency</i></b>	<b><i>SED Reduction Efficiency</i></b>
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 <sup>1</sup>	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 <sup>1</sup>	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

<sup>1</sup> 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.

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

<b><i>Agricultural BMPs (continued)</i></b>	<b><i>How Credited</i></b>	<b><i>TN Reduction Efficiency</i></b>	<b><i>TP Reduction Efficiency</i></b>	<b><i>SED Reduction Efficiency</i></b>
Dairy Precision Feeding / and Forage Management <sup>1</sup>	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
<b><i>Urban and Mixed Open BMPs</i></b>				
Stormwater Management::	Efficiency			
Wet Ponds and Wetlands <sup>1</sup>	Efficiency	30%	50%	80%
Dry Detention Ponds and Hydrodynamic Structures <sup>1</sup>	Efficiency	5%	10%	10%
Dry Extended Detention Ponds <sup>1</sup>	Efficiency	30%	20%	60%
Infiltration Practices	Efficiency	50%	70%	90%
Filtering Practices	Efficiency	40%	60%	85%
Erosion and Sediment Control <sup>1</sup>	Efficiency	33%	50%	50%

<sup>1</sup> 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.

PRETTYBOY RESERVOIR WATERSHED RESTORATION ACTION STRATEGY

<i>Urban and Mixed Open BMPs (continued)</i>	<i>How Credited</i>	<i>TN Reduction Efficiency</i>	<i>TP Reduction Efficiency</i>	<i>SED Reduction Efficiency</i>
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 <sup>1</sup>	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
<i>Resource and Septic BMPs</i>				
Forest Harvesting Practices <sup>1</sup>	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

<sup>1</sup> 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)

<b>Agricultural BMPs Requiring Peer Review</b>	<b>How Credited</b>	<b>TN Reduction Efficiency</b>	<b>TP Reduction Efficiency</b>	<b>SED Reduction Efficiency</b>	<b>CBP Lead Status Estimated Completion Date</b>
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

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<b><i>Agricultural BMPs Requiring Peer Review (continued)</i></b>	<b><i>How Credited</i></b>	<b><i>TN Reduction Efficiency</i></b>	<b><i>TP Reduction Efficiency</i></b>	<b><i>SED Reduction Efficiency</i></b>	<b><i>CBP Lead Status Estimated Completion Date</i></b>
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
<b><i>Urban and Mixed Open BMPs Requiring Peer Review</i></b>					
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

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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
<b>Urban and Mixed Open BMPs Requiring Peer Review (continued)</b>	<b>How Credited</b>	<b>TN Reduction Efficiency</b>	<b>TP Reduction Efficiency</b>	<b>SED Reduction Efficiency</b>	<b>CBP Lead Status Estimated Completion Date</b>
Riparian Grass Buffers – Urban and Mixed Open	TBD	TBD	TBD	TBD	TBD
<b>Resource BMPs Requiring Peer Review</b>					
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

<b>Shoreline BMPs</b>	<b>How Credited</b>	<b>TN Reduction Efficiency</b>	<b>TP Reduction Efficiency</b>	<b>SED Reduction Efficiency</b>
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

<b>Resource BMPs</b>	<b>How Credited</b>	<b>TN Reduction Efficiency</b>	<b>TP Reduction Efficiency</b>	<b>SED Reduction Efficiency</b>	<b>CBP Lead Status Estimated Completion Date</b>
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
<b>Resource BMPs (continued)</b>	<b>How Credited</b>	<b>TN Reduction Efficiency</b>	<b>TP Reduction Efficiency</b>	<b>SED Reduction Efficiency</b>	<b>CBP Lead Status Estimated Completion Date</b>
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

## Appendix E

### Pollutant Load and Pollutant Load Reduction Analysis

#### E.1 Introduction

While the Total Maximum Daily Load HSPF model developed by Maryland Department of the Environment provided the total phosphorus loads and the reduction needed to meet water quality standards within the Prettyboy Reservoir (Appendix L), the scale of the modeling was not useful from the standpoint of analysis of subwatershed loadings. A simple model was used to derive subwatershed loadings as described in E.2. In order to assess if the restoration action strategy would meet the TMDL phosphorus reduction goals, it was necessary to determine the pollutant load reduction attributable to each best management practice. This analysis is described in E.3.

#### E.2 Pollutant Load Analysis

The pollutant load analysis was conducted in order to obtain information on phosphorus loads by subwatershed. A simple method of phosphorus loading per acre by land use was used to determine the loads. The land use per acre loadings used in the analysis were derived from the Hydrologic Simulation Program Fortran (HSPF) model (Appendix L). In the case of agriculture, an average per-acre loading based on the agricultural land uses in the HSPF model was used. Since information was not available on the distribution of various agricultural activities in the subwatersheds, averages by HSPF model segment were used. Table E-1 presents the per-acre loadings by land use.

