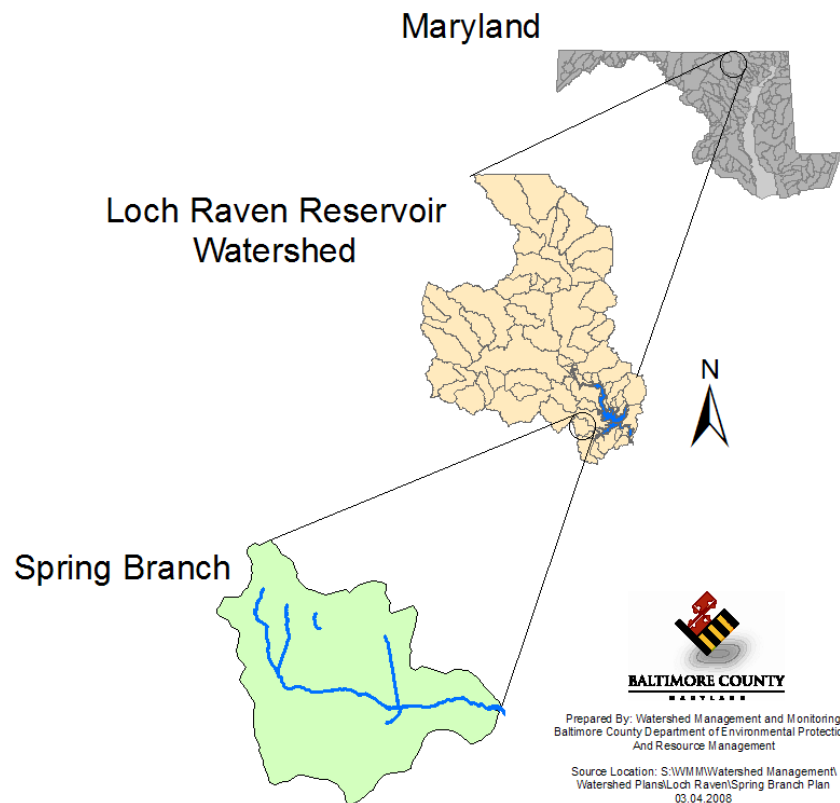


# Spring Branch Subwatershed - Small Watershed Action Plan

(Addendum to the Water Quality Management Plan for Loch Raven Watershed)

## Volume 1



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# Spring Branch Subwatershed Small Watershed Action Plan

## Table of Contents

### Volume 1

<b>CHAPTER 1</b>	<b>INTRODUCTION</b>	
1.1	Project History and Background	1-1
1.2	Watershed Overview	1-2
1.3	Document Organization	1-3
 <b>CHAPTER 2</b>	 <b>CHARACTERIZATION</b>	
2.1	Introduction	2-1
2.2	Natural Landscape	2-1
2.2.1	Climate	2-1
2.2.2	Location and Physiographic Province	2-2
2.2.3	Geology	2-2
2.2.4	Topography	2-3
2.2.5	Soils	2-5
2.2.5.1	Hydrologic Soil Groups	2-6
2.2.5.2	Soil Erodibility	2-7
2.2.6	Stream Systems	2-9
2.3	The Human Modified Landscape	2-9
2.3.1	Land Use	2-9
2.3.2	Impervious Surfaces	2-12
2.3.3	Wastewater	2-13
2.3.4	Stormwater	2-15
2.3.5	Zoning and Build-Out	2-18
2.4	Monitoring Data	2-22
2.4.1	Chemical Monitoring	2-22
2.4.2	Biological Monitoring	2-29
2.4.3	Geomorphological Monitoring	2-31
2.5	List of Impaired Waters and Total Maximum Daily Load	2-33
2.5.1	Methylmercury	2-33
2.5.2	Biological	2-34
2.5.3	Nutrients and Sediment	2-34
2.6	Spring Branch Pollutant Load Analysis	2-35
 <b>CHAPTER 3</b>	 <b>SUBWATERSHED GOALS AND STAKEHOLDER OUTREACH</b>	
3.1	Subwatershed Goals	3-1
3.2	Stakeholder Outreach	3-3
 <b>CHAPTER 4</b>	 <b>RESTORATION STRATEGIES</b>	
4.1	Overview	4-1
4.2	Phase I- Spring Branch Stream Restoration Project	4-2
4.3	Phase II- Spring Branch Stream Restoration Project	4-3
4.4	Results and Benefits	4-4
4.5	Monitoring	4-4

<b>APPENDIX A</b>	<b>EPA A THROUGH I CRITERIA</b>	<b>A-1</b>
<b>APPENDIX B1</b>	<b>PUBLIC OUTREACH</b>	<b>B-1</b>
<b>APPENDIX B2</b>	<b>PUBLIC RESPONSE AND TECHNOLOGY TRANSFER</b>	
<b>APPENDIX C</b>	<b>CHESAPEAKE BAY PROGRAM LOAD REDUCTION CREDITS</b>	<b>C-1</b>

### **List of Tables**

2-1	Spring Branch Geology	2-2
2-2	Spring Branch Slope Distributions	2-4
2-3	Spring Branch Hydrologic Soil Groups	2-6
2-4	Spring Branch Erodibility	2-8
2-5	Spring Branch Land Use	2-9
2-6	Spring Branch Impervious Cover	2-12
2-7	Spring Branch Storm Drain Characteristics	2-16
2-8	Spring Branch Stormwater Management Facilities	2-18
2-9	Spring Branch Historical Development Patterns	2-18
2-10	Spring Branch Zoning	2-20
2-11	Spring Branch Build-Out Analysis	2-22
2-12	Relationship Between Discharge and Pollutant Concentration	2-23
2-13	Pollutant Load Reductions Due to Stream Restoration	2-27
2-14	Spring Branch Cut and Fill for Two Time Periods	2-32
2-15	Spring Branch Pollutant Load Analysis	2-35
2-16	Spring Branch Pollutant Load Reduction	2-36

## **List Of Figures**

1-1	Spring Branch Subwatershed Location	1-3
2-1	Spring Branch Geology	2-3
2-2	Spring Branch Topography	2-5
2-3	Spring Branch Hydrologic Soil Groups	2-7
2-4	Soil Erodibility based on the K factor	2-8
2-5	Spring Branch Land Use	2-10
2-6	Aerial View of Spring Branch	2-11
2-7	Spring Branch Impervious Surfaces	2-13
2-8	Spring Branch Public Sewer Lines	2-15
2-9	Spring Branch Storm Drain System	2-17
2-10	Historical Development in Spring Branch	2-19
2-11	Zoning in Spring Branch	2-21
2-12	Chemical Monitoring Sites	2-24
2-13	Total Suspended Solids Data	2-25
2-14	Total Nitrogen Data	2-25
2-15	Total Phosphorous Data	2-26
2-16	Yearly Mean EMCs for Spring Branch Monitoring Sites	2-28
2-17	Longitudinal Stream Profiles for Nitrogen Concentrations	2-29
2-18	Spring Branch BIBI Scores, Site by Season	2-30
2-19	Spring Branch BIBI Scores, Season by Site	2-31
4-1	Spring Branch Subwatershed Restoration Projects	4-2

## **Spring Branch Subwatershed Small Watershed Action Plan Volume 2: Appendices D Through G**

<b>APPENDIX D</b>	<b>Spring Branch Stream Restoration – Conceptual Plan Report (Biohabitats 1995)</b>	<b>D-1</b>
<b>APPENDIX E</b>	<b>Lower Spring Branch – Preliminary Assessment Analysis Report (Biohabitats 2005)</b>	<b>E-1</b>
<b>APPENDIX F</b>	<b>Lower Spring Branch – Concept Report (Biohabitats 2006)</b>	<b>F-1</b>
<b>APPENDIX G</b>	<b>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</b>	<b>G-1</b>

# CHAPTER 1

## INTRODUCTION

### 1.1 Project History and Background

The Baltimore County Department of Environmental Protection and Resource Management (DEPRM) initiated the Spring Branch Small Watershed Action Plan in 2008 in response to US Environmental Protection Agency comments regarding the Loch Raven Plan inadequacy in meeting the EPA generated A through I criteria for watershed planning. This plan follows in the footsteps of prior and continuing efforts to address the environmental conditions of the Loch Raven Reservoir watershed. The previous and continuing efforts include:

- Reservoir Management Agreement (1979 through 2005)
- Water Quality Management Plan for Loch Raven Watershed (1997)
- Source Water Assessment (2004)

#### ***Reservoir Management Agreement***

Loch Raven Reservoir is one of three reservoirs in the Baltimore Metropolitan System serving 1.8 million people. Spring Branch is one of the subwatersheds within the Loch Raven Reservoir watershed that drains directly to the reservoir. The Loch Raven reservoir 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.

### ***Water Quality Management Plan for Loch Raven Watershed***

Tetra Tech, Inc. developed the Water Quality Management Plan for Loch Raven Watershed in 1997 under contract to Baltimore County Department of Environmental Protection and Resource Management. The plan included the development of a pollutant load model using the EPA Storm Water Management Model (SWMM) for the entire watershed, stream stability assessments (based on case study areas), overall watershed characterization, a management planning analysis, and the development of management planning areas and management actions. Due to the size of the Loch Raven watershed (~140,000 acres) and limitation on funding availability, a case study approach was taken for the stream stability assessment, while the balance of the analysis was conducted watershed wide. Fourteen subwatersheds out of 46 subwatersheds were selected for the stream stability assessment. The selected subwatersheds provided a representation of the distribution of the land use within the Loch Raven Reservoir watershed and included subwatersheds dominated by urban, suburban, agricultural, and forest land uses. The Spring Branch subwatershed was not selected for inclusion in the case study assessments, as the stream had already been selected for a stream restoration project and a detailed assessment of the stream had already been completed (see Appendix F, *Spring Branch Stream Restoration – Conceptual Plan Report* (Biohabitats, 1995)).

### ***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.

## **1.2 Spring Branch Subwatershed Watershed Overview**

The Spring Branch is a 1,005-acre subwatershed located in the Loch Raven Reservoir watershed (Basin No. 02130805), which in turn is located in the Gunpowder River Basin (Figure 1-1). The Spring Branch subwatershed is in the Piedmont region of Maryland. The subwatershed drains directly to southwestern portion of the Loch Raven Reservoir. It was primarily developed in the 1950-1970 time period and predates the environmental regulations that are currently in place. The controlled storm water discharge resulted in severe stream erosion within the subwatershed.

Prior to 1980, to address the problems in Spring Branch, Baltimore County straightened, and channelized Spring Branch to maximize land for development and to divert stormwater. Sizing of many bridges and culverts frequently did not account for flows during large storms, subsequently causing backwater effects and flooding. Sewer lines were installed in the stream valleys for gravity flow and ease of construction. Structures were built close to stream banks without accounting for water level increases during large storms, and storm drains linked impervious surfaces directly to streams. The removal of vegetative buffer areas and development of vast areas of impervious surface compounded adverse effects on this stream. At the time, there was little understanding of the influence these practices would have on long-term stream stability and water quality.

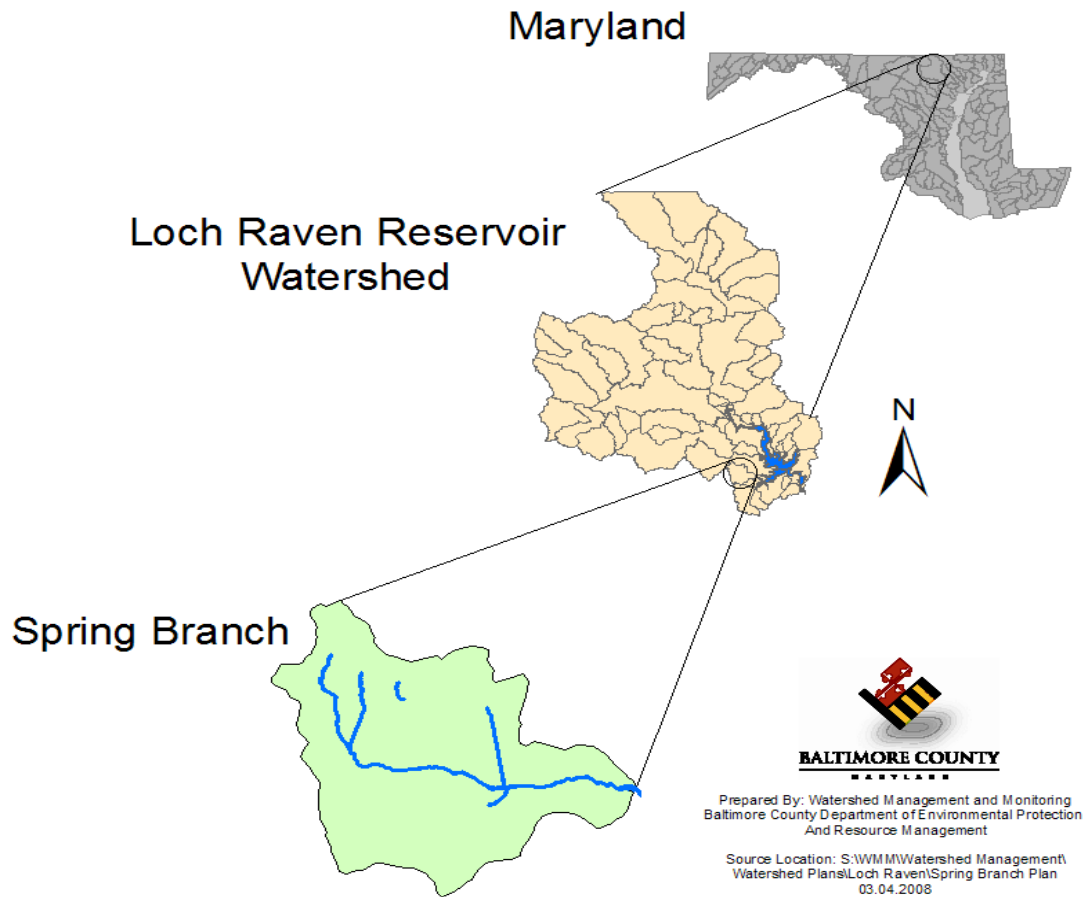


Figure 1-1: Location of the Spring Branch Subwatershed.

### 1.3 Document Organization

This plan is organized in five chapters. Chapter 1 presents a short overview of previous planning efforts and a brief description of the subwatershed.

Chapter 2 presents a characterization of the subwatershed, including a GIS analysis of the landscape features, a summary of existing data, and a pollutant loading analysis based on the Loch Raven Total Maximum Daily Load for Phosphorus and Sediment.

Chapter 3 presents the overall subwatershed goals and objectives, stakeholder outreach, and education efforts.

Chapter 4 summarizes the plan for restoration of the Spring Branch subwatershed.

A series of appendices provides additional detailed information used in the development and support for the Spring Branch Small Watershed Action Plan (SWAP). These appendices include:

- Appendix A – A description on how the Spring Branch SWAP process meets the US Environmental Protection Agencies A through I Criteria for watershed planning.
- Appendix B1 – Public Outreach.
- Appendix B2 - Public Response and Technology Transfer.
- Appendix C – A copy of the Chesapeake Bay Program – Best Management Practice pollutant load reduction credits.

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

- Appendix D – *Spring Branch Stream Restoration – Conceptual Plan Report* (Biohabitats, 1995)
- Appendix E – *Lower Spring Branch – Preliminary Assessment Analysis Report* (Biohabitats, 2005)
- Appendix F – *Lower Spring Branch – Concept Report* (Biohabitats, 2006)
- Appendix G – *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**

## **CHARACTERIZATION**

### **2.1 Introduction**

The physical aspects of a watershed provide the background and context for the associated biological and hydrological processes, as well as for the development that takes place on the land at the hands of man. In this chapter, we will describe both the natural physical context and the human use and present state of the land in the Spring Branch subwatershed. Included in this chapter will be a summary of water quality and living resources.

The Spring Branch subwatershed lies mainly within the Piedmont Region of Maryland. The natural Piedmont landscape is characterized by rolling hills, extensive forests, thick soils on deeply weathered crystalline bedrock, and abundant forest litter that minimizes overland flow.

This chapter will be presented in five parts: the first will document the natural background state of the natural resources of the basin (Section 2.2), the second will describe the present state of the landscape as it is now, after several centuries of human modification (2.3), the third will present the monitoring data available for Spring Branch (2.4), the fourth will discuss the 303(d) listings and the TMDLs applicable to Spring Branch (2.5), and the last section will present the Spring Branch pollutant loading analysis (2.6).

### **2.2 The Natural Landscape**

The natural landscape includes many factors that provide the background context and foundation for land use. Among the factors are the physiographic province, the underlying geology and the surface soils, the climate that effects the formation and erosion of soils, the stream drainage system, and the forest and wetland cover.

#### **2.2.1 Climate**

The climate of the region can be characterized as a humid continental climate, with four distinct seasons modified by the proximity of the Chesapeake Bay and Atlantic Ocean (DEPRM, 2000). Rainfall is evenly distributed through all months of the year, with most months averaging between 3.0 and 3.5 inches per month. Storms in the fall, winter, and early spring tend to be of longer duration and lesser intensity than summer storms, which are often convective in nature with scattered high-intensity storm cells. The average annual rainfall, as measured at the

Westminster Police barracks, is ~44 inches per year. The average annual snowfall is approximately 21 inches, with the majority of accumulation in December, January, and February.

The climate of a region affects the rate and form of soil formation and erosion patterns, and, by interacting with the underlying geology, influences the stream drainage network pattern and the resulting topography. Climate also affects the distribution and composition of the flora and fauna of the aquatic and terrestrial ecosystems.

### 2.2.2 Location and Physiogeographic Province

The Spring Branch subwatershed is located in the Cockeysville area to the west of the Loch Raven Reservoir. The Spring Branch subwatershed lies mainly within the Piedmont Physiographic Province, with the lower portion overlapped by geological formations more typical of the Coastal Plain Physiographic Province. The highest point of the subwatershed, located just south of Padonia Road, is 536 feet in elevation. The lowest point in the watershed is located Spring Branch discharges to the reservoir, which is 242 feet in elevation. The Piedmont Physiographic Province is characterized by rolling hills of varying steepness dissected by streams that occur in dendritic drainage patterns.

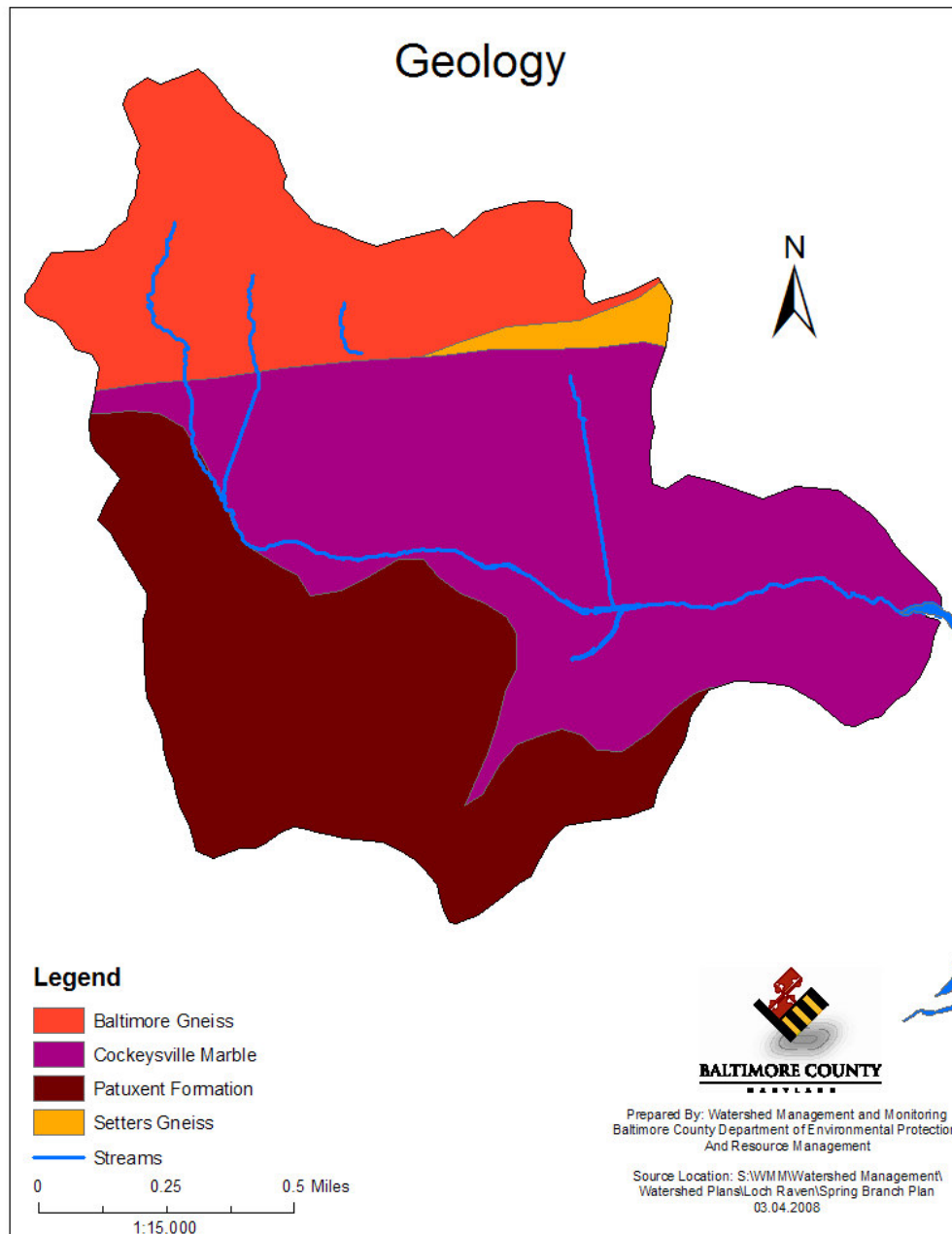
### 2.2.3 Geology

The headwaters of Spring Branch subwatershed are located at the top of a geological feature known as the Texas Dome. This is an area of local uplifting characterized by a relatively flat top and steep sides. The geological formations of the Spring Branch subwatershed are shown in Figure 2-2, with the acres and percentage of each geological type shown in Table 2-1. These formations affect the chemical composition of surface and groundwater, as well as the recharge rate to groundwater. They are also key to soil formation. As such, the geology is closely correlated with water quality in pristine systems, and affects the buffering of pollution to stream systems in developed areas.

**Table 2-1: Spring Branch Geology**

<b>Geology</b>	<b>Physiographic Province</b>	<b>Acres</b>	<b>Percent</b>
Cockeysville Marble	Piedmont	442	44.0
Baltimore Gneiss	Piedmont	224	22.2
Setters Gneiss	Piedmont	17	1.7
Patuxent Formation	Coastal Plain	323	32.1
<b>Total</b>		<b>1006</b>	<b>100.0</b>

Cockeysville marble underlies 44% of the Spring Branch subwatershed. This rock type provides buffering capacity and due to solution of the bedrock generally provides a greater infiltration capacity for the overlying soil. Approximately a quarter of the underlying bedrock is gneiss. This bedrock type is metamorphic. The density and distribution of cracks in this rock type control the amount of water holding capacity of the bedrock. This may be limited. The Patuxent Formation, an unconsolidated formation, underlies one-third of the subwatershed. This unconsolidated formation is associated with the Coastal Plain Physiographic Province. At this location we have the interface of the Coastal Plain with the Piedmont, where the unconsolidated sediments of the Coastal Plain overlap the bedrock formations of the Piedmont.



**Figure 2-2: Spring Branch Subwatershed Geology**

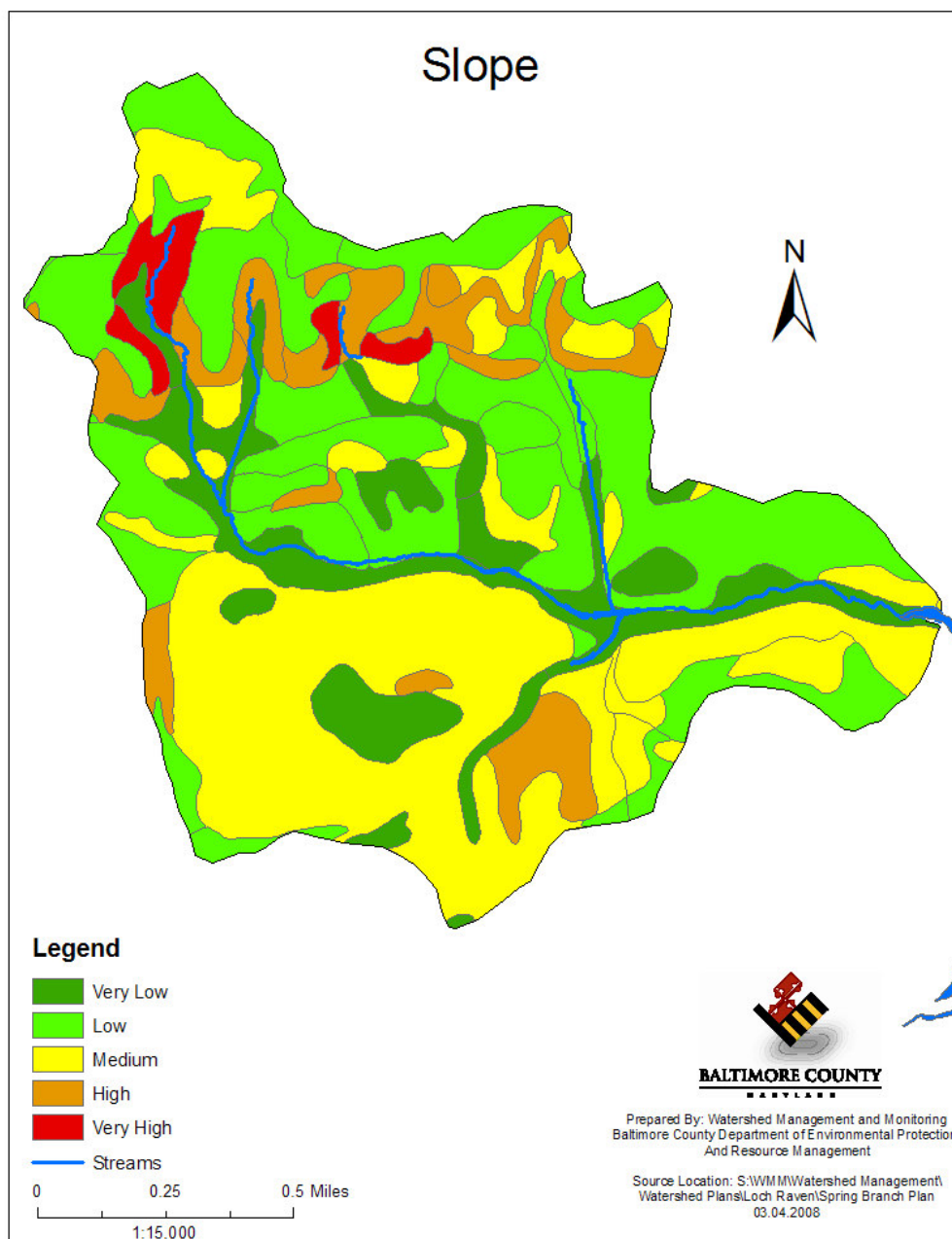
#### **2.2.4 Topography**

The shape of the land, including its steepness and degree of concavity, affect surface water flows and soil erosion, as well as the suitability for development. The Piedmont Region is characterized by rolling hills of varying steepness. Steep slopes are more prone to overland flow and soil erosion, and therefore have a greater potential for generation of pollutants. Table 2-2 displays the results for Spring Branch based on the Baltimore County Soil Survey. Figure 2-2 displays the distribution of the slope categories.

**Table 2-2: Spring Branch Topography**

<b>Slope Category</b>	<b>Slope Range</b>	<b>Acres</b>	<b>Percent</b>
a	0-3%	154	15.3
b	3-8%	362	36.0
c	8-15%	362	36.0
d	15-25%	103	10.2
e	>25%	25	2.5
<b>Total</b>		<b>1006</b>	<b>100</b>

The Spring Branch subwatershed is characterized by moderate to steep slopes throughout most of the subwatershed. A band of high to very high slopes occurs in the upper portion of the subwatershed (Figure 2-2). This is a result of the uplifting associated with the Texas Dome geological feature. The top of the dome (above the band of steep slopes) is relatively flat, as is the base of the dome. The steeper slopes in the upper portion of the watershed provide additional energy to the stream flow due to the steeper nature of the stream channel. This can result in greater erosion of the channel after development has occurred.



**Figure 2-2. Spring branch Subwatershed Topography**

### 2.2.5 Soils

Soil type and moisture conditions greatly affect how land may be used and the potential for vegetation and habitat on the land. Soil conditions are also one determining factor for water quality and quantity in streams and rivers. Soils are an important factor to consider in targeting projects aimed at improving water quality or habitat.

### 2.2.5.1 Hydrologic Soil Groups

The Natural Resource Conservation Service (USDA) classifies soils into four Hydrologic Soil Groups (HSG) based on the soil's runoff potential. Runoff potential is the opposite of infiltration capacity; soils with high infiltration capacity will have low runoff potential, and vice versa. The four Hydrologic Soils Groups are A, B, C and D, where A's generally have the smallest runoff potential and D's the greatest. Soils with low runoff potential will be less prone to erosion, and their higher infiltration rates result in faster flow-through of precipitation to groundwater. However, alluvial soils are often found to be susceptible to erosion.

Details of the hydrological soils classification can be found in 'Urban Hydrology for Small Watersheds' published by the Engineering Division of the Natural Resource Conservation Service, United States Department of Agriculture, Technical Release-55.

**Group A** is composed of sand, loamy sand or sandy loam types of soils. It has low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well-to excessively drained sands or gravels and have a high rate of water transmission.

**Group B** is silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly of moderately deep to deep, moderately well to well-drained soils with moderately fine to moderately coarse textures.

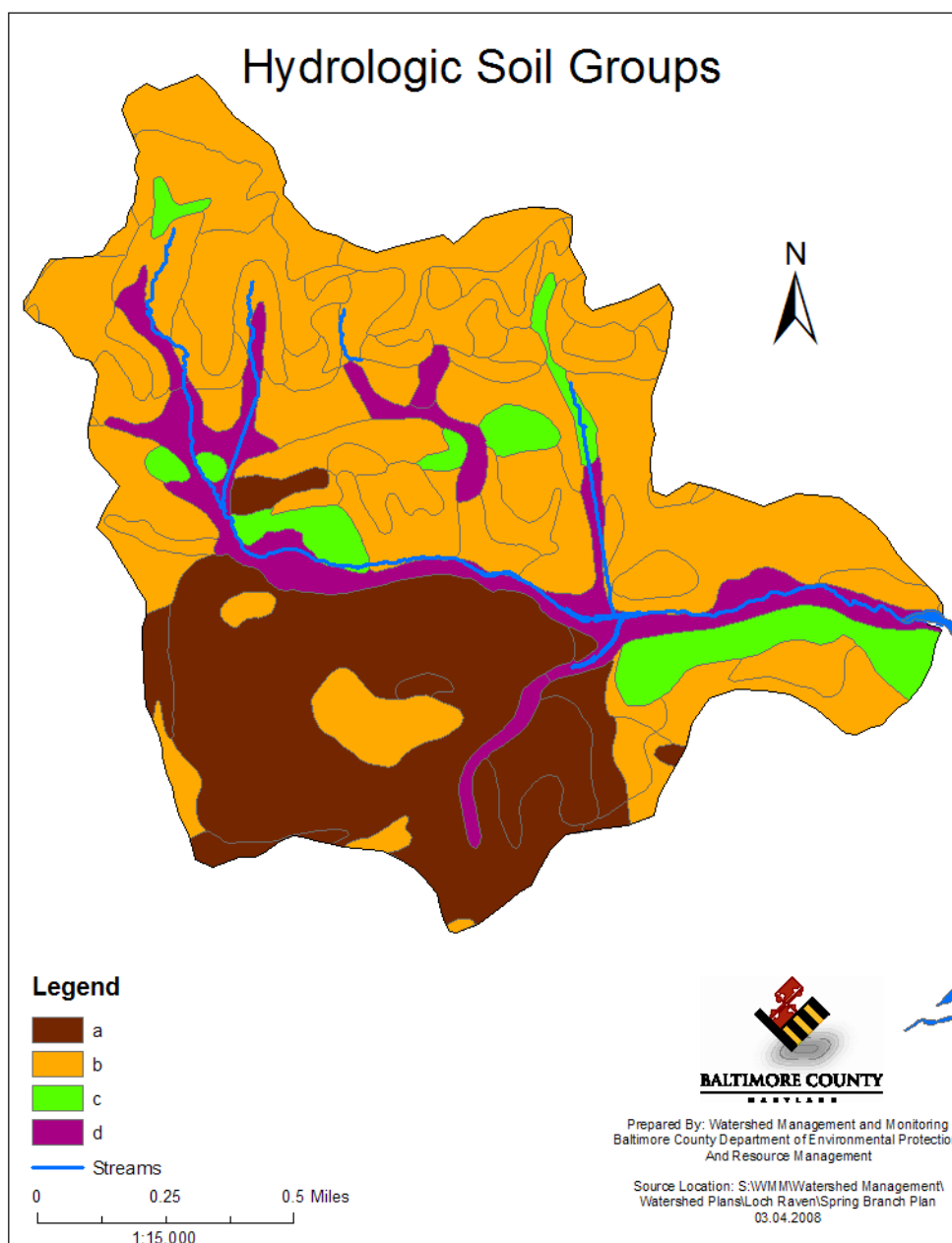
**Group C** soils are sandy clay loam. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water, and the soils have moderately fine to fine structure.

**Group D** soils are clay loam, silty clay loam, sandy clay, silty clay or clay. This Hydrologic Soil Group (HSG) has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils lying over nearly impervious material.

Spring Branch subwatershed hydrologic soil group distribution is displayed in Figure 2-3 and in Table 2-3. Spring Branch soils are dominated by soil types that provide high to moderate infiltration rates. The low to very low infiltration rates are associated with soils that lie along the stream system where the high water table limits infiltration rates.

**Table 2-3: Spring Branch Hydrologic Soil Groups**

Hydrologic Soil Group	Infiltration Rate	Acres	Percent
A	High	271	27.0
B	Moderate	560	55.6
C	Low	70	7.0
D	Very Low	105	10.4
<b>Total</b>		<b>1,006</b>	<b>100.0</b>



**Figure 2-3. Spring Branch Subwatershed - Hydrological Soil Groups**

#### 2.2.5.2 Soil Erodibility

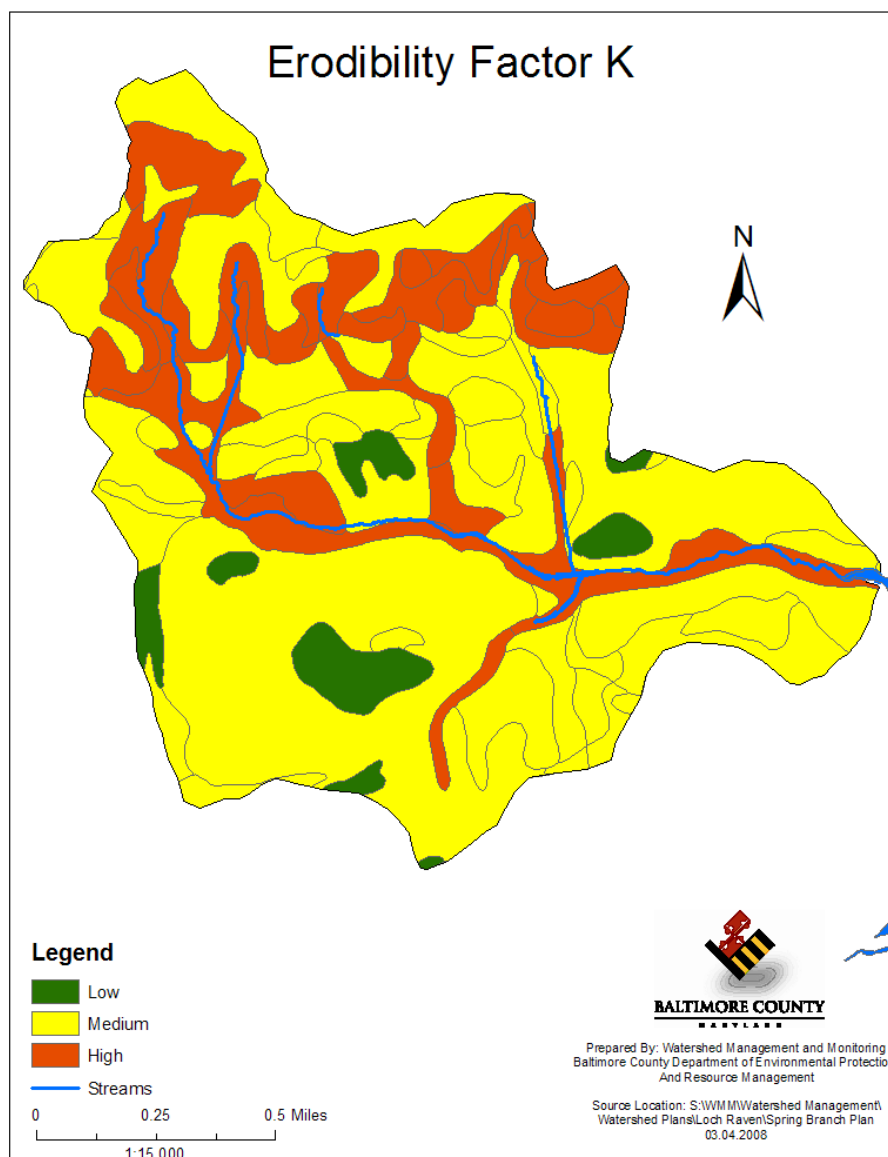
The erodibility of the soil is its intrinsic susceptibility to erosion. It is one factor (known as the K factor) in the Universal Soil Loss Equation, which estimates the rate of erosion at an actual site. Erodibility is based on the physical and chemical properties of the soil, which determine how strongly soil particles cohere with one another. Figure 2-4 shows soil erodibility in the Spring Branch subwatershed, and Table 2-4 is the summary erodibility factor. Low erodibility is defined as a K factor  $<0.24$ , medium is K between 0.24 and 0.32, and high is  $K > 0.32$ . These classes are based on groupings in the data that resulted in three classes. They also represent the

breaks used in the Baltimore County *Steep Slopes and Erodible Soils Analysis* for determining riparian buffer widths.

Spring Branch is characterized by soils that are either highly or moderately erodible. The highly erodible soils are located along the stream channel and along the face of the Texas dome.

**Table 2-4: Spring Branch Erodibility**

K Factor	Erodibility Category	Acres	Percent
.01 - 0.24	Low	52	5.1
0.25 - 0.32	Medium	694	69.0
>0.32	High	260	25.9
<b>Total</b>		<b>1006</b>	<b>100.0</b>



**Figure 2-4. Soil Erodibility based on the K factor**



## 2.2.6 Stream Systems

Stream systems are a watershed's circulatory system, and the most visible attribute of the hydrological cycle. Streams are the flowing surface waters, and are distinct from both groundwater and standing surface water (such as lakes), though they are connected with both of them. The stream system is an intrinsic part of the landscape, and closely reflects conditions on the land. Streams are a fundamental natural resource, with myriad benefits for plants, animals, and humans. Maintaining a healthy stream system is a priority for many individuals and organizations, and requires ensuring that stream flows and water quality closely mimic the conditions found in un-impacted watersheds.

The Spring Branch subwatershed has 3.96 miles of stream channel. This results in stream density (miles of stream/square miles of drainage area) of 2.52. Compared to Other Piedmont streams this stream density is low and indicates that some of the stream channel has either been buried or the hydrology has been altered in such a fashion that perennial baseflow is not supported in the remaining channel. The last is evident in the southern portion of the subwatershed where a concrete swale has replaced the stream channel and is dry except during storm events. In order to address the erosion in the mainstem of Spring Branch, concrete had been installed in previous years. Prior to the restoration much of the concrete had deteriorated with increased erosion.

## 2.3 The Human Modified Landscape

The natural landscape has been modified for human use over time. The intensity of this modification has increased, starting with the colonization of Maryland in the 1600s. This modification has resulted in environmental impacts to both the terrestrial and aquatic ecosystems. This section will provide a characterization of the human modified landscape and will explain how that modification is associated with impacts on the natural ecosystem. The characterization will progress from the general characteristics of land use and land cover to specific human impacts including impervious cover, drinking water and wastewater, storm water systems, discharge permits, zoning, and build-out analysis.

### 2.3.1 Land Use

Based on MDP 2002 GIS land use data, the Spring Branch subwatershed is predominately urban in nature. Table 2-5 tabulates the acreage by land use category, while Figure 2-5 displays the distribution within the subwatershed.

**Table 2-5: Spring Branch Land Use**

Land Use Category	Land Use Description	Acres	Percent
11	Low Density Residential	332	33.0
12	Medium Density Residential	551	54.8
13	High Density Residential	37	3.7
16	Institutional	18	1.7
41-43	Forest	67	6.7
<b>Total</b>		<b>1,005</b>	<b>99.9</b>

As can be seen from Table 2-5 the majority of Spring Branch is residential (91.5%) of varying degrees of density, but the bulk of the residential is in the medium density residential category. Forest cover accounts for only 6.7% of the land use, with the majority in the lower portion of the watershed. Forest cover is underestimated based on the land use. There exists an extensive canopy cover as can be seen in Figure 2-6.

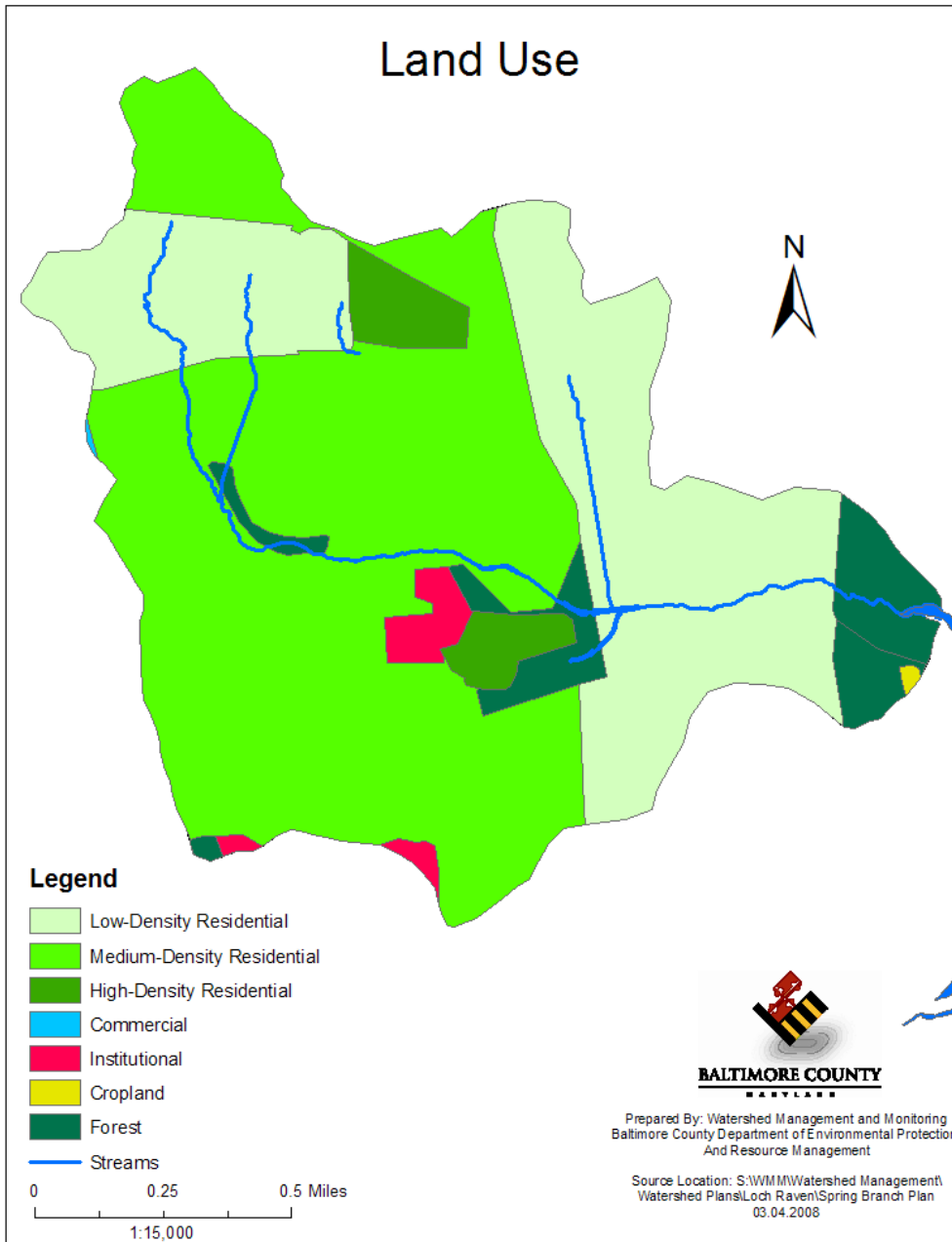


Figure 2-5. Spring Branch Subwatershed – Land Use

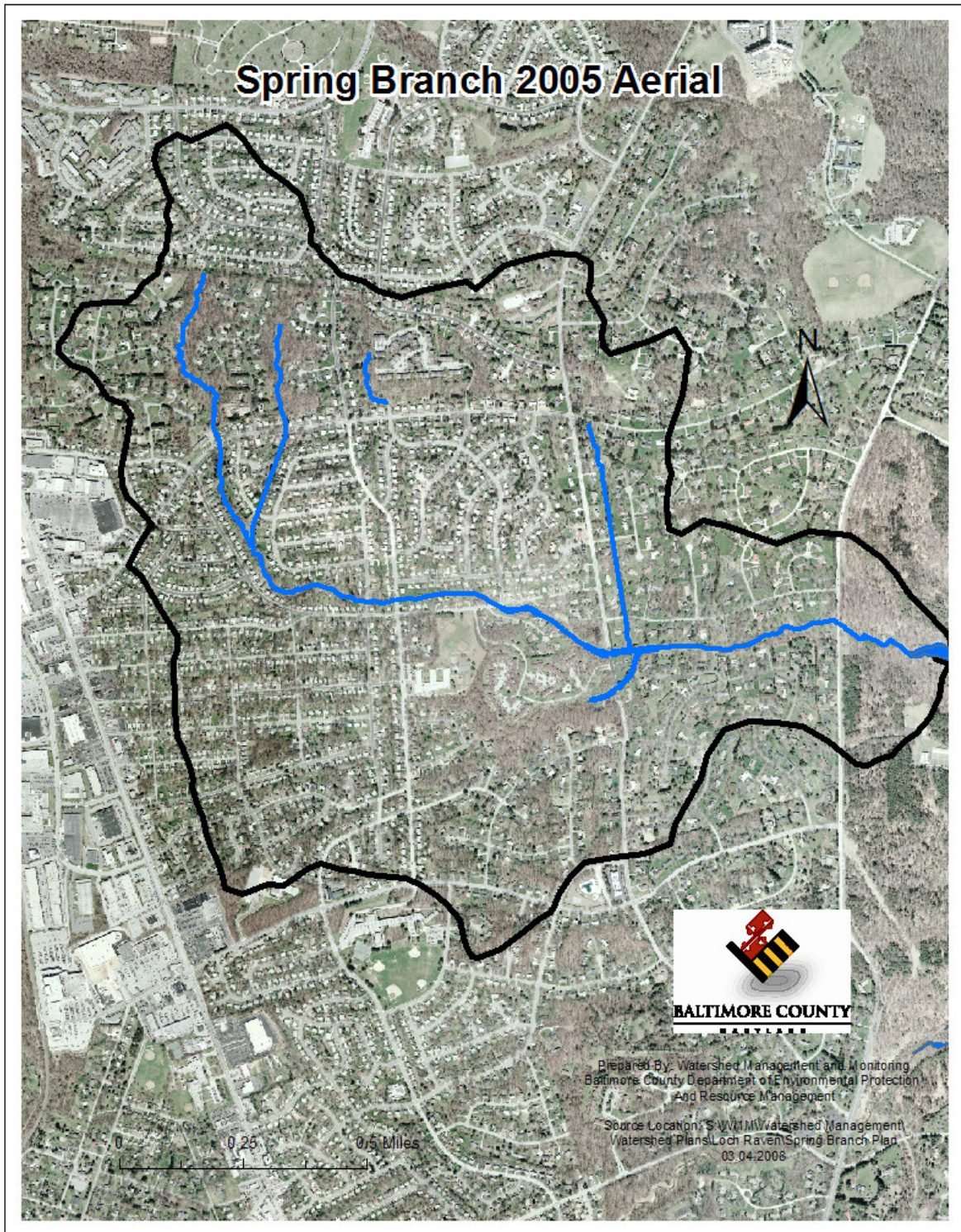


Figure 2-6: Spring Branch Aerial



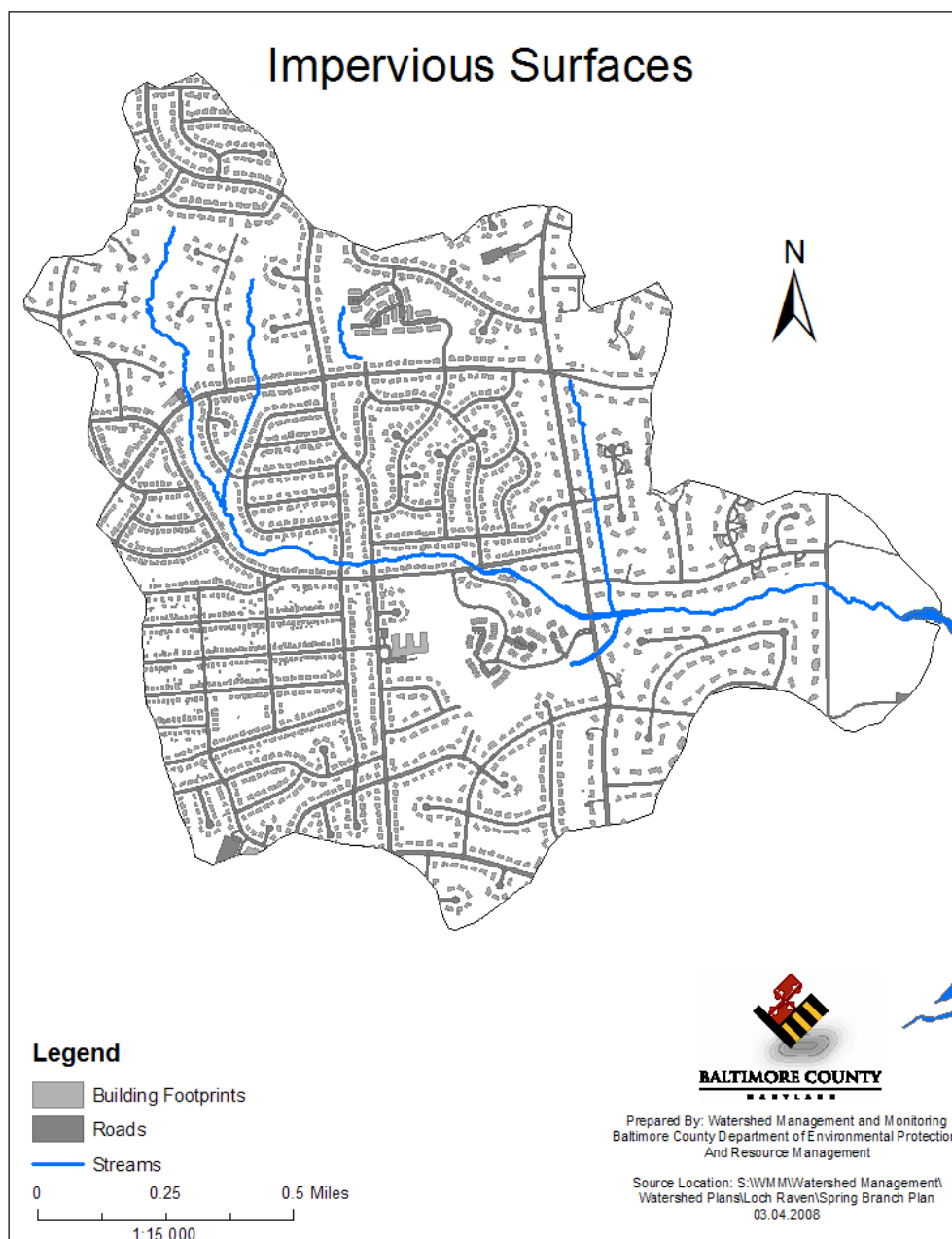
Land use has pronounced impacts on water quality and habitat. A forested watershed diminishes erosion, absorbs nutrients and slows the flow of water into streams. Roads, parking areas, and roofs are collectively called impervious surface. Impervious surfaces block the natural seepage of rain into the ground. Unlike many natural surfaces, impervious surfaces typically concentrate stormwater runoff, accelerate flow rates, and direct stormwater to the nearest stream. This can cause bank erosion and destruction of in-stream and riparian habitat. Watersheds with small amounts of impervious surface tend to have better water quality in local streams than watersheds with greater amounts of impervious surface.

### ***2.3.2 Impervious Surfaces***

To derive estimates of impervious surface acreages in the Spring Branch subwatershed a GIS analysis using the digitized ‘footprint’ of impervious surfaces based on the interpretation of aerial photographs from 1997 was used. Two data layers were created, one that displays roadways and parking lots, and a second that displays buildings, including sheds and detached garages. Sidewalks and driveways were not captured as part of either GIS data layer, therefore, the impervious cover estimate will be a little lower than the actual impervious cover. Table 2-6 shows acreages covered by buildings and roads, while Figure 2-7 displays the distribution.

**Table 2-6: Spring Branch Impervious Cover**

<b>Category</b>	<b>Acres</b>	<b>Percent</b>
Roads	94.6	9.4
Buildings	92.8	9.2
<b>Total</b>	<b>187.4</b>	<b>18.6</b>



**Figure 2-7: Spring Branch Impervious Cover**

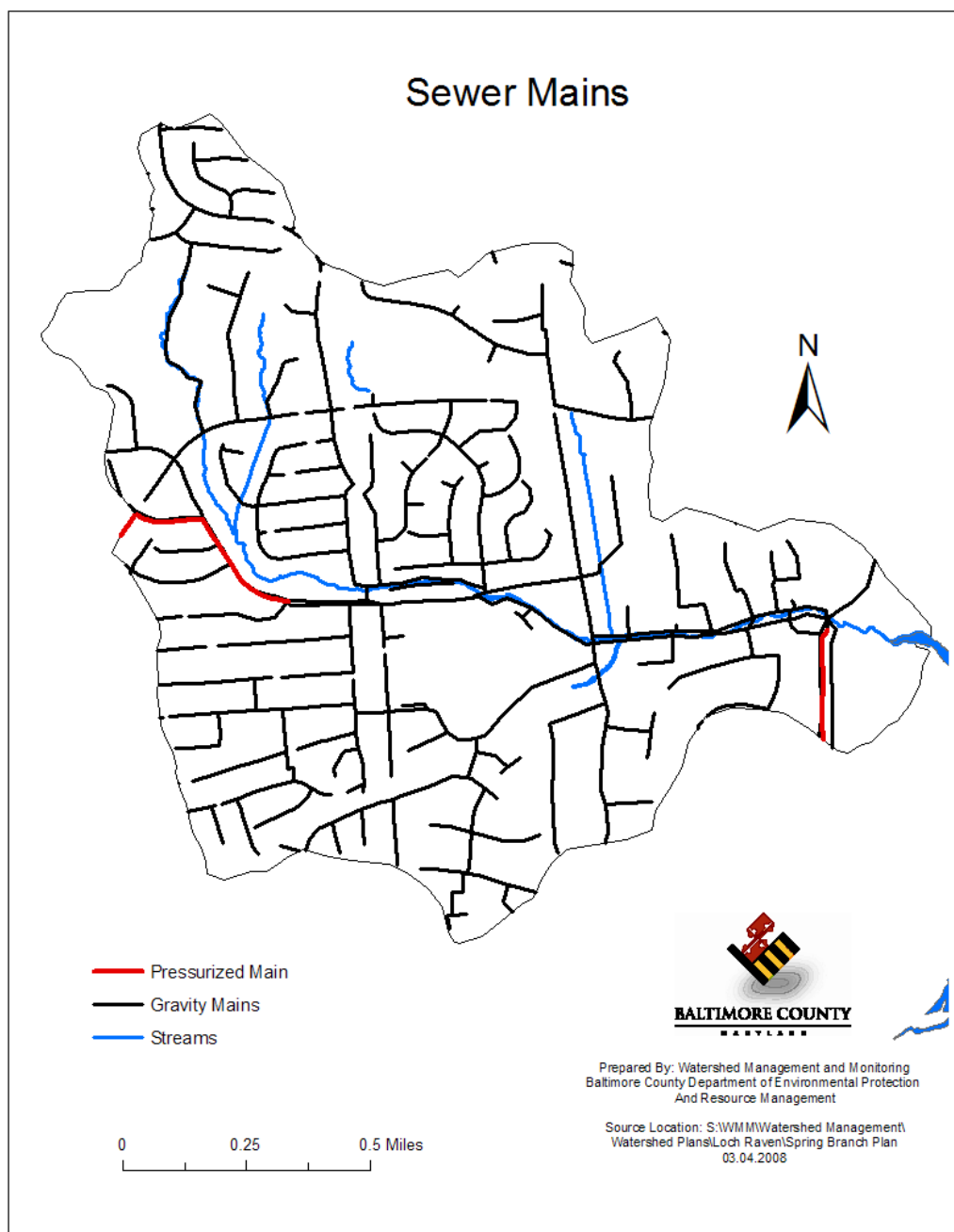
### 2.3.3 Wastewater

Wastewater created through human use must be treated and disposed. This may be accomplished in two ways, either through on-site individual wastewater treatment systems (septic systems) or through public conveyance to a municipal wastewater treatment plant. Residential wastewater consists of all of the water that is typically used by residents, including wash water, bathing water, human waste, and any other rinse water (paint brush, floor washing, etc). Spring Branch is entirely served by public sewer.

A public sewer system conveys wastewater from individual residences or businesses to a facility that treats the wastewater prior to discharge. The system itself consists of the building sewer and cleanouts on individually owned properties. The individual landowner is responsible for the maintenance of this part of the system. The part of the system that is in the public right-of-way is owned and maintained by the local government. The public system consists of the gravity piping system, access manholes, pumping stations, and force mains.

Environmental impacts associated with the public sewer system are usually the result of sewage overflows. These overflows usually result from blockages within the sewage system, pumping station failures, infiltration or exfiltration of sewage effluent due to sewer line deterioration/failure. The environmental impacts themselves include high Biological Oxygen Demand, nutrients, bacteria, and turbidity.

Within Spring Branch subwatershed there are 22.8 miles of public gravity sewer lines and 0.67 miles of force mains. The locations of these lines are displayed in Figure 2-8. While many of the lines are located in the street right-of-way, there are also lines that parallel the streams system. The lines adjacent to streams are subject of exposure and damage from stream erosion. Prior to the Phase I – Spring Branch stream restoration project, a number of lateral lines were exposed by stream erosion and were leaking sewage into the stream channel. A review of our Sanitary Sewer Overflow (SSO) database indicted that no sanitary sewer overflows occurred in Spring Branch in the time period of 2001 through 2007.



**Figure 2-8: Spring Branch Subwatershed Public Sanitary Sewer Line Locations**

### **2.3.4 Stormwater**

Stormwater consists of the surface and shallow subsurface water that runs off during and immediately after storm events. Impervious surfaces placed in a watershed increase the amount of runoff that makes its way to the streams. Soil characteristics and slope as well as the amount and intensity of rainfall affect the amount of runoff water. Stormwater can carry pollutants from impervious surfaces and agricultural operations into the streams. The increase in the amount of runoff due to impervious surfaces (high) and agricultural operations (moderate) typically results

in stream erosion that destroys natural habitat and impairs natural ecological function of the stream.

The storm drainage system consists of either, curb and gutter, with associated inlets and piping system, or drainage swales. The function of either system is to remove water quickly from roadways to prevent flooding and other potentially hazardous situations. However, the environmental impact from the two types of systems is different. The curb and gutter system with inlets, piping and storm drain outfalls removes water quickly from impervious surfaces and routes that water to low spots in the topography, usually directly to the nearest stream. This type of system delivers not only increased volumes of water, but untreated pollutants associated with impervious surfaces. Drainage swales (road side ditches) do not move the water as efficiently as curb and gutter systems. Therefore, the water is slowed somewhat prior to entering the stream. The drainage swales also allow some infiltration into the soil, thus reducing the amount of water eventually delivered. The infiltration and the slower movement of water also provide some filtering of pollutants. The majority of the storm drainage systems within the Spring Branch subwatershed fall into the curb and gutter category.

Starting in the mid-1980s, stormwater management was required by Maryland Department of the Environment for new development to control the quantity of runoff. The State's stormwater management regulations evolved from the initial requirement for control of water quantity to including water quality control in the early 1990s. In 2000 a new stormwater design manual was released by MDE requiring additional water quality and quantity controls along with stormwater management for large-lot subdivisions.

There are a variety of types of stormwater management facilities that have different pollutant removal capabilities. The initial dry pond design for water quantity management has the lowest pollutant-removal efficiency, while those facilities that infiltrate or otherwise filter the water have among the highest pollutant-removal capabilities.

Table 2-7 characterizes the storm drain system within the Spring Branch subwatershed, while Table 2-8 summarizes the information the stormwater management facilities present in the subwatershed. Figure 2-9 shows the distribution of both the storm drain system and the stormwater management facilities.

**Table 2-7: Spring Branch Storm Drainage System Characteristics**

	<b>Major &gt;36" Diameter</b>	<b>Minor &lt;36" Diameter</b>	<b>Total</b>
Number of outfalls	9	41	50
Number of inlets	40	151	191
Length of Storm Drain (feet)	7,565	19,335	26,900
Acres	329	282	611

Drainage to the storm drain system covers 61% of the subwatershed drainage area. This storm drain conveyance provides fast delivery of runoff to the stream during storm events resulting in a quick response to the stream system.



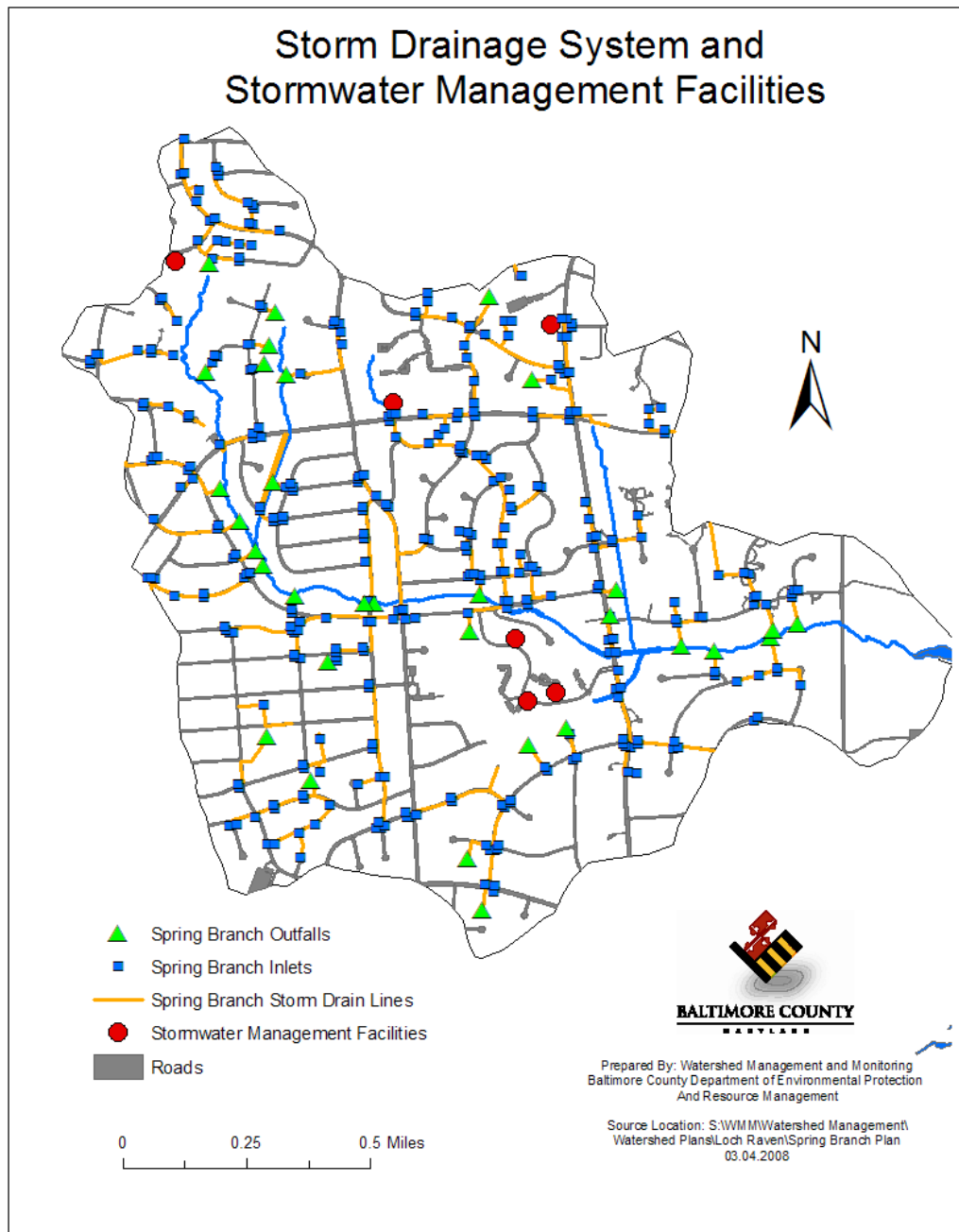


Figure 2-9: Spring Branch Subwatershed Storm Drain System and Stormwater Management

**Table 2-8: Spring Branch Stormwater Management Facilities**

Storm Water Structure Number	Structure Type	Drainage Area	Ownership	Year Approved
138	Dry Pond	11.43	Private	1981
956	Underground Storage	3.65	Private	1977
957	Underground Storage	2.81	Private	1977
958	Underground Storage	2.80	Private	1977
1020	Dry Pond	6.81	Public	1991
2880	Wet Pond (Retrofit)	45.37	Public	1996
		<b>72.87</b>		

Only 7.2% of watershed area is served by stormwater management. This is reflective of the fact that the majority of development in the subwatershed occurred prior to the implementation of stormwater management requirements. In fact, some of the earliest stormwater management facilities installed occur in this subwatershed. The wet pond, which serves 45.37 acres was installed as part of the Spring Branch Restoration – Phase I.

### 2.3.5 Zoning and Build-Out

“Zoning is the legal mechanism by which county government is able, for the sake of protecting the public health, safety, morals, and/or general welfare, to limit an owner’s right to use privately-owned land.” (Baltimore County Office of Planning, 2003). Zoning therefore controls the development patterns that occur over time. Build-out is the analysis of the number of residential units that could be built in a given area, based on the current zoning. Build-out looks at the existing development and, based on the density (allowable housing units), attempts to determine how many more residential units can be built in the future. This analysis is conducted to estimate the potential future impacts due to urban development.

### Historical Development

Using the tax parcel Geographic Information System data layer, the decade of lot improvement can be determined. Table 2-9 presents the information on when residential development occurred in Spring Branch and Figure 2-10 displays the distribution of residential development by decade.

**Table 2-9: Spring Branch Historical Development Patterns**

Decade of Development	Number of Residential Units	Percent
<1930's	5	0.2
1930's	4	0.2
1940's	67	3.3
1950's	984	48.6
1960's	608	30.0
1970's	201	10.0
1980's	144	7.1
1990's	10	0.5
2000's	2	0.1
	<b>2,025</b>	<b>100</b>

As can be seen from Table 2-9, the majority of the residential development in Spring Branch occurred in the 1950's and 1960's with 79% of the development occurring in those two decades. The 1970's experienced a decrease in residential development with only 201 units built.

Stormwater management requirements were mandated in 1984. The last two decades have seen limited development within the subwatershed with the addition of only 12 more houses.

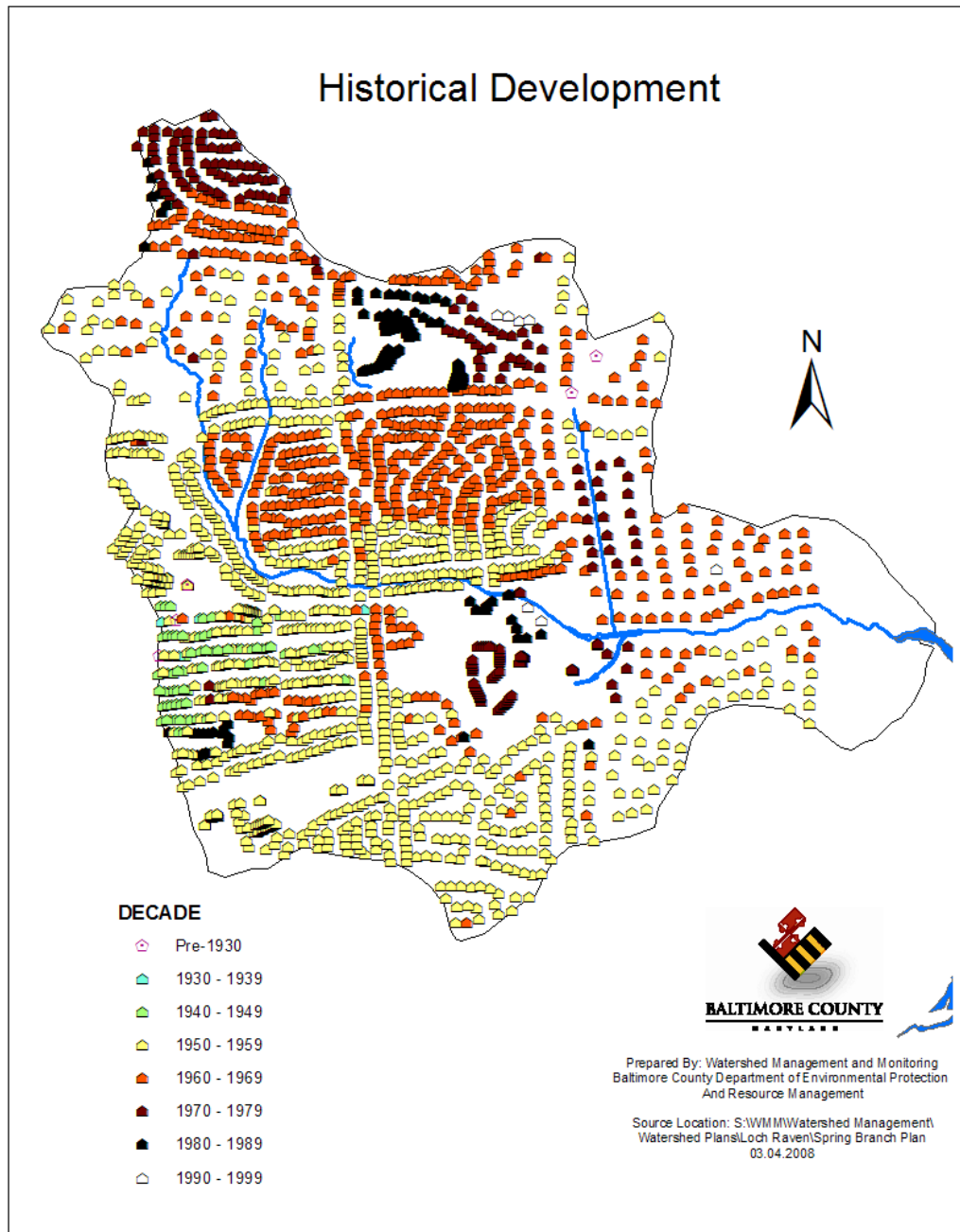


Figure 2-10: Spring Branch Historical Development

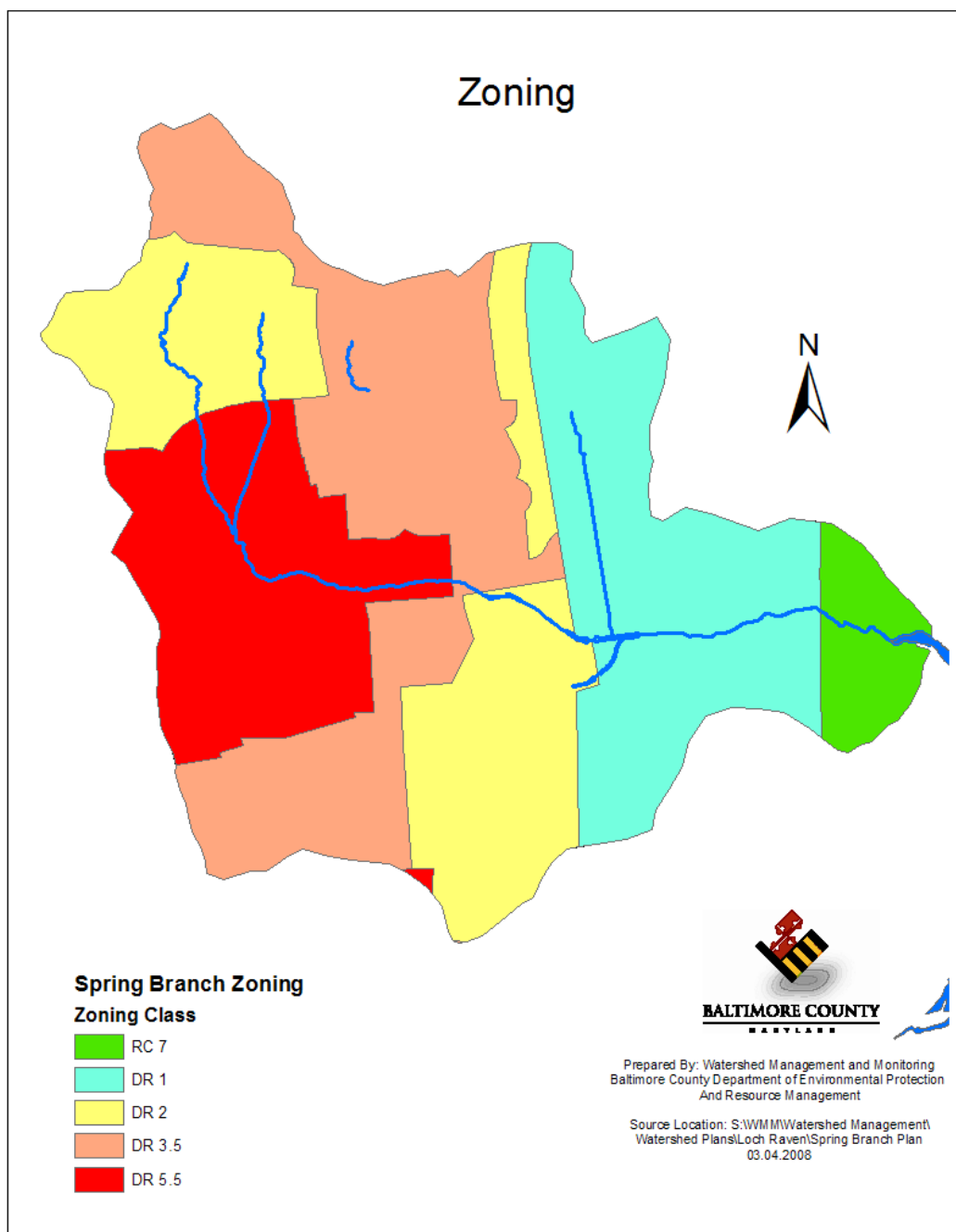
**Zoning**

The zoning for the Spring Branch subwatershed is strictly residential with varying allowable densities. Table 2-10 presents the acreage by zoning category and the number of allowable residential units based on the acreage. Figure 2-11 displays the distribution of the zoning categories.

**Table 2-10: Spring Branch Zoning**

<b>Zoning Category</b>	<b>Allowable Density</b>	<b>Acres</b>	<b>Percent</b>	<b>Number of Allowable units</b>
DR1	1 unit per acre	226.4	22.5	226
DR2	2 units per acre	254.4	25.3	508
DR3.5	3.5 units per acre	284.5	28.5	995
DR5.5	5.5 units per acre	193.8	19.3	1065
RC7	1 unit per 25 acres	46.3	4.6	1
		<b>1,005.4</b>	<b>100</b>	<b>2,795</b>

Approximately 52% of the subwatershed is zoned for low density residential (DR1, DR2, RC7), while the balance is zoned for medium density residential (DR3.5, DR5.5). A comparison with Table 2-9 on historical development would indicate that an additional 773 residential units can be developed within the subwatershed.



**Figure 2-11. Zoning in the Spring Branch Subwatershed**

### **Subwatershed Build-Out**

The watershed build out analysis for the Spring Branch subwatershed was conducted using the zoning data layer and the parcel tax assessment data layer to identify improved properties. The maximum legal density was used to assess the number of potential new residential units for properties that have already been improved, (but are below full density) and for un-improved properties. The publicly owned land and roadways were excluded from the analysis, as these lands will not be developed. The results are displayed in Table 2-11.

Table 2-11: Spring Branch Build-Out Analysis

Zoning Category	Acres	Built Acres	Public Lands & Roads	Acres Available for New Development	Number of Allowable units	Number of Built Units	Potential Number of New Units	Minor Sub Units	Total New Units
DR1	226	189	18	19	226	203	20	1	21
DR2	254	192	23	36	508	365	72	0	72
DR3.5	285	199	46	40	995	805	140	27	167
DR5.5	194	143	32	19	1065	647	107	18	125
RC7	46	0	46	0	1	0	0	0	0
	<b>1,005</b>	<b>723</b>	<b>165</b>	<b>114</b>	<b>2,795</b>	<b>2,020</b>	<b>339</b>	<b>46</b>	<b>385</b>

There were a few improved lots that were above the allowable zoning density. If these lots were to be subdivided a total of an additional 46 units could be developed (Table 2-11, Minor Sub column). After removing the acreage of public lands and roadways, only 114 acres are available for new development. While the zoning would indicate that a total of 2,795 residential units could be built (an additional 773 units over the existing 2,022 existing units), this analysis indicates that only 385 more units could be developed within the subwatershed. However, based on the trend exhibited under the historical development discussion, it is anticipated that any new residential development will be limited.

## 2.4 Monitoring Data

Monitoring within the Spring Branch subwatershed commenced in 2004 as part of our NPDES MS4 Permit application. At that time it consisted of storm event chemical monitoring only. In 2005 the chemical monitoring continued under our first 5-year NPDES-MS4 Permit. The site had been selected based on the stream having been selected for a stream restoration project. The chemical monitoring took place at an outfall located at the headwaters of the stream and in-stream just prior to Potspring Road. This was also the extent of the stream restoration project. Additional chemical monitoring was conducted in the adjacent Long Quarter Branch subwatershed; again with a headwater storm drain outfall monitoring location and an in-stream monitoring location. This permitted a paired watershed, up-stream down-stream, before-after, comparison to determine the pollutant load reductions. The biological and geomorphological monitoring did not commence prior to the stream restoration project. Thus all of the results are post restoration only, from 1999 through 2005.

This section will summarize the monitoring information on Spring Branch in relation to the stream restoration project. New pollutant load reductions will be calculated using more recent chemical data (Section 2.4.1). The success of stream restoration in improving the biological community will be assessed (2.4.2) and the stability of the stream channel post restoration will analyzed (2.4.3).

### 2.4.1 Chemical Monitoring

The chemical data for Spring Branch was analyzed to determine both the short term and longer-term pollutant load reduction due to stream restoration. The Spring Branch stream restoration was constructed between late September 2006 and the end of February 2006. The chemical data was divided into three groups; before stream restoration (March 1995 - September 1996), immediate post restoration (June 2007 – February 2001), and more recent data (April 2004 – May 2005). Previous analysis had included the results from a paired watershed (Long Quarter Branch). Since comparable data for Long Quarter Branch were not available for the more recent

time period only the Spring Branch data was used for the comparisons of pollutant load reduction. The Spring Branch monitoring locations are shown in Figure 2-12.

The analysis included the creation of linear regression equations based on the  $\log_{10}$  transformations of the discharge, suspended sediment, and nutrient data. This resulted in the development of a linear regression equation for each pollutant and each time period. The equations are presented in Table 2-12. The data points and the regressions are shown in Figures 2-13 (Total Suspended Solids), 2-14 (Total Nitrogen), and 2-15 (Total Phosphorus). Each Figure displays three graphs representing the three time periods used in the analysis (pre-restoration, immediate post-restoration, and seven years post-restoration).

**Table 2-12: Regression Equations Relationship Between Discharge (CFS) and Pollutant Concentrations**

<b>Time Period</b>	<b>Total Suspended Solids</b>	<b>Total Nitrogen</b>	<b>Total Phosphorus</b>
1995 – 1996	$.4141 + 1.211 * (\log \text{CFS})$	$.5621 - .1079 * (\log \text{CFS})$	$-1.0016 + .3705 * (\log \text{CFS})$
1997 – 2001	$.5454 + 0.5998 * (\log \text{CFS})$	$.3877 - .0808 * (\log \text{CFS})$	$-1.3768 + .3233 * (\log \text{CFS})$
2004 – 2005	$-.0647 + 1.0448 * (\log \text{CFS})$	$.3187 - .0434 * (\log \text{CFS})$	$-1.5049 + .7061 * (\log \text{CFS})$

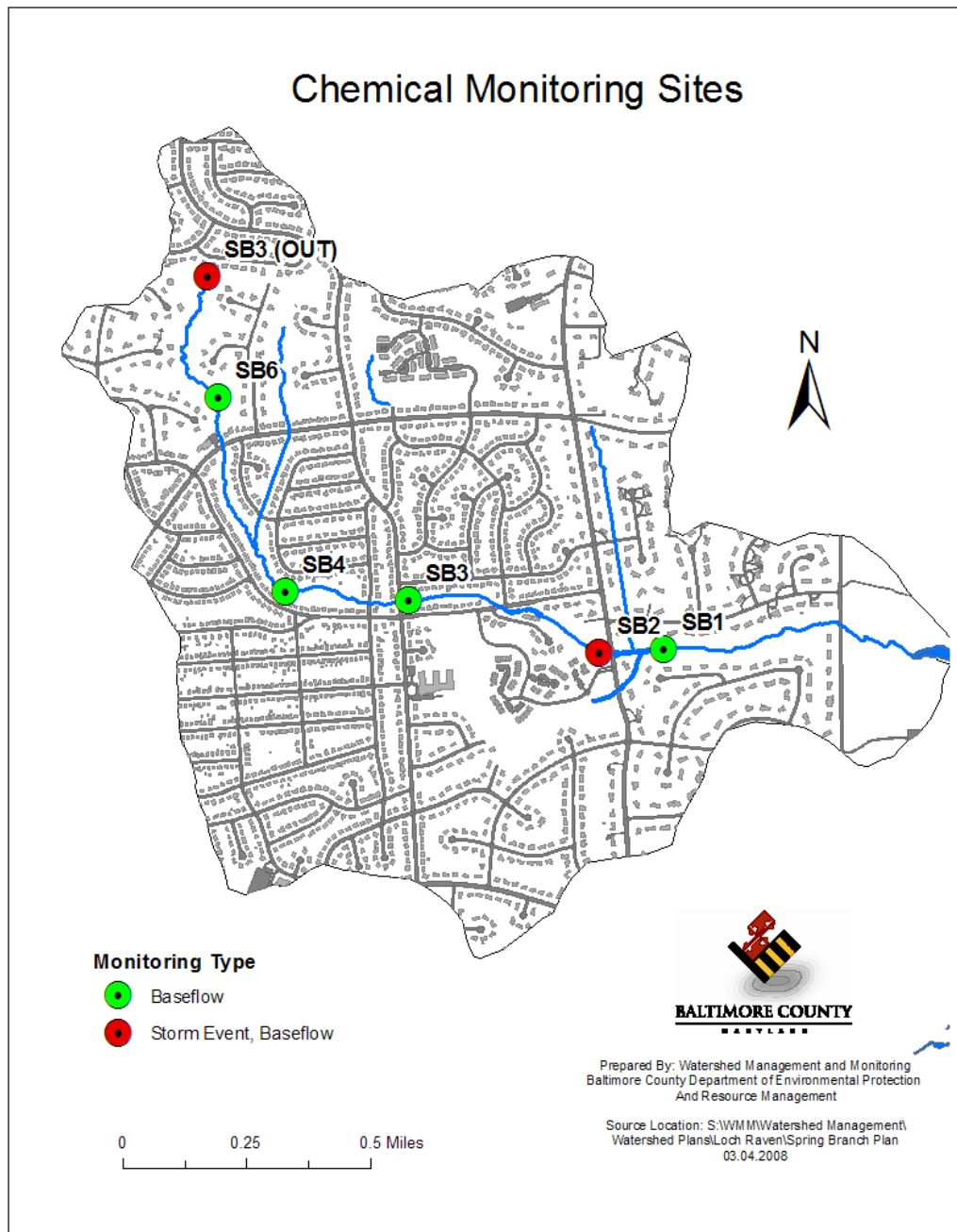


Figure 2-12: Spring Branch Monitoring Locations



# SPRING BRANCH SMALL WATERSHED ACTION PLAN

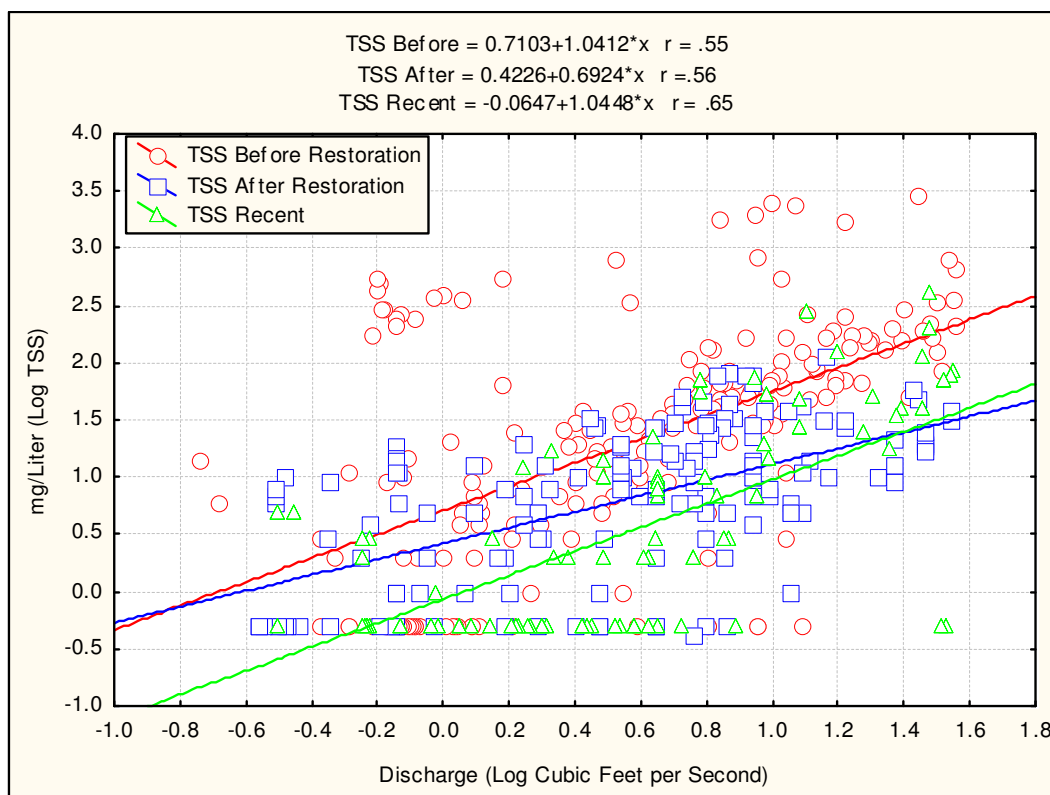


Figure 2-13: Total Suspended Solids (TSS) Data and Regressions for the Three Time Periods.

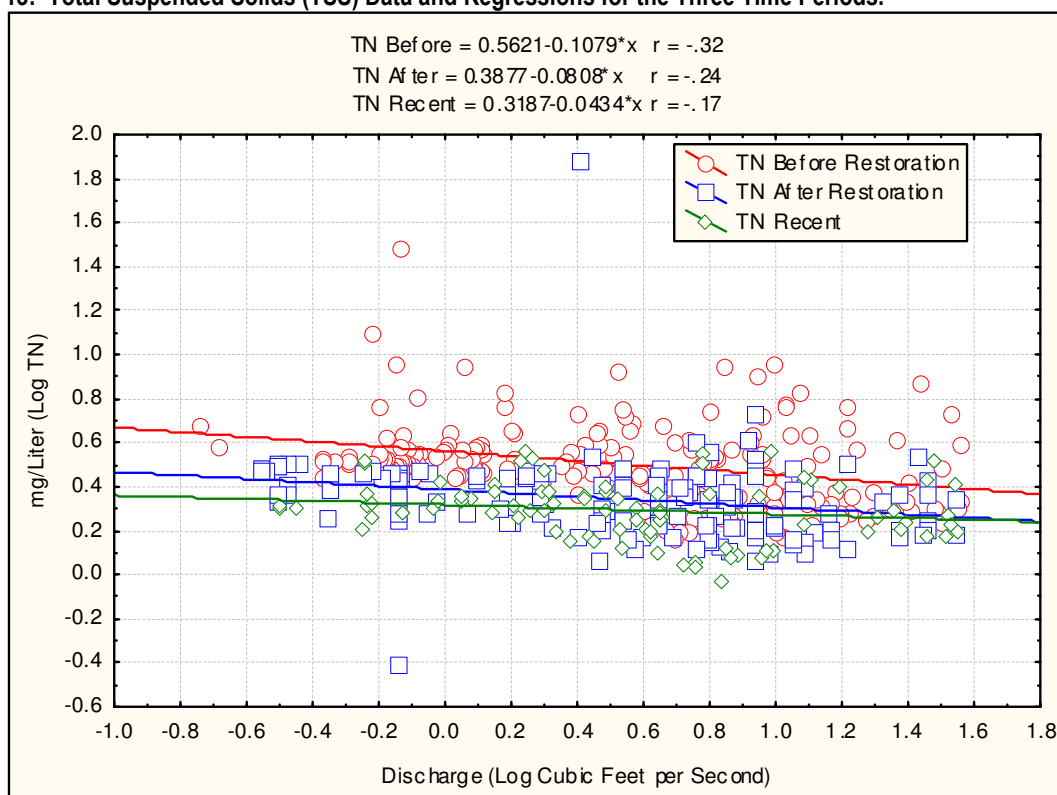
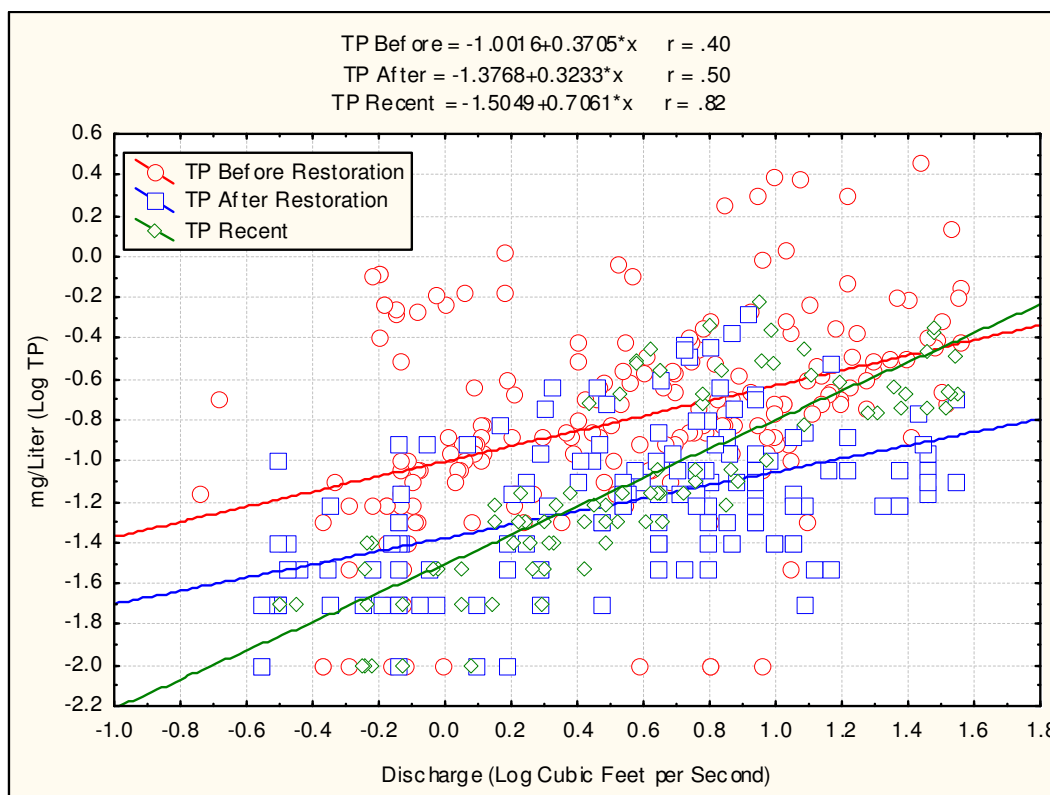


Figure 2-15: Total Nitrogen (TN) Data and Regressions for the Three Time Periods



**Figure 2-14: Total Phosphorus (TP) Data and Regressions for the Three Time Periods.**

A water level sensor was installed in Spring Branch and a rating curve was developed from in-stream discharge measurements made with a pygmy meter. The only period of record for which good data was derived was from July 28, 1999 through March 31, 2001. Data was recorded at 10 minute intervals through this time period result in >73,000 individual discharge readings. The regression equations determined above, relating pollutant concentration to discharge, were used to determine the pollutant concentration for each 10-minute interval. From this data the load was calculated for each 10-minute interval using the following formula:

$P_L = (P_C \cdot .000008345) \cdot (CFS \cdot 448.8 \cdot 10)$ , where

$P_L$  = Pollutant Load,

$P_C$  = Pollutant Concentration,

.000008345 = Conversion factor to convert mg/L to pounds per gallon,

CFS = Cubic feet per second,

448.8 = Conversion factor to convert cubic feet per second to gallons per minute

10 = number of minutes in the interval.

The results obtained by the above formula were standardized to both an annual pollutant load for the drainage area and an annual pollutant load per acre. The reduction in the pollutant load due to stream restoration was then calculated on both a percent reduction for the drainage area to the restored stream and on a linear foot of stream reduction. The per linear foot of the stream restoration pollutant load reduction was used previously and is the current standard used by the Chesapeake Bay Program for pollutant load credits for stream restoration. The results are shown in Table 2-13.

Table 2-13: Pollutant Load Reductions Due to Stream Restoration

Monitoring Period	Annual Drainage Area Load	Annual per Acre Load	% Pollutant Load Reduction	Pollutant Reduction/Linear Foot	CBP Credit
<b>Total Suspended Solids</b>					
Before	44,237	92.0			
After	9,382	19.5	78.8 %	3.49	2.55
7 Years After	7,505	15.6	83.0 %	3.67	
<b>Total Nitrogen</b>					
Before	5,393	11.2			
After	3,629	7.5	33.0%	.176	.02
7 Years After	3,127	6.5	42.0 %	.227	
<b>Total Phosphorus</b>					
Before	203.9	0.42			
After	81.2	0.17	59.5%	.0123	.0035
7 Years After	114.2	0.24	42.9%	.0090	

The differences between the Chesapeake Bay Program credit and the calculations presented here are due to several factors.

- In the original calculations, a non-linear estimation procedure on untransformed data was used to determine the pollutant loads. That procedure was forced to go through the origin to remove negative pollutant concentrations. With these calculations, the data were  $\log_{10}$  transformed to enable a linear regression procedure to be preformed. This procedure automatically results in no negative concentrations.
- To account for differences in the range of range of discharge measured during the three period. The 2004-2005 data highest discharge measurement was 35.48 cfs. This was used as the cutoff for developing the regression equations for the other two periods. The water level sensor record was analyzed and it was found to have only 0.04% of the records above 36 cfs. In the original analysis no provision was made to ensure that the data spanned the same range.
- In the initial analysis an adjustment was made to the original pollutant load reduction determination using the results from the headwater outfall and the Long Quarter Branch in-stream monitoring site. No such adjustment was made in this analysis, as there was no data for the Long Quarter Branch in-stream monitoring site.

As with all effectiveness studies of Best Management Practices, additional studies are necessary to determine the range of effectiveness of stream restoration for pollutant load reduction. However, on the basis of this single study, urban stream restoration provides an effective mechanism to address the reductions necessary to meet the Total Maximum Daily Loads and Chesapeake Bay Program – Tributary Strategies requirements.

Mean EMC concentration were calculated for the 1995-2000 time period for Total Suspended Solids, Total Nitrogen, Total Phosphorus, and metals (Cd, Cu, Zn, Pb). The results are displayed in Figure 2-16. In the case of TSS, TN, and TP there was a clear decrease in the mean EMC's after stream restoration compared to prior to restoration, while for metals the pattern is not as clear-cut.

## SPRING BRANCH SMALL WATERSHED ACTION PLAN

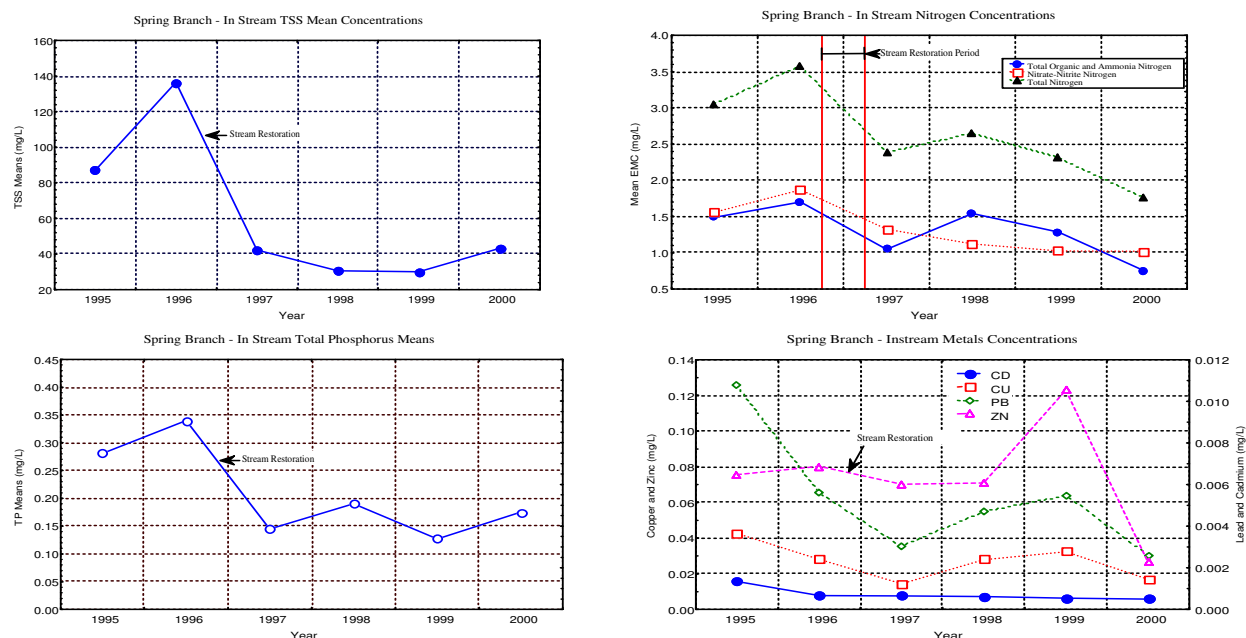


Figure 2-16: Yearly mean EMCs for the Spring Branch in-stream monitoring site.

### *Baseflow analysis*

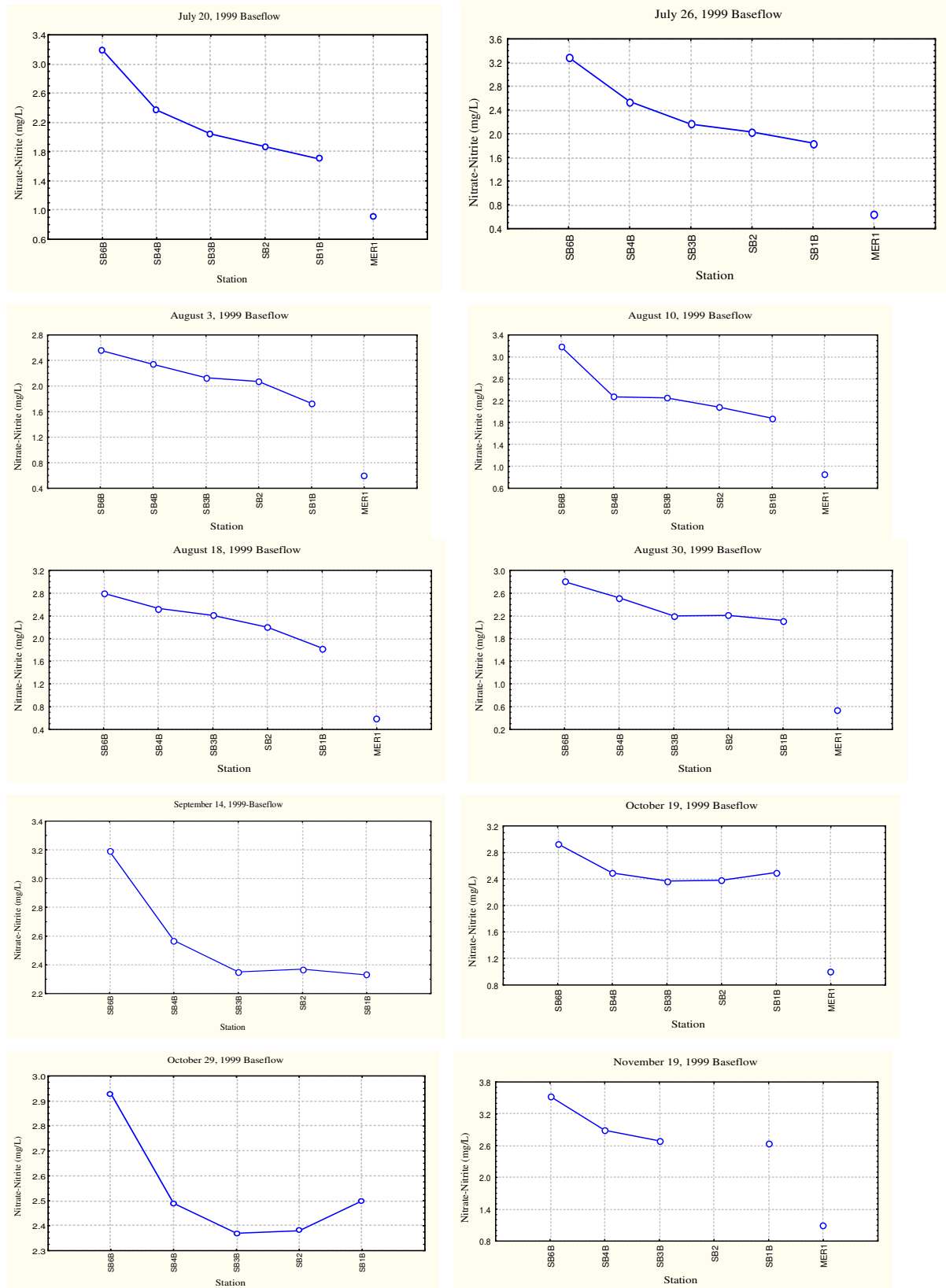
In 1999, a baseflow analysis was conducted to look at nitrate/nitrite concentrations changes longitudinally as one proceeded down stream. A total of five sites within Spring Branch were sampled on ten different dates. An adjacent subwatershed (Merryman's Branch) was sampled to provide an outside reference point. The results are displayed in Figure 2-17.

As can be seen from Figure 2-17, the concentration of nitrate/nitrite nitrogen decreased downstream in almost every sampling period. There are several possibilities for the decrease:

- the processing of nitrate within the stream system by uptake and denitrification resulted in a decrease in concentration;
- the addition of flow to the stream from storm drain outfalls that flow during dry weather and/or the input of groundwater into the stream channel have lower concentrations that result in a dilution of the nitrate/nitrite nitrogen concentration.

Due to staffing limitations, the determination of which mechanism is resulting in lower nitrate/nitrite nitrogen concentrations was not made. The Merryman's Branch subwatershed site results indicate that the concentration of nitrite/nitrite nitrogen was lower for each sampling date. Merryman's Branch has high-density urban residential development in the headwaters, but the lower half is forested and in pasture. As with the Spring Branch sites the much lower Merryman's Branch concentrations could be due to either processing of nitrogen within the stream channel or dilution by input of lower concentration groundwater.

## SPRING BRANCH SMALL WATERSHED ACTION PLAN



**Figure 2-17: Longitudinal Spring Branch Stream profiles for nitrate-nitrite nitrogen concentrations**

## 2.4.2 Biological Monitoring

The focus of the Spring Branch biological monitoring project was on improvements in the benthic macroinvertebrate community as a result of the stream restoration that was completed in February 1997. The research design includes three stations within the restoration area, one site below the restoration area and a reference site in Merryman's Branch (Figure 2-12). Samples have been collected since the spring of 1997 until the spring of 2005. Until Fall 2003 sampling was conducted using a Surber sampler with three replicates collected at each riffle station. For the Fall 2003 monitoring and subsequent monitoring seasons sampling was conducted using the MBSS sampling protocols using a D-net. One D-net sample was collected at each of the monitoring sites, where previously three replicate Surber samples were collected. This change was necessitated by the amount of staff time needed to sort each individual Surber sample. Greater detail on the research design has been included in earlier reports. The results for the time period of 2001 through 2005 are displayed graphically in Figure 2-18 and 2-19.

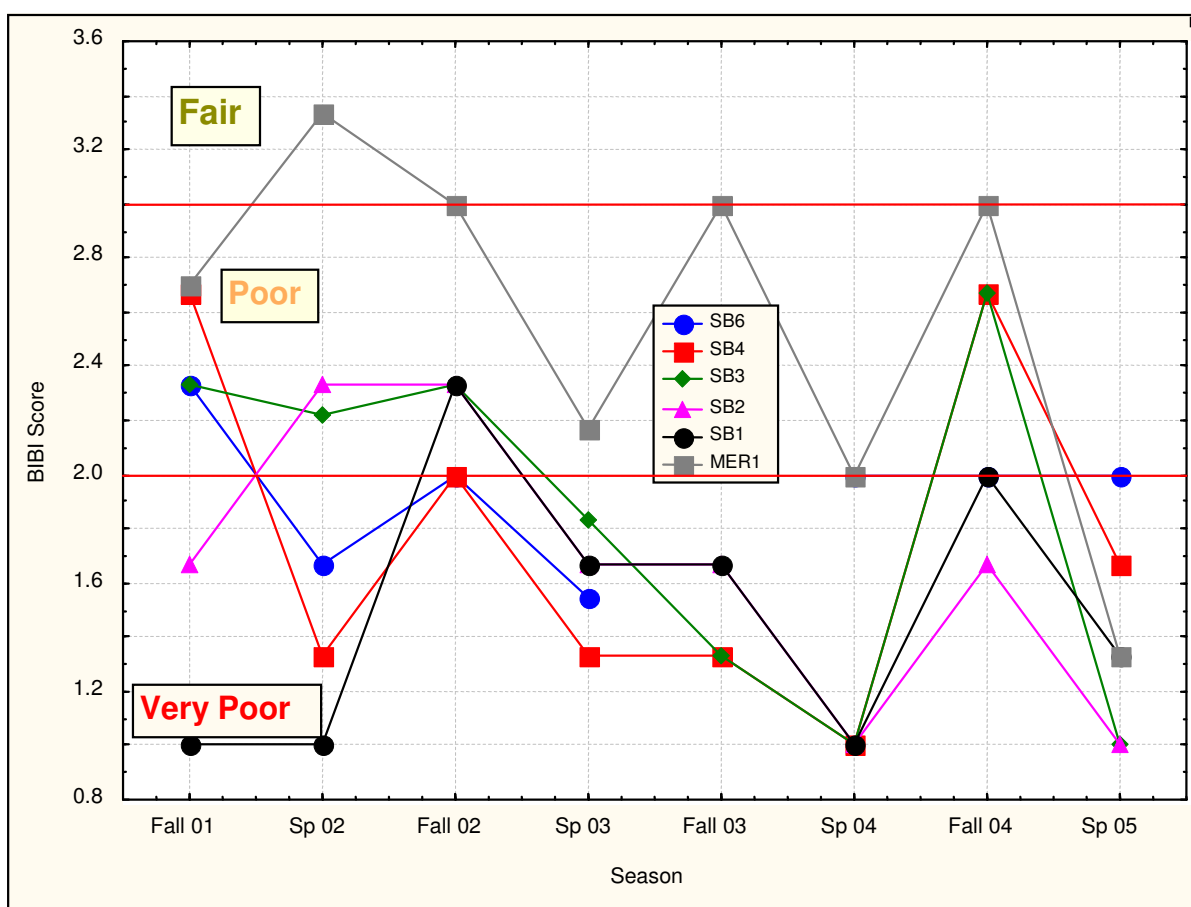


Figure 2-18: Spring Branch BIBI Scores, Site by Season.

Figure 2-18 shows BIBI results for each station by the sampling season. The figure shows that there is no consistent pattern of improvement at any of the sites. Merryman's Branch, the reference site is the only site to achieve a fair rating during the monitoring period, but even that site had excursions into poor ratings. The drought of 2001 and 2002 followed by the third wettest year on record in 2003 could have masked any recovery in the biological community due to stream restoration. The samples from the spring of 2005 were all in the very poor range.

Figure 2-19 displays the changes at each site over the sampling period. SB1, the site below the restored reach was consistently rated as very poor by the BIBI scores. Sites within the restored reach ranged from poor to very poor, but scored better than SB1 with the exception of spring 2003. Merryman's Branch was rated higher during most seasons, but was below SB6 in the fall of 2001.

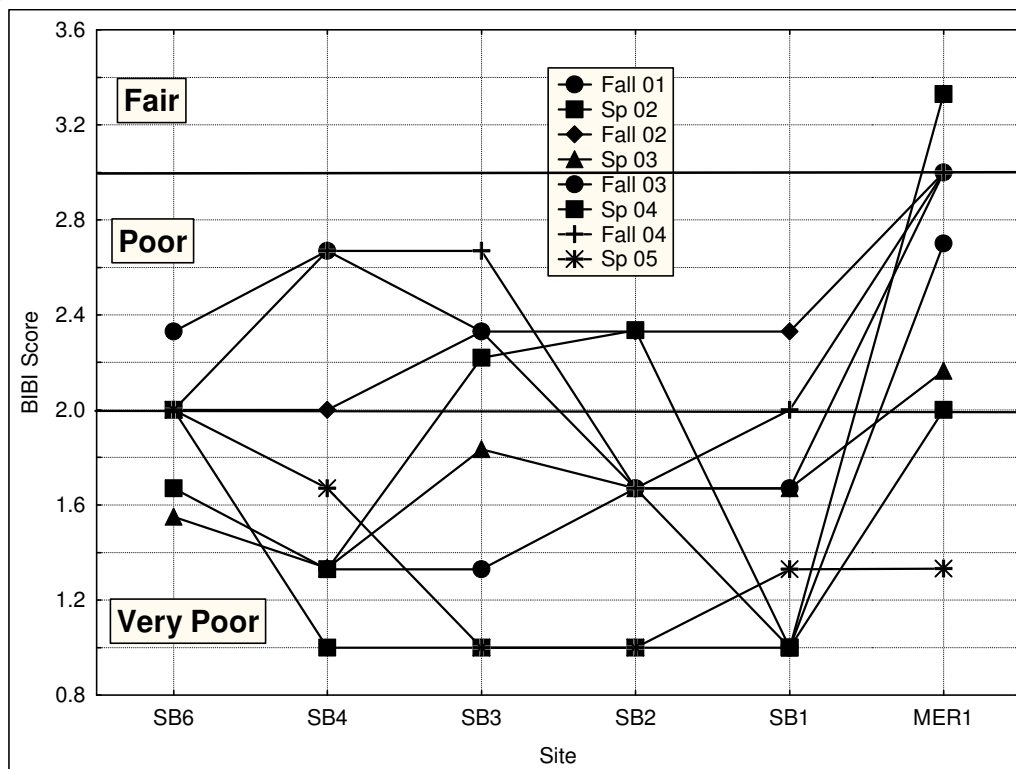


Figure 2-19: Spring Branch BIBI Scores, Season by Site.

The biological monitoring of Spring Branch did not indicate any improvement in the biological community due to stream restoration, although any improvement may have been masked by the extreme conditions experienced during the monitoring period.

### 2.4.3 Geomorphological Monitoring

Baltimore County DEPRM completed a stream restoration design and construction project on Spring Branch in Timonium, Maryland in March 1997. The stream was severely eroded and eroding due to urbanization in its 481-acre watershed, constructed mostly in the 1960's. The over 10,000 foot long project incorporated natural stream channel geometry design parameters and soil bioengineering approaches. After construction was complete, DEPRM retained Biohabitats, Inc., the design firm, to provide stream channel geometry monitoring for two years following construction to monitor the stability and success of the project. The findings of the first two years of monitoring were that the channel is stable overall even though some erosion and aggradation had occurred. This amount of erosion and aggradation was considered to be within the range of normality for a stable channel. In their report, Biohabitats stated, "More than half of the cross sections monitored at the site have experienced almost no change in geometry". Additionally, the profile data shows that the streambed has maintained its design geometry. Furthermore, the channel has not shown any serious erosion of the banks indicating any changes in the pattern of the stream which would lead to any future property loss."

Subsequent to the first two years, DEPRM staff conducted geomorphological monitoring in April, 2001, March, 2003, April, 2004, and January, 2005. In 2001 three of the 14 monumented cross sections used in the first two years monitoring period were located and surveyed. They are CX3, CX11, and CX12 located above Timonium Road, above Green Drive, and below Green Drive respectively. In 2003, 2004 and 2005 CX# 3, CX# 5, CX# 8, CX# 11, and CX # 13 were found and surveyed. The cross sections proceed in a downstream direction beginning with CX # 3 above Timonium Road, except CX#5 is on a tributary to Spring Branch above Hollowbrook Rd.

In addition to the above cross sections, three longitudinal profiles approximately 300 feet long each were surveyed in 2003, 2004, and 2005. Profile #1 corresponds roughly to Biohabitat's Profile #1 and passes through a step/pool sequence ending just above Timonium Road. Profile # 2 is in the vicinity of Biohabitat's Profiles #3 and #4 sequence and passes through CX8, and Profile #3 is in the vicinity of Biohabitat's Profile #5 and passes through CX13 and a riffle pool sequence. The beginning and end points of Biohabitat's original profiles could not be located, however these re-runs should include much of the same stream areas.

Table 2-14 quantifies the degree of cutting and filling of cross sections CX #3, CX #5, CX #8, CX #11, and CX #13 for the periods of 1999 – 2005 and 2004 – 2005. The values are in cubic feet based on an assumed one-foot wide width along the cross section.

**Table 2-14: Spring Branch Cross Sections 3, 5, 8, 11, & 13 - Cut and Fill for Two Time Periods**

<b>CX 3: Change (cu ft)</b>	<b>Period: 2004 – 2005</b>	<b>Period 1999 – 2005</b>
Total Cut (negative value)	-3.3	-3.1
Total Fill	2.7	1.5
Total Change	6	4.6
Net Change	-0.6	-1.6
<b>CX 5: Change (cu ft)</b>	<b>Period: 2004 – 2005</b>	<b>Period 1999 – 2005</b>
Total Cut (negative value)	-0.3	-1.6
Total Fill	1.8	0.5
Total Change	2.1	2.1
Net Change	1.5	-1.2
<b>CX 8: Change (cu ft)</b>	<b>Period: 2004 – 2005</b>	<b>Period 1999 – 2005</b>
Total Cut (negative value)	-0.5	0
Total Fill	3.1	7.5
Total Change	3.6	7.5
Net Change	2.6	7.5
<b>CX 11: Change (cu ft)</b>	<b>Period: 2004 – 2005</b>	<b>Period 1999 - 2005</b>
Total Cut (negative value)	- 1.3	-0.2
Total Fill	2.2	5
Total Change	3.5	5.2
Net Change	0.9	4.8
<b>CX 13: Change (cu ft)</b>	<b>Period: 2004 – 2005</b>	<b>Period 1999 - 2005</b>
Total Cut (negative value)	-5.5	-8.6
Total Fill	2	9.5
Total Change	7.5	18.2
Net Change	-3.5	0.9

Upon examination of these values, a trend is evident going from upstream to downstream sections. The net change was positive (deposition) during the 1999 – 2005 time period for the lower cross sections in contrast to a net degradation in the upstream CX3 and tributary cross section CX5. This primarily reflects levee build up - especially for CX 13. Although CX13



shows the greatest net cut of the sections for the recent year, this section has undergone the most total change due to reshaping its channel effectively making it deeper and more narrow including the levee (bank shoulder) buildup. It is also apparent that the greatest total changes for the cross sections occurred in the years prior to 2005. The data indicates that the stream restoration of Spring Branch has resulted in a stable stream channel that has undergone minor adjustments. Furthermore, the stream was subjected to a record rainfall year including tropical storm “Isabele” in 2003 and held up well.

## **2.5 303(d) List of Impaired Waters and Total Maximum Daily Load (TMDL)**

The Loch Raven Reservoir watershed does not attain the full extent of its designated uses as defined in Maryland water quality regulations. These areas, known as “impaired waters”, are tracked by MDE under Section 303(d) requirements of the Federal Clean Water Act.

Maryland Department of the Environment uses the 303(d) list of impaired waters to determine the need for establishing Total Maximum Daily Loads (TMDLs). A TMDL is the maximum amount of pollutant a given waterbody can assimilate and still meet the standards for its designated use. A waterbody may have multiple impairments and multiple TMDLs to address them. MDE is responsible for establishing TMDLs.

In general, TMDLs have two key parts:

- 1- Maximum pollutant load that the water can accept while still allowing the waterbody to meet its intended use.
- 2- Allocation of the maximum pollutant load to point and nonpoint pollutant sources in the watershed.

The list of impairments for waterbodies and any associated total maximum daily loads in the Loch Raven Reservoir watershed are summarized below. More information on the 303(d) list can be found at: [http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/index\\_new.asp](http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/index_new.asp)

A new listing of impaired waterbodies will be prepared in 2008. The current impairment listings for the Loch Raven Reservoir watershed include:

- Methylmercury
- Sediment
- Nutrients
- Biological Community

### **2.5.1 Methylmercury**

The State’s 303(d) list in 2002 included listings for mercury contamination for Loch Raven Reservoir and the other two Baltimore-area reservoirs. The entire Loch Raven Reservoir watershed was listed. The listings were based on observed mercury content in fish tissue and on a recent change in the EPA methodology for calculating the risk associated with human consumption of contaminated fish. Total Maximum Daily Loads (TMDLs) have been completed for all three reservoirs and submitted to EPA for approval. EPA granted approval in August 2004.

As part of this effort, MDE submitted a TMDL for mercury for Loch Raven Reservoir watershed of 196.6 grams per year. Although TMDLs as originally defined explicitly call for daily loads,

many agencies estimate allowable loads on a per-year basis, rather than a daily basis. This load was primarily allocated to “load” or non-point sources (180.9 grams per year). With MDE’s preparation of this TMDL, Loch Raven Reservoir watershed was placed on the Category 4A list for mercury, the list of impaired water bodies for which TMDLs have been completed. Since the primary source of mercury pollution in the watershed is atmospheric deposition from sources outside the watershed (especially from coal-fired electric power generating plants), this characterization and the SWAP will not further address this contaminant. The TMDL for Methylmercury may be viewed at:

[http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/TMDL\\_final\\_lochraven\\_Hg.asp](http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/TMDL_final_lochraven_Hg.asp) .

### **2.5.2 Biological**

The 2006, 303(d) list includes Loch Raven Reservoir watershed as being biologically impaired. These listings result from Maryland Biological Stream Survey (MBSS) 2000-2004 data.

The current method that MDE uses to list streams for biological impairment allows for entire 12-digit watersheds to be listed based on one sample with low biological integrity (either fish or macro-invertebrates). MDE is considering revising this standard, and works with local authorities to verify if such listings are based on systemic biological problems associated with particular pollutants, or if there are other causes. In the latter case, the water body could potentially be taken off the impaired list. As part of the revised standard, streams and 12-digit watersheds with only one sample with a low index of biological integrity could be targeted with a more intense monitoring effort to verify if the impaired listing is justified.

### **2.5.3 Nutrients and Sediment**

The 303(d) list for 1996 included the entire Maryland portion of Loch Raven Reservoir watershed as being “impaired” due to elevated concentrations of nutrients and for sediment. While nitrogen levels are elevated in the Loch Raven Reservoir, the primary nutrient of concern is phosphorous, due to its significant connection with chlorophyll a levels in the reservoir.

For the Loch Raven Reservoir Watershed, in 2006 MDE submitted to the EPA a Total Maximum Daily Load for phosphorous of 54,941 pounds per year; this represents a 50% reduction from 1997 levels. This load was allocated as follows: 30,184 pounds were allocated to non-point sources (55%) and 22,010 were allocated to point sources (40%), with an additional allocation of 2,747 pounds as a margin of safety (5%).

The sediment impairment listing is due to the infilling of the reservoir with remediation intended to extend the length of time before the reservoir fills in. The sediment Total Maximum Daily Load for sediment is 28,925 tons/year. This load was allocated as follows: 27,715 tons were allocated to non-point sources (96%) and 1,201 tons were allocated to point sources (4%), with the margin of safety implicit in the modeling. This represents a 25% reduction from the baseline sediment load.

The scenario run by Maryland Department of the Environment projected a 15% reduction in Total Phosphorus from developed lands and a 0% reduction for sediment. These will be the initial targets for meeting the urban land reductions for the Loch Raven TMDL.

EPA granted approval of the nutrient TMDL in March of 2007. The TMDL may be viewed at:

[http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/TMDL\\_final\\_gunpowder\\_P\\_sed.asp#TMDL\\_Loch\\_Raven\\_Reservoir](http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/TMDL_final_gunpowder_P_sed.asp#TMDL_Loch_Raven_Reservoir)

## 2.6 Spring Branch Pollutant Load Analysis

In order to scale the Loch Raven Reservoir watershed Total Maximum Daily Load to the Spring Branch subwatershed and to compare loading results derived from other modeling methodologies and monitoring data, a series of analyses were performed. The modeling methodologies that were compared included:

- The Maryland Department of the Environment – Total Maximum Daily Load analysis using the HSPF model.
- The Chesapeake Bay Program – Watershed Model using the HSPF model.
- The Loch Raven Water Quality Management Plan – pollutant loading analysis using the SWMM model.
- The Baltimore County Department of Environmental Protection – land use pollutant load simple model.
- The Baltimore County Department of Environmental Protection – monitoring results for Spring Branch subwatershed.

With the exception of the Spring Branch monitoring results, the analysis was performed using a spreadsheet with either per acre loading for impervious cover and urban pervious cover (MDE-TMDL, CBP-Watershed models) or per acre loading based on land use (Loch Raven – SWMM, DEPRM – Simple Model). The results of the analysis are displayed in Table 2-15.

**Table 2-15: Spring Branch Subwatershed – Pollutant Load Analysis**

	<b>MDE TMDL (HSPF)</b>	<b>CBP (HSPF)</b>	<b>Loch Raven SWMM</b>	<b>DEPRM</b>	<b>SB Monitoring</b>
<b>TP – Annual Load</b>	645	1,681	695	526	422.1
<b>TP Load/Acre</b>	0.64	1.67	0.69	0.52	0.42
<b>Sediment – Annual Load</b>	111,765	461,937	186,104	134,284	92,460
<b>Sediment Load/Acre</b>	111	460	185	134	92
<b>TN – Annual Load</b>	4,436	15,424	7,132	5,566	11,256
<b>TN Load/Acre</b>	4.41	15.35	7.10	5.54	11.2

As can be seen from Table 2-15, the Chesapeake Bay Program – Watershed Model consistently calculates higher loads for each of the three constituents analyzed, while the monitoring resulted in the lowest loads for Total Phosphorus and Sediment and somewhat higher loads for Total Nitrogen compared to the other calculation methods. Since meeting the Total Maximum Daily Load reductions is one of the primary goals in the development of Small Watershed Action Plans, the pollutant loads derived from the MDE-TMDL model will serve as the base for determining the necessary load reductions. As indicated in Section 2.5 the scenario run by MDE

for meeting the TMDL load reduction assumes a 15% reduction in Total Phosphorus from urban lands and no reduction in sediment.

An analysis of the completed Phase I Spring Branch restoration and the designed restoration for Phase II was conducted to determine if the target load reductions will be met. Phase I included the installation of a stormwater wet pond at the headwaters of the stream system and restoration of 10,000 linear feet of stream channel. Included with the restoration of the stream channel was planting of 7.1 acres of riparian buffer, and installation of velocity dissipaters at the storm drain outfalls along the stream. Phase II includes the restoration of an additional 2,500 linear feet of eroded stream channel. In order to calculate the pollutant removal from the stormwater management facilities installed as part of development and the wet pond installed as part of the restoration project, the drainage areas were calculated. Using the loading rates for impervious cover and urban pervious cover derived from the MDE – TMDL model the load to each facility was calculated. The load reduction efficiency was determined using the Chesapeake Bay Program Best Management Practice efficiency table (Appendix C). The loads to the facilities were then reduced by the efficiency. The results are displayed in Table 2-16 in the second and third lines (SWM Removal, Phase I Wet Pond Retrofit). For the load reduction due to the stream restoration the results from the Spring Branch – Phase I study were used. A mean per linear foot load reduction for each constituent was derived by averaging the short term post restoration monitoring and the longer term post restoration monitoring (Table 2-13 above). This resulted in the following reduction numbers:

- Total Suspended Solids – 3.58 pounds per linear foot of restoration
- Total Phosphorus – 0.0107 pounds per linear foot of restoration
- Total Nitrogen – 0.202 pounds per linear foot of restoration

The results are displayed in Table 2-16. As can be seen from the table, the percent reductions of Total Phosphorus and Sediment exceed the targets set by the MDE scenario for meeting the TMDL for Loch Raven Reservoir watershed.

**Table 2-16: Spring Branch Restoration – Pollutant Load Reduction**

	<b>Total Phosphorus</b>	<b>Sediment</b>	<b>Total Nitrogen</b>
TMDL Load	645	111,765	4436
SWM Removal	1.8	306	5.7
Phase I Wet Pond Retrofit	14.5	4,036	55.9
Phase I Stream Restoration	107.0	35,800	2,020.0
Phase II Stream Restoration	26.8	8,950	505.0
Total Pollutant Removal	150.1	49,092	2,586.6
<b>% Removal</b>	<b>23.3%</b>	<b>43.9%</b>	<b>58.3%</b>

# **CHAPTER 3**

## **SUBWATERSHED GOALS AND STAKEHOLDER OUTREACH**

### **3.1 Subwatershed Goals**

The Baltimore County Stream Restoration Program prioritizes projects, in part, by evaluating opportunities identified in the watershed plans. The Spring Branch Restoration project was selected prior to the completion of the Loch Raven Watershed Plan so the site was selected based on a watershed approach and systematic assessment to address the severity of problems and restoration goals. Restoration priority was further determined by several factors, including (1) benefit of the project to overall watershed health, (2) restoration sustainability and availability of easements, (3) stakeholder input and concerns, (4) protection of existing infrastructure (roads, bridges, utilities), and (5) estimated restoration cost.

Baltimore County Department of Environmental Protection and Resource Management (DEPRM) evaluated the entire length of Spring Branch and initiated the Phase I Spring Branch Stream Restoration Project in 1993. This project was selected to be the pilot project for stream restoration in Baltimore County. The consultant team was selected in late 1993 and the conceptual design was initiated in 1994. The project was selected for the following reasons:

- Numerous stream erosion complaints dating back 10-15 years
- Significant loss of private property.
- Exposed sanitary sewer line repeatedly repaired by DPW
- Water quality degradation - biological monitoring station indicated poor conditions
- Reservoir Management Agreement - Goal to reduce sediment and phosphorus loadings
- Typical urban residential stream - no buffers, development encroachment, attempts to stabilize banks by citizens with yard debris.
- Sedimentation from stream bank and channel erosion due to uncontrolled stormwater runoff and encroachment.
- Drains to Loch Raven Watershed – Drinking water reservoir for Baltimore Metropolitan Area.

Due to the importance of the Loch Raven Reservoir as a public drinking water supply and natural trout habitat, streams which drain to the reservoir have been designated a top priority for stream restoration. The goals of the restoration project include:

- Restore stream channel stability
- Reduce sediment loading to the Reservoir
- Improve water quality to Spring Branch and to Loch Raven
- Eliminate repeated sewer lateral breaks
- Provide community education and participation
- Establish buffers (mowed yards to trees)
- Eliminate loss of property

Baltimore County has an ambitious plan to restore streams throughout the entire County. Spring Branch was selected as the pilot project to combine many innovative techniques along the 2 miles of stream and provide immediate water quality benefits to the Reservoir. This project received a *Community Innovation Award* in 1997 from the Chesapeake Local Government Advisory Committee. Baltimore County was selected for its contribution and commitment to the protection and restoration of streams, rivers, and the Chesapeake Bay through the implementation of the Spring Branch Stream Restoration Project.

As Spring Branch Project was initiated prior to the preparation of the Loch Raven Watershed Water Quality Management Plan, 1997, the Plan excludes the Spring Branch Watershed as a potential restoration area.

#### ***Total Maximum Daily Load for Nutrients and Sediment***

With the development of the Total Maximum Daily Load (approved by EPA March, 2007) for nutrient and sediment pollution to the Loch Raven Reservoir, the additional goal of improving water quality to meet the pollutant load reduction targets was incorporated. The TMDL (*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*) developed by Maryland Department of the Environment (MDE) can be found in Volume 2, Appendix G.

Briefly, this TMDL found that Total Phosphorus needed to be reduced by 50% to meet water quality standards for dissolved oxygen and chlorophyll *a* in the Loch Raven reservoir. The scenario developed included a 15% reduction of Total Phosphorus and no sediment reduction from developed lands. The model indicated that changes in the nitrogen load would not result in changes in the dissolved oxygen and chlorophyll *a*. The sediment reduction is based on the preservation of reservoir volume for drinking water. It is anticipated that restoration projects that address phosphorus will also address sediment.

The opportunities for restoration of urbanized and the cost can severely limit the extent that pollutant load reductions can be met by urban restoration. When those opportunities present themselves, and when stakeholder support is present, Baltimore County, to the extent that funding is available, avails themselves of the opportunity. Spring Branch subwatershed presents such an opportunity. The entire subwatershed will be addressed between the completed Phase I restoration, and the Phase II restoration currently designed and designated for construction in the summer of 2008.

### **3.2 Spring Branch Watershed Restoration – Stakeholder Outreach**

Baltimore County works to identify and develop rapport among individuals and organizations directly and indirectly affected by restoration efforts. The Stream Restoration Program has benefited from fostering partnerships with a wide array of stakeholders, including: residential, commercial, and industrial property owners; local and regional non-profit organizations, research institutions, and conservation groups; and government agencies with vested interest as regulatory bodies or policy-makers. State and federal agencies, community associations, and environmental advocacy groups have proven instrumental in efforts to inform, guide and support DEPRM's restoration goals.

During both Phases of the planning and design of the Spring Branch Restoration Projects, community meetings were held and on-going communication was conducted throughout each milestone to ensure stakeholder understanding and support. Several permanent easements were secured along Phase I to permit construction activities and to allow monitoring and maintenance. One big challenge was educating property owners about the importance of maintaining vegetative buffers along streams. Since many residents prefer the neat appearance of a well-manicured lawn, it is sometimes difficult to convince property owners that riparian vegetation is necessary for the stability and health of the stream. DEPRM worked with property owners to establish native plantings that require minimum maintenance and provide aesthetic benefits.

For Phase I of the Spring Branch Restoration, DEPRM conducted a public outreach program to inform and educate local citizens and affected homeowners about the project. This effort included a homeowner survey, stream tours, community meetings, mailings, newspaper articles, and stream walks. An educational video was prepared, displays of the project were featured at local festivals, and newspaper articles were published on the project. DEPRM has conducted numerous demonstration tours of the project to further assist in transfer of the technology to others. Local support and valuable input were received from citizens. Examples of the letters to residences and of public information prepared and distributed is included in Appendix B1 and B2.

For Phase II an initial community meeting was conducted to explain the project and to engage the property owners in the importance of the restoration project. Preliminary plans were discussed and one-on-one meetings were conducted with several property owners. Several access agreements have been secured and the community has been advised of the status of the project.

# **CHAPTER 4**

## **RESTORATION STRATEGIES**

### **4.1 Overview**

#### ***Project Description***

Both phases of Spring Branch restoration address impacts of urbanization, including a flashy flow regime, rapid erosion, declining ecological function, failing infrastructure, poor water quality and property damage. The existing conditions in the watershed included primarily medium density residential land uses with an imperviousness of approximately 20%.

Restoration includes the establishment of a stable planform by adjusting sinuosity and armoring stream banks at key locations, water quality improvement with storm drain retrofits, reconnection of the stream to the floodplain, and re-establishment of the riparian/wetland ecosystem. In addition to these objectives, Phase I included infrastructure improvements including concrete channel removal, and sanitary sewer stabilization. As well as storm drain retrofits, including a 4-cell headwater-settling basin. The location of the Phase I and Phase II restoration projects is depicted in Figure 4-1. The total cost of design and construction of Phase I was \$2.25 million and Phase II is estimated to be \$1.3 million.

#### ***Restoration Strategies***

This urban stream has experienced severe bank erosion and instability due to extensive development in the 1,005-acre watershed, which occurred during the 1950's and 1960's prior to stormwater management regulations. Based on pre-restoration monitoring results, a significant amount of sediment and associated phosphorus was being carried down Spring Branch each year. Since the stream drains directly into the Loch Raven Reservoir, a source of drinking water for 1.8 million users in the Baltimore metropolitan region, the effects of sediment and pollutant transport into this impoundment and the Chesapeake Bay extended well beyond the stream itself.

In early 1997 the Baltimore County Department of Environmental Protection and Resource Management (DEPRM) completed the restoration of approximate two miles of Spring Branch (Phase I) along with the creation of associated wetlands and construction of storm drain outfall retrofits to provide storm flow attenuation and water quality enhancement. In 2008, the Lower Spring Branch Stream Restoration Project (Phase II) will be completed. Phase II will restore approximately 2,500 linear feet of Spring Branch between Dulaney Valley Road and Pot Spring Road by creating a stable channel using natural stabilization techniques.



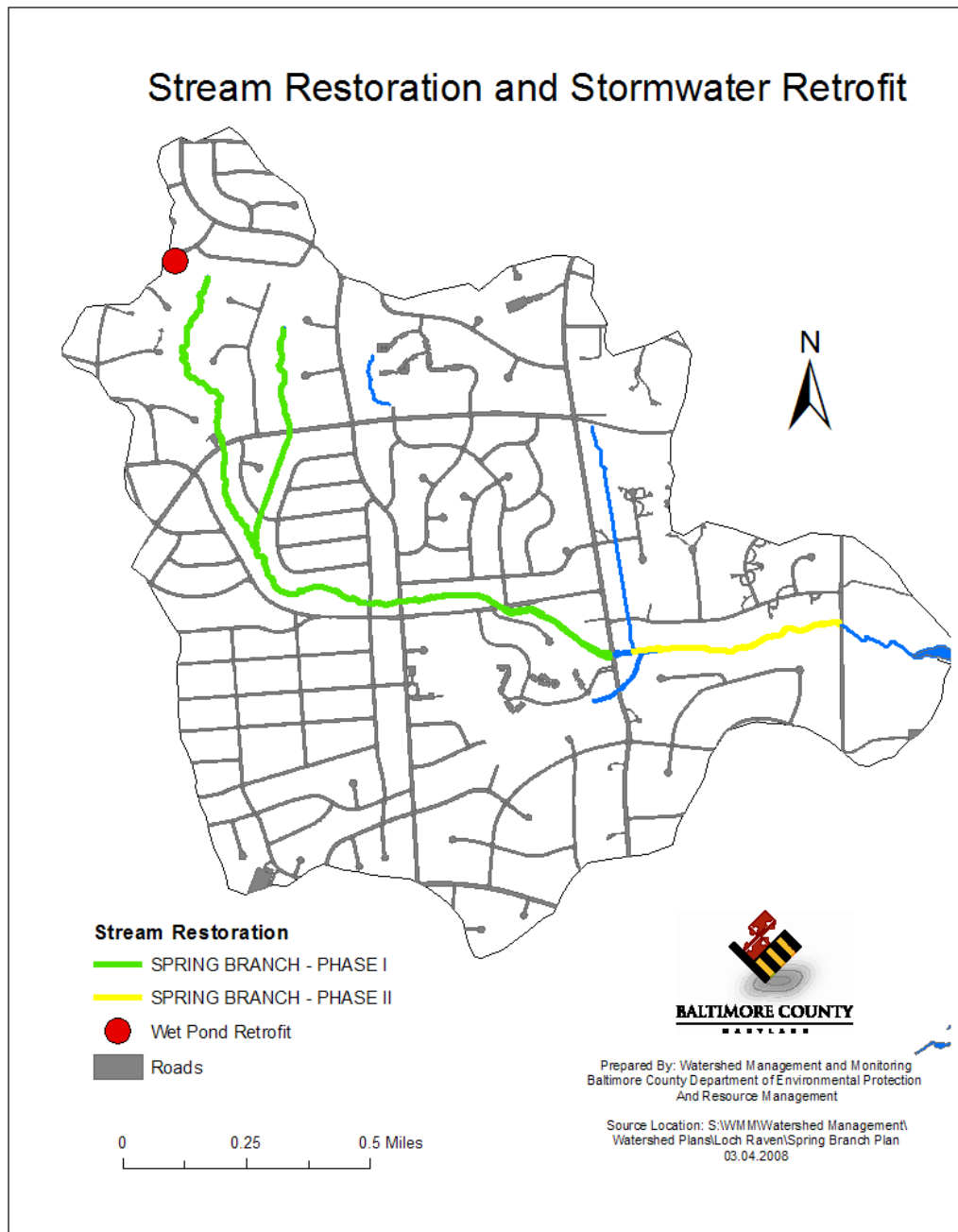


Figure 4-1: Spring Branch Subwatershed Restoration Projects

## 4.2 Phase I – Spring Branch Stream Restoration Project

Phase I of Spring Branch is located in a heavily developed headwater area. The typical problems of stream buffer removal, flashy flow regime, and floodplain encroachment were evident. Two sections of failed concrete and multiple sewer line crossings disrupted ecological connectivity. The system had severely eroding banks due to structural failures and the clear water discharge from the high percentage of imperviousness in the watershed.

Spring Branch was an unstable stream with a steep gradient, dropping over 180 feet in two miles of length. The channel passed through confined areas of residential development and had evolved from a quiet brook into an eroded chasm 30 feet wide and up to 15 feet deep. Adjacent homeowners were experiencing flooding, loss of streamside property and depreciation of property values due to reduced aesthetics, habitat, and safety hazards. The stream had been channelized and straightened over the years with areas of no vegetation along the banks.

Recognizing that outdated traditional stream improvements such as channelization, lining the stream with concrete, and doing piecemeal repairs do not work, DEPRM elected to apply a relatively new design approach that accommodates the natural forces and processes of streams.

The design process utilized applied fluvial geomorphologic principles along with hydraulic engineering. Features such as step-pools, meander patterns and flood plains were incorporated into the new channel of Spring Branch. Following construction-grading, the new stream channel and other disturbed areas were stabilized using bio-engineering techniques incorporating natural materials such as boulders, tree root wads, and live fascines to provide soil and channel stability. As a result, a channel geometry and sinuosity was created that is consistent with streams of Maryland's Piedmont Plateau.

The Spring Branch initiative was an integration of related projects that included, in addition to the stormwater management retrofits, the relocation of an exposed sanitary sewer line and the removal of 1740 feet of concrete lined channels. The stormwater retrofit was comprised of a 4-cell detention and settling basin to treat the runoff from the headwaters of the drainage area. Maryland Small Creeks and Estuary funding was utilized for this water quality retrofit. The retrofit was planted with wetland vegetation and riparian vegetation around the entire site. Each storm drain outfall was incorporated into the design and the construction included rock lined step pools to dissipate energy at the end of pipe.

To prevent erosion and provide aquatic habitat benefits, various soil and bioengineering techniques were applied to stabilize the stream banks. Live fascines, brush mattresses and live branch layers were employed to provide a natural appearance and effective stabilization. Reforestation of twelve acres of disturbed areas with a variety of native trees and shrubs was completed in conformance with the County's Forest Conservation Act. Developer fee-in lieu-of mitigation funds were utilized for the plantings.

### **4.3 Phase II – Spring Branch Stream Restoration Project**

The Lower Spring Branch project study area is located between Pot Spring and Dulaney Valley Road and includes 80 feet of an intermittent concrete-lined tributary. The study reach is approximately 2,600 feet long and receives water from a 1.58 square mile watershed. This project will extend the 1997 restored reach of Spring Branch to Dulaney Valley Road.

The impacts to the lower portion of the stream include channelization, concrete armoring, and stormwater runoff from residential development. This has resulted in considerable bank erosion, generally along the left bank, as the stream flows through the neighborhood and persistent flooding at the downstream end of the project area. Prior to the 1980s,

Lower Spring Branch was straightened, channelized, and armored to maximize land for development and to divert stormwater. Sizing of the culvert at Dulaney Road did not account for flows during large storms, subsequently causing backwater effects and flooding. Sewer lines are installed in the stream valleys adjacent to the stream. The removal of vegetative buffer areas and development of vast areas of impervious surface compounded adverse effects on this stream.

#### **4.4 Results And Benefits**

The stream restoration involves several techniques including bioengineering (live fascines, live branch layering and native planting), bank stabilization (root wads, rock toe protection) and in-stream structures (vortex rock weirs, step pools). Stabilizing the channel geometry, providing bank protection and recreating stream, wetland and floodplain areas along this degraded stream system will address the need for habitat regarding species of concern. The proposed channel reconfiguration provides a more heterogeneous and stable substrate, thereby increasing the diversity and abundance of aquatic insects. The creation of pools and riffles will provide habitat and cover for adult fish as well as spawning and nursery areas for some of those species.

The improvements to Spring Branch will benefit the species of concern, such as anadromous fish and waterfowl. With the implementation of this stream/riparian restoration project several important functions can be restored in the watershed.

For Baltimore County, the Spring Branch is a landmark pilot project utilizing innovative restoration approaches. This project was the first stream restoration project in Baltimore County and was completed in 1997. The success of this project gave DEPRM the confidence that the natural channel design approach can be used successfully for other stream restoration projects implemented through the County's Capital Improvement Program.

When Phase II is complete, over 14,000 linear feet of stream will be restored. This project will focus on the diverse role freshwater stream systems play in maintaining suitable habitat for the living resources of the Chesapeake Bay.

Based on the pollutant load reduction analysis in Chapter 2 (Section 2.6). The combined pollutant load reduction for Phase I and Phase II will be ~23% for total phosphorus, ~44% for sediment and ~58% to nitrogen.

#### **4.5 Monitoring**

A ten-year monitoring program was implemented on Phase I to measure the stability of the stream channel. Water quality monitoring was also conducted to measure changes in pollutant loading from storm flows, as well as, biological monitoring (Chapter 2, Section 2.4). The new stream channel has withstood several large storms (during and post construction), and the sediment loading appears to be greatly reduced in and along the streambed. Improved habitat and aquatic resources are expected to occur over time. Citizen and landowner response has been very positive to date.

A physical monitoring program will be implemented for Phase II that will include surveyed monumented stream cross sections, survey of longitudinal profile, evaluation of structures, bed and bank stability assessment and sediment transport functions. The water

quality analysis for Phase II will be limited to biological monitoring of the benthic macroinvertebrate community of the restored stream section, with both upstream and downstream monitoring, and an outside reference site located at Merryman's Branch.

# **APPENDIX A**

## **US ENVIRONMENTAL PROTECTION AGENCY**

### **A THROUGH I CRITERIA FOR WATERSHED PLANNING**

This appendix will provide information on how the development of the Spring Branch Subwatershed Small Watershed Action Plan addresses the US Environmental Protection Agency (EPA) A through I criteria for watershed planning. It will serve as a guide to the location within the document, including the appendices, where each criteria is addressed.

*a. An identification of the causes and sources or groups of sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (b) below. 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).*

Loch Raven Reservoir watershed is listed by the Maryland Department of the Environment (MDE) as being impaired by nutrients, bacteria, methyl-mercury in fish tissue, and stream biology is impaired. The Spring Branch subwatershed is located within the Loch Raven Reservoir watershed. 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 Spring Branch subwatershed 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 G, as support for the phosphorus load reductions necessary to achieve water quality standards within the Loch Raven Reservoir, of which Spring Branch is a part. EPA approved the TMDL in March 2007.

In order to refine the estimates of phosphorus loads for the Spring Branch subwatershed, an analysis was conducted based on the per-acre loading rates developed in the TMDL model, the Chesapeake Bay Program watershed model, the Loch Raven SWMM model, the DEPRM simple model, and Spring Branch monitoring data. This data is presented in Chapter 2.6.

Additional information was analyzed to refine specific sources of impairment. This information is presented in Chapter 2.

***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 C. The estimate of pollutant reduction for stream restoration was based on the re-analysis of the Spring Branch data presented in Chapter 2.4 Using the information in Appendix C, and the reanalysis of the Spring Branch stream restoration data, the phosphorus load reductions for the various actions were calculated and presented in Chapter 2, Table 2-16.

***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 meet the pollutant load reductions detailed in the TMDL (Appendix G) and analyzed specifically for Spring Branch, Chapter 2.6. Chapter 2.6 details the pollutant reductions that will be achieved through implementation of the Spring Branch – Phase I and Phase II restoration. The reductions achieved are above the scenario developed through the TMDL. This will help develop a credit for pollutant load reduction in subwatersheds that have limited restoration potential.

***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.***

The costs for Spring Branch Phase I and Phase II Restoration are presented in Chapter 4.

***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 Exhibits A and B.

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

Spring Branch Restoration- Phase I was completed in 1997. Spring Branch Restoration – Phase II is due for construction the summer of 2008. With the completion of these two phases, the restoration of Spring Branch will be complete. Educational activities identified for all of Loch Raven Reservoir watershed will continue. Some of these activities will reach Spring Branch residents.

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

Interim, measurable milestones are not needed for this subwatershed, as the restoration will be complete with the implementation of Phase II.

***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. 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. The efficiency for stream restoration pollutant load reduction is based on the re-analysis of the Spring Branch monitoring data; detailed in Chapter 2.4.

***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 4 details the monitoring that will occur to evaluate the effectiveness of implementation of Phase II. Phase I was extensively monitored for stream stability, pollutant load reduction, and aquatic biological community improvement.

# **APPENDIX B1**

## **PUBLIC OUTREACH**

- **Homeowner Survey**
- **Stream Tour Agenda**
- **Public Information Meeting Notices**
- **Power Point Presentation for Public Meeting**

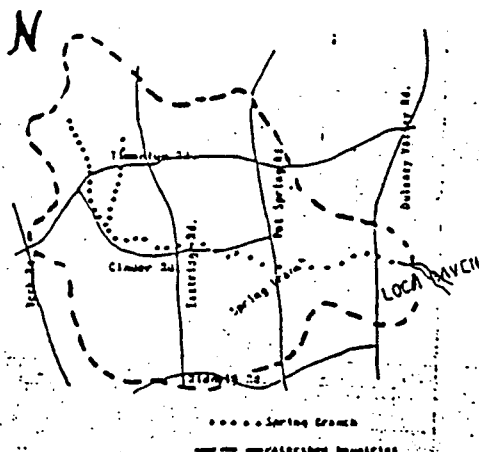


# SPRING BRANCH NEEDS YOUR HELP FOR EARTH MONTH, 1994

THE BALTIMORE COUNTY CITIZENS  
FOR STREAM  
RESTORATION CAMPAIGN  
WILL BE CONDUCTING A SURVEY OF THE  
ALMOST 2000 HOMES IN THE  
SPRING BRANCH WATERSHED DURING APRIL.  
HELP US FIND OUT WHAT THE COMMUNITY KNOWS ABOUT  
WATER QUALITY ISSUES

JOIN US  
SATURDAY, APRIL 9  
TIMONIUM U. M.  
CHURCH  
2300 POT SPRING RD.  
NOON - 2:00 PM  
TO VOLUNTEER CALL  
TERRY LEHR  
MARYLAND SAVE OUR  
STREAMS  
969-0087

Baltimore County  
Citizens for Stream Restoration Campaign



Maryland Save Our Streams



## **Save Our Streams**

258 Scotts Manor Drive \* Glen Burnie, Md 21061  
(410)969-0084 or (800)448-5826

# **Spring Branch Watershed Household Survey Draft Report**

November 1, 1994

Prepared for the:  
**Baltimore County  
Citizens for Stream Restoration Campaign**

### **Contents:**

Introduction and narrative  
Sample of survey form  
Spring Branch watershed map--delineating distribution areas  
Spring Branch watershed map--delineating response areas  
Breakdown of responses by question  
Responses illustrated as pie charts  
List of survey respondents who gave names and addresses

SPRING BRANCH SURVEY  
REPORT

The Spring Branch watershed is located in the Timonium area of Baltimore County, and is part of the Loch Raven Reservoir. In co-operation with DEPRM, SOS developed a forty-eight question survey about the daily routines in and around the house that can affect the water quality of Spring Branch. This survey form was distributed by community volunteers, in the watershed, beginning April, 1994.

There are about 1996 homes located in this watershed. The area was divided into 11 turfs. Seven of the turfs were distributed, and one volunteer was given an area along Gateswood Rd. and Chapelwood Lane (adjacent to the waterway) that was a combination of two turfs. Two other sections of turfs were distributed by staff and volunteers from McDonough School. Of the 2200 surveys printed, about 1500 were handed out to volunteers to be distributed in the community. The survey area with houses directly located adjacent to the waterway was a priority to be covered. Many of the volunteers were not able to fill their commitments due to scheduling problems (softball, soccer, vacation, work) and weather conditions were some of the reasons given.

Only one turf "3" was completely covered. Turf "8" was returned with only 1 survey completed, due to work problems, one volunteer would not respond to any correspondence with staff, and the volunteer teams from turfs "6&7" and "2" mailed surveys to the SOS offices, that were not received by staff.

Eighty-seven responses were received, which is about a 4.5% of population return. On the back of the survey questionnaire, residents were asked to mark where they lived in the watershed. Thirteen surveys do not response to this section. Dividing the area map into 16 sections (see map), the response was the majority from section 6 (41), and from section 10 (12). These adjacent turf areas are along Eastridge Rd., and Timonium Rd. Sections 2, 7, 13, and 14 had two responses, while sections 1, 8, and 9 has one response each. No response was marked for sections 1, 4, 5, 13, 15, and 16. Forty-six of the survey participants gave their name, address, and phone number on the questionnaire.

Of the 87 survey responses, based on repondent's report 52 were from houses 1/4 mile or less from the waterway and 17 were between 1/4 to 1/2 mile. This is because the houses directly adjacent to the waterway were a priority.

According to the responses received, the majority of the households have lived in the Spring Branch watershed for over twenty years and consist of two members. Only one household had six or more occupants.

The majority of the responses (41) to the questionnaire stated that they had no conception of what Spring Branch's water quality might be, while 17 perceived it to be fair, six poor, and eight did not response. There were no excellent responses.

As to the major causes of the pollution to the waterway, 21 gave no response, while some had multiple selections. Mud, solids/sediments and junk/trash were both selected 17 times, while toxics, poisons and animal waste, nutrients each were felt to be the major pollutant on 11 questionnaires. Three residents selected other pollutants such as lawn clippings, leaves, and branches as the cause.

As to the heating methods for the houses in the watershed that responded, only one was heated by oil, while the rest where gas or electric. The lone oil tank reported in the survey was located in the basement of the building. There was no fireplace or woodstove responses to the question reported.

Fifty of the responses stated that they owned two transportation vehicles, 16 had one vehicle, 15 had three, three had four vehicles, and two gave no response.

Several questionnaires has several responses to the question as to where these vehicles were parked. The largest response was in the driveway (69), while 24 selected garage kept, 18 times street was selected, carport once and one resident did not respond.

The survey responses were 28 stated yes, 27 no to the question do they wash their own vehicles. Only 7 responded yes that they knew where the nearest oil/antifreeze collection center was, fifty stated no they didn't, while 14 did not answer the question.

Even through only 7 stated yes that they knew where the collection center was, there were additional answers as to where it was located. Twenty-seven gave a location. Twelve stated the Texas Landfill, 11 Cockeysville, four the service station (one named Citco), and one each for the dealer, Glen Burnie, the County yard, and Hi Gear Auto.

Of the 86 survey received, 72 households do not change their own oil or antifreeze, 2 did not respond, and 12 stated yes they do. There were 16 responses that the used oil/antifreeze was taken to the collection center, which was the only response to the question.

Forty nine homes that answered the survey do not use a professional lawn service, while 38 do. One survey did not have a response. The services brought from the lawn service was stated to be 28 for cutting grass, 12 trim work, 24 for chemical treatment (one respond stated it was an organic service and another stated only natural product service provided), for fertilization 21 (two

respondents stated it was an organic service and another stated only natural product service provided), while 43 failed to respond to the question. The chemical treatment services were stated to be 21 seasonally, twice annually, and one monthly. The fertilization treatment was recorded as 16 seasonally, 3 annually, and none monthly.

Thirty households responded no they did not maintain a vegetable/flower garden, while 11 did, but there were additional answers to the size of a garden. Sixteen gardens were listed to less than 100 square feet, 14 from 100 to 200 square feet, and 6 from 400 to 800 square feet. Nineteen responses were they did not know the square footage, while 8 did not response.

A large percentage of the responses (59) stated that they used commercial fertilizer, 27 natural, organic alternatives, 3 commercial chemicals, five none, and 12 did not response. As to how often the gardens were fertilized, 23 responses were for seasonally treatment, 21 annually, 5 monthly, 4 never, once twice a year, and 18 had no response. There was no weekly treatments reported. The chemical treatment to the gardens were reported to be 49 never, 11 seasonally, 4 annually, and 3 occasionally. There was no monthly or weekly treatments reported, while 22 did not answer this question.

Multiple responses were received to the question about there being trees, shrubs or ground covering plants on the lawns of the responses. Eighty-six reported trees, 83 had shrubs, 58 ground covering plants, and one reported yard of grape vines. As to how much lawn residents would be willing to landscape, 25 reported over 20 %, 19 between 10-20%, 18 less than 10%, 5 none, and 20 did not response.

In respond to a series of questions related to lawn care practices the follow answers were received: as to the question about if the lawns were watered regularly, 56 stated no, 26 yes, 1 was watered by rain, and three did not respond; 56 lawns have their walkways edged, 25 do not, 2 do occasionally, and 5 had no response; while 45 stated they do not have a mulching mower, 35 do, while 7 did not respond. Multiple methods were listed by the residents on several surveys regarding how grass, leaves, and shrub clippings were reported to be disposed of. Their responses were: 44 in the trash/landfill, 24 stated a compost pile, 13 by a lawn service, 3 along the stream bank, 2 no response, and 7 had other methods (such as mulch, leave in woods or on lawn). No responses were for placing in the stream or in the storm drain.

In regards to pest control problems, 39 survey responds were that they do it themselves, 28 use a professional/commercial service, 3 stated nothing is done, and 13 did not respond to the question. The pests reported were mostly household insects and hornets/wasps, followed by termites, ants, gypsy moths, beetles,

mosquitoes, rodents, slugs, fleas, tent caterpillar, and aphids. Twenty-nine surveys stated no problem, and 9 did not answer. Sixty-three of the surveys reported they had not used a professional pest control service in the last three years, and only 22 reported yes. One survey had a none respond tabulated.

Fifty of the received questionnaires reported that there was a sump pump at the residence. As to how often these pumps discharge, 7 were reported to work seasonally, 7 never, 4 daily, 1 weekly, where 5 were listed other. This includes 1 seldom, 1 only 2 to 3 times a year, 1 when it rains, and two broken or not plugged in. Sixteen residents did not know how often the pump worked. Twenty-four sump pumps were reported to discharge to the lawn, eight to the curb, 2 to the driveway, 12 unknowns, and 7 no responses. There were 38 houses reported not to have a sump pump, while only 1 no response was received.

Forty-one of the responses received stated that there were no water conservation fixtures in the home, while 31 sated yes to the question. Nine residents did not know, while there were 7 no answers.

As to having a pool at the property, 64 responds were negative, and only 12 did have a pool. There were 11 none responses to this question. The break down of the reported pools were 8 in-ground, 3 above ground, and 1 no respond. The sizes of the pools varied. One was given as an 18 x 31 ft. pool, while each following listed gallon size was reported once: 100, 1500, 1700, 10000, 25000, 28000, 35000, 40000, and 44000. One did not know and 1 no respond were reported. Ten of the pool owners do not use a professional service, and only 2 reported uses a service. While only 2 of the pools were heated, one by gas and one solar energy, and one no response. The pools filter types were listed 1 cartridge, 5 sand, 2 DE, 1 earth and three didn't know what type of filter.

As to the number of answers to having a spa or hot tub, there were 3 possible answers, 62 no, and 22 no reponses. All 3 of the reported hot tubs were heated by electric, while 2 used a cartridge filter, and 1 owner didn't know what type of filtering system was used. The backwash flow was listed to be into the lawn by 2 residents, and again one didn't know where the backwash went.

Seventy-two households reported that they do recycle, 14 do not, and one stated "sometimes". As if the negative responses would participate in curbside recycling, when it is avaiable in their area, 14 stated yes, 3 no, 2 didn't know, and one respond "more often". As to the recycling center currently used, it was recorded as Cockeysville 19, the Texas landfill 16, County paper pick-up 14, Reynolds Aluminuim 2, and one each for Towson-Parkville Recycling Center and Baltimore Recycling Center. One resident didn't know, and 11 gave no response to the question.

A large number (52) replied that they use "environmentally friendly" products or home remedies in or around their homes. To this question, 19 replied no, while 17 did not reponse. Sixty-nine of the received completed surveys households, stated that they would use the most environmentally safe products if readily available. Several responses clarified their answer that if the products were as effective, not exclusively and "I think so". Sixteen responses were recorded a Don't know and there were 10 no responses. One of the no reponses questioned for what uses would the products be.

There is an inconsistence in the number of responses to certain questions, such as know collection center, size of gardens, used of chemical and fertilizer treatments. This may be confusion on the responses due to the wording of the question. It is possible that many residents confused the questions about the gardens with lawns, including care, services and treatments.

Possible activities that could be used as a follow-up to this suvey are several education campaigns. It appears there is a need for more knowledge about disposal of grass and lawn clippings. Two survey responses were onto the stream bank. During meetings and conversations with watershed residents during this project, several beleived placing lawn waste on the stream banks stablized them. Residents should be aware that a small amount of leaves are natural in the waterway, but excessive material degrades the water quality. There are many residents that need more information about the avaiable recycling stations in the area. One response was Glen Burnie to the nearest oil/antifreeze collection center. Hopefully, stream walks can be organized to make the watershed citizens more aware of stream ecology. It must be cautioned that many of the residents may be older, and accessiability to the stream should be an easier pathway, or other methods used.

# SPRING BRANCH STREAM TOUR

Saturday, March 25, 1995

## AGENDA

10:00-10:15 AM Registration

10:15-10:30 AM Introduction

Rebecca Pitt, Save Our Streams

10:30-10:45 AM Video - "Restoring the Past,  
Preserving the Future"

10:45-11:15 AM DEPRM's Restoration Plans;  
Spring Branch Watershed

Don Outen, DEPRM

11:15-11:30 AM BREAK

11:30-1:30 PM Tour of Spring Branch

Don Outen/Candy Szabad, DEPRM

1:30-1:45 PM Where Do We Go From Here?

Suzi Wong, Save Our Streams

1:45-2:00 PM Wrap Up/Return to School



# **SPRING BRANCH STREAM TOUR**

with  
BALTIMORE COUNTY  
DEPARTMENT OF ENVIRONMENTAL PROTECTION AND  
RESOURCE MANAGEMENT (DEPRM)

**JOIN US ON A TOUR OF SEVERAL SECTIONS OF THE  
RESTORED STREAM**

**SATURDAY MAY 16, 1998  
10:00 AM**

**MEET AT ST TIMOTHY LUTHERAN CHURCH  
PARKING LOT**

**100 E. TIMONIUM ROAD**

**PLEASE WEAR APPROPRIATE CLOTHING AND BOOTS FOR  
WALKING IN AND AROUND THE STREAM**

**FOR MORE INFORMATION PLEASE CONTACT  
JO OWEN 410-252-5515 OR CANDY SZABAD (DEPRM) 410-887-2904**

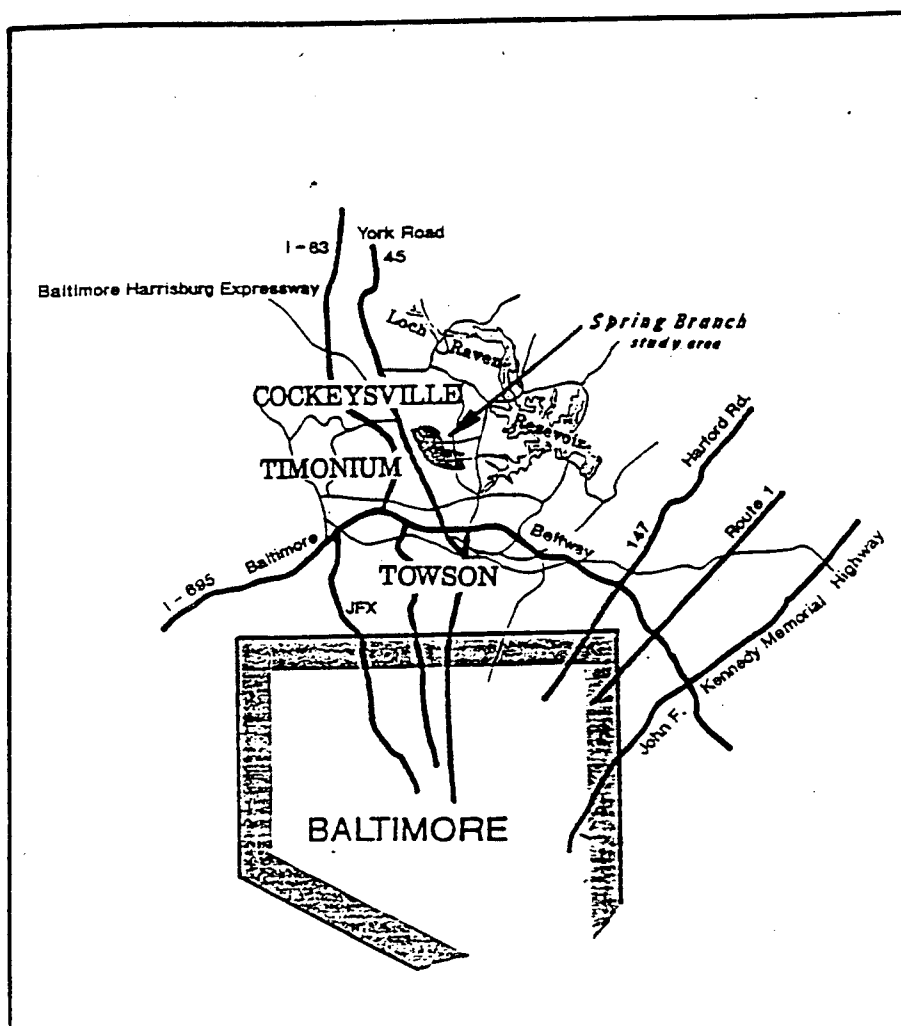
***RAIN DATE FOR HEAVY RAIN ONLY - MAY 23<sup>RD</sup> PLEASE CALL TO CONFIRM***

FEBRUARY 26, 1996

The Baltimore County Department of Environmental Protection and Resource Management is conducting a public meeting on Wednesday, March 27, 1996 to discuss the proposed stream restoration improvements to Spring Branch in Timonium. The meeting will be held in the cafeteria of Duhaney High School at 7:30pm.

All property owners adjacent to the stream are urged to attend.

For further information please call the Department of Environmental Protection and Resource Management at 887-2904.



# ***SPRING BRANCH STREAM RESTORATION PROJECT***

The Baltimore County Department of Environmental Protection and Resource Management is conducting a public meeting on Wednesday, March 27, 1996 to discuss the proposed stream restoration improvements to Spring Branch in Timonium. The meeting will be held in the cafeteria of Dulaney High School at 7:30pm. All property owners adjacent to the stream are urged to attend. For further information please call the Department of Environmental Protection and Resource Management at 887-2904.

March 7, 1996

Dear Property Owner:

Baltimore County is proposing improvements to the stream and/or County owned land adjacent to your property. This stream, known as Spring Branch, is a tributary to the Loch Raven Reservoir. The Department of Environmental Protection and Resource Management would like you to attend the following informational community meeting:

**DATE:                    MARCH 27, 1996**

**TIME:                    7:30 PM**

**PLACE:                DULANEY HIGH SCHOOL CAFETERIA**

Baltimore County representatives will present the proposed improvements to Spring Branch and answer any questions you may have.

Should you have any questions, please call Candace Szabad or Chin Y. Lien of my staff at 887-2904.

Very truly yours,

Donald C. Outen, A.I.C.P.  
Bureau Chief  
Bureau of Water Quality and  
Resource Management

DCO:jj



Baltimore County  
Department of Environmental Protection  
and Resource Management

Office of the Director  
401 Bosley Avenue, Suite 416  
Towson, Maryland 21204  
(410) 887-3733  
Fax: (410) 887-4804

August 15, 1996

Dear Spring Branch Property Owner:

The long awaited construction of the stream restoration project on Spring Branch is scheduled to begin. The County's contractor, the firm of Coastal Design and Construction, Inc., will begin to work in the stream in the next couple of weeks.

We appreciate your continued cooperation and patience on this extremely complex project.

Should you have any questions, please call Candace Szabad or Chin Y. Lien of my staff at 887-2904.

Very truly yours,

A handwritten signature in black ink, appearing to read "G. Perdikakis", is written over a horizontal line.

George G. Perdikakis  
Director

GGP:cs





Baltimore County  
Department of Environmental Protection  
and Resource Management

Bureau of Engineering Services  
401 Bosley Avenue, Suite 416  
Towson, Maryland 21204  
(410) 887-3768  
Fax: (410) 887-4804

September 24, 1996

DEAR SPRING BRANCH PROPERTY OWNER:

As you are aware, the Spring Branch Stream Restoration Project is underway. Your property is located adjacent to the proposed restoration work. The work area has been or will soon be located with wooden stakes with pink ribbon labeled LOD (Limit of Disturbance). These stakes also mark the location of the property line. If you have any structures or landscape features located on County property (between the LOD stake and the stream), you may want to remove those items as soon as possible. Any items within the work area may be subject for removal. Any items left within the work area are done so at your own risk.

If you have any questions, please contact Candace L. Szabad of the Department of Environmental Protection and Resource Management at 887-2904.

Sincerely,

A handwritten signature in black ink, appearing to read "CYL", written over a horizontal line.

Chin Y. Lien, P. E., Supervisor  
Capital Improvements Section  
Bureau of Resource Management  
and Engineering Services

CYL:cs



May 30, 1997

DEAR SPRING BRANCH PROPERTY OWNER

The construction activity in Spring Branch has now been completed. I would like to take this opportunity to thank each of you for your interest and patience during the construction of this important stream restoration project. This Department will be monitoring the success of this project throughout the year.

I would like to remind you to dispose of your grass clippings and other yard waste properly and not to dispose of any yard waste in the stream or on the banks. It is crucial to the success of the project to *keep all yard waste out of the stream and off the banks*. The banks of the stream have been planted with variety of trees and shrubs and a mix of seed. To ensure proper growth, please *do not mow* these areas.

Once again, thank you for your cooperation and I hope that you are pleased with the results of the restoration effort.

Very truly yours,

George G. Perdikakis  
Director

GGP:cs

# Spring Branch Stream Restoration

- ◆ Naturalized channel
- ◆ Stable slopes
- ◆ Stream improvement
  - water quality
  - habitat
  - aesthetics





# Spring Branch Stream Restoration

- ◆ Type of Work Effort
  - Grading
    - ❖ Dirt Removal
    - ❖ Sculpting New Channel
  - Stabilization
    - ❖ Reseeding
    - ❖ Naturalized Landscape
    - ❖ Sod and Lawn Replacement



# Spring Branch Stream Restoration

## ◆ Bioengineering Methods:

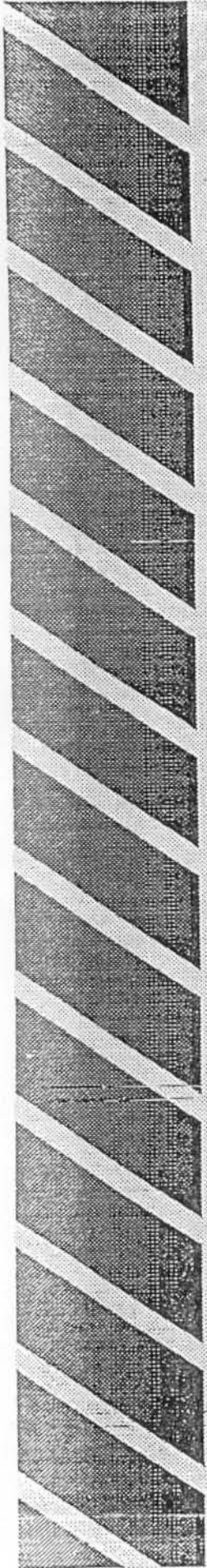
- Root Wads
- Rock Toe protection
- Live Fascines
- Coir Fiber Role
- Live Branch Layering
- Live Brush Matress
- Native Plant Seeding





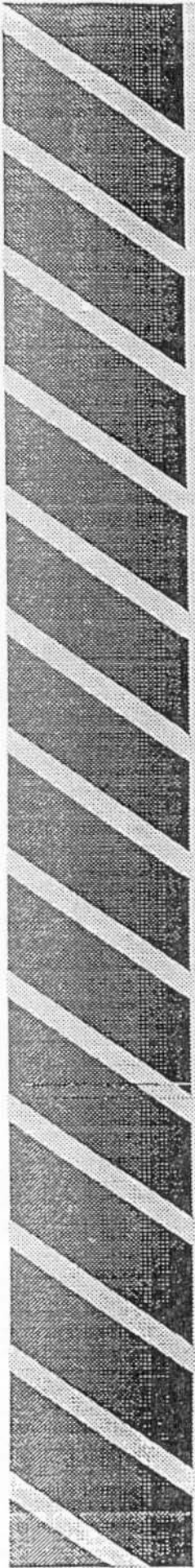
# Spring Branch Stream Restoration

- ◆ Stream Construction Methodology
  - Disturb Small areas of the channel
  - Proceed Section at a time
  - Minimize Disturbance to Private Property
  - Limit Disturbed area to <1,000 feet of channel at a time.
  - Limit Construction Access
  - Protect Existing Landscape.



# Spring Branch Stream Restoration

- ◆ Will the entire channel be disturbed?
  - No!
- ◆ Will all the trees be removed?
  - No!
- ◆ What will happen on my property?
  - Probably Nothing!





## **APPENDIX B2**

### **PUBLIC RESPONSE AND TECHNOLOGY TRANSFER**

- **Letters from Local Citizens**
- **Letters from Firms**
- **Script for Video**
- **Newspaper Articles**

FILE

February 0, 1997

Mr. Chin Y. Lien, P.E., Supervisor  
Capital Improvements Section  
Bureau of Resource Management  
and Engineering Services  
401 Bosley Avenue, Suite 416  
Towson, MD 21204

Mr. Lien,

The neighbors of Coldbrook Road wish to express their thanks and appreciation for the team of engineers and workers that dealt with the Spring Branch restoration project (tracking# 199661250). You, and especially M's Candace Szabad, were most helpful, and patient in responding to the questions and concerns which many of us had during the restoration period. M's Szabad was quick to respond to issues, and was very cooperative in dealing with requests for assistance.

The project appears to be completed in the Coldbrook Road area. For the most part, the neighbors of Coldbrook generally like the finished work. With the plantings installed by the County, and the property grading which took place, all of us anticipate seeing a more beautiful and natural setting along the Spring Branch stream.

Please express our thanks to the various work crews that participated in this project.

Mr. & Mrs. Lillian L. L. L.

217 Coldbrook Rd.

Mr. & Mrs. George Brown 219 Coldbrook Road

Mr. & Mrs. John Snyder 225 Coldbrook Rd

Mr. & Mrs. MICHAEL J. NEWELL SR 122 SPRINGSIDE DR

Mr. and Mrs. Lawrence Townsend

213 Coldbrook Road Timonium 21093

Mr. C. Johnson 215 Coldbrook Rd Timonium

F I

Post-It routing request pad 7664

## ROUTING - REQUEST

READ GGP  
HANDLE CLV  
APPROVE CLS  
FORWARD A copy of this letter to  
RETURN be placed in Candy's

J. R. ZARFOSS  
207 COLDBROOK RD.  
TIMONIUM MD 21093

BUREAU OF WATER QUALITY AND RESOURCE MGMT.  
401 BOSLEY AVE. SUITE 416  
TOWSON MD. 21204

REFERENCE - SPRING BRANCH RESTORATION, 199661250  
ATTN: CHIN Y. LIEN, SUPERVISOR CAPITAL IMPROVEMENT

DEAR MR. LIEN,

I WISH TO COMMEND YOU AND THE  
PROJECT TEAM FOR AN