Table E-1: Average Annual Per Acre Phosphorus Loadings by Land Use (pounds)

DNR 12-digit Subwatershed	Urban Impervious	Urban Pervious	Crop	Pasture	Forest
0313	3.11	0.49	1.93	0.77	0.17
0314	3.09	0.32	2.42	0.90	0.19
0315	3.14	0.19	2.50	0.84	0.18
0316	3.11	0.34	2.21	0.80	0.18
0317	3.11	0.34	2.21	0.80	0.18

The land use distribution for each subwatershed was used to calculate the load by land use type, using the loading rates in Table E-2. The urban impervious and urban pervious were combined to give a developed lands load. An average load per acre for each subwatershed was then calculated, based on the total phosphorus load and the subwatershed drainage area. The results are shown in Table E-2.

E-2: Average Annual Phosphorus Loads by Subwatershed (pounds)

DNR 12-digit Scale	Subwatershed Scale	Developed Land Phosphorus	Agricultural Phosphorus	Forest Phosphorus	Total Phosphorus	#s Phosphorus per Acre
0313	Compass Run	154	706	33	893	1.16
	Poplar Run	161	511	68	741	0.75
	Silver Run	85	796	65	933	1.08
	Frog Hollow	150	534	80	763	0.78
	Prettyboy Branch	126	2,290	69	2,485	1.29
	Prettyboy Direct Drainage 1	80	45	208	333	0.26
	Prettyboy Direct Drainage 2	170	858	204	1,232	0.68
	Prettyboy Direct Drainage 3	363	2,329	551	3,242	0.66
	Prettyboy Direct Drainage 4	114	1,096	169	1,379	0.81
<b>0313 Total</b>		<b>1,390</b>	<b>9,165</b>	<b>1,446</b>	<b>12,001</b>	<b>0.79</b>
0314	Georges Run	749	7,061	224	8,034	1.50
	Murphy Run	708	3,618	139	4,465	1.34
	Peggys Run	139	3,046	42	3,226	1.92
<b>0314 Total</b>		<b>1,595</b>	<b>13,725</b>	<b>405</b>	<b>15,725</b>	<b>1.52</b>
0315	Grave Run	365	3,771	253	4,388	1.03
	Indian Run	91	544	51	686	0.68
<b>0315 Total</b>		<b>456</b>	<b>4,315</b>	<b>304</b>	<b>5,074</b>	<b>1.03</b>
0316	Gunpowder Falls	835	2,873	339	4,046	0.50
	Muddy Creek	157	2,166	63	2,386	1.34
	Walker Run	134	2,038	113	2,284	1.59
<b>0316 Total</b>		<b>1,126</b>	<b>7,076</b>	<b>515</b>	<b>8,717</b>	<b>0.77</b>
0317	South Branch	581	2,271	151	3,002	0.82
	South Branch Gunpowder Falls	484	2,440	169	3,093	0.74
<b>0317 Total</b>		<b>1,065</b>	<b>4,711</b>	<b>320</b>	<b>6,095</b>	<b>0.78</b>
<b>Prettyboy Watershed Percentages</b>		<b>5,631</b>	<b>38,993</b>	<b>2,988</b>	<b>47,612</b>	<b>1.02</b>

The result of this calculation indicate that 47,612 pounds of phosphorus are delivered to the Prettyboy reservoir annually. This load calculation does not include point sources (506 pounds) or stream scour (1,188). When these two components are added in, the result is 49,307 pounds, compared to the HSPF model load of 50,532. The load calculated in this fashion is only 2.4% less than the TMDL load.

It can be seen that the average per-acre load distributions vary among subwatersheds from a low of 0.26 pounds/acre/yr (Prettyboy Direct Drainage 1) to a high of 1.92 pounds/acre/yr (Peggys Run).

### E.3 Pollutant Load Reduction Analysis

The TMDL for phosphorus in the Prettyboy Reservoir watershed indicates “a cap” of 23,192 pounds of phosphorus annually in order to meet water quality standards in the reservoir. This requires a reduction of 27,340 pounds of phosphorus to meet the TMDL reduction requirements.

In order to assess the extent of restoration that is needed to meet this goal, an analysis was conducted. In this analysis, the opportunities for restoration were identified through the Characterization Report (Appendix F) in the appropriate units (either acres, linear feet, or units). Pollutant load reduction efficiencies from the Chesapeake Bay Program (Appendix C) or from the Maryland Department of Agriculture were used to determine the per-acre pounds of reduction. The Maryland Department of Agriculture supplied the extent of agricultural best management practices funded through the MACS program for the Prettyboy Reservoir watershed from January 1998 through March of 2007. This data is presented in Table E-3.

Table E-3: Agricultural BMP Installed and Pounds of Phosphorus Removed

<b>BMP</b>	<b>Extent</b>	<b>Units</b>	<b>Lbs P/Unit/Year</b>	<b>Lbs P/Year</b>
Waste Storage Structure	1	Structure	101	101
Conservation Cover	163.4	Acres	1.13	185
Fencing (27,737 lf)	279.7	Acres	0.55	154
Riparian Herbaceous Cover	5.7	Acres	1.08	6
Riparian Forest Buffer	103.2	Acres	2.15	222
Filter Strip	2.3	Acres	1.08	2
Grassed Waterway	10.97	Acre	1.08	12
Rooftop Runoff Structure	7	Number	13	91
Nutrient Management Plans	19,709	Acres	0.3	5,913
SCWQ Plans	18,110	Acres	0.1	1,811
Cover Crop 2007	733	Acres	0.13	95
<b>Total Phosphorus Removed</b>				<b>8,592</b>

Table E-4 lists the best management practices, how the phosphorus reductions are credited, the percentage reduction, the number of units available (usually in acres, but maybe linear feet, or number of structures), the projected participation by the private landowners, the calculated pounds of phosphorus removed, the pounds removed by already implemented practices, and the remaining phosphorus left to be removed after accounting for each practice. The last column presents the remaining phosphorus reduction after subtracting the phosphorus addressed by the best management practices. This starting amount is 27,340 pounds.

This table is meant to be a reduction scenario and provide target numbers to meet the TMDL requirements for phosphorus reduction. These practices and numbers have been transferred to Actions in Appendix A, as the initial strategy to meet water quality standards. As implementation moves forward, some practices will be found to be more acceptable than others resulting in an adaptive management shift in the target actions to meet the TMDL requirements.

It should be noted that the agricultural practices indicated as being installed can be considered a minimum. Best management practices applied by farmers without cost-share funding are not accounted for within Table E-3 or Table E-4. The development of a best management practice tracking process will take into account all of the practices that are on the ground and present a better picture of the actions necessary to meet the phosphorus reduction goal.

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Table E-4: Best Management Practice Targets and Phosphorus Reduction

BMP	How Credited	TP Efficiency	Units Available	Projected Participation	TP Removed	Already Implemented	TP Remaining
<b>Urban BMPs</b>							
Stormwater Management	Efficiency	Varies by Type	387	NA	82.5	82.5	27,257
Riparian Forest Buffers	Land use conversion +Efficiency	25% for 2 upland acres	269	75%	242.1	0	27,015
Reforestation	Land use conversion		4,627	40%	227.6	0	24,495
Stream Restoration	Linear Foot	.0035#	4,600	100%	16.1	0	26,787
Urban Nutrient Management	Efficiency	22%	4,627	50%	168.0	0	26,619
<b>Agriculture</b>							
Nutrient Management Plans	Acre	0.3	22,117	100%	6,635.1	5,913	19,984
SCWQ Plans	Acre	0.1	22,117	100%	2,211.7	1,811	17,772
Riparian Forest Buffers 100' – pasture	Land use conversion +Efficiency	60% for 2 upland acres	734	50%	596.0	222	17,716
Riparian Forest Buffers 35' – crop	Land use conversion +Efficiency	60% for 2 upland acres	2,041	20%	1,239.7		15,936
Riparian Grass Buffer – Crop	Land use conversion +Efficiency	60% for 2 upland acres	2,041	50%	3,653.4.	20	12,283
Tree Planting (highly Erodible soils)	Land use conversion		3,697	30%	2,018.6		10,264
Off Stream Watering with Fencing	Efficiency	60%	4,879	50%	600.1	154	9,664
Cover Crops	Acres	.13	22,117	10%	287	95	9,377
Waste Storage Structures	Number	101#/Unit	NA	NA	505	101	8,872
Rooftop Runoff Structure	Number	13#/Unit	NA	NA	20	91	8,612
Contineous No-Till Above Fall Line	Efficiency	40%	17,238	50%	6,895.2		1,717
Conservation Plans on Conventional Till	Efficiency	15%	5,171	40%	621	185	1,096
Conservation Plans on Conservation Till and Hay	Efficiency	5%	12,067	50%	603		493
Conservation Plans on Pasture	Efficiency	10%	4,879	50%	200		293
Off Stream Watering without Fencing	Efficiency	30%	4,879	25%	300		-7
<b>Total Pounds Phosphorus Removed Annually (% of load reduction to meet TMDL)</b>						<b>8,675 (32%)</b>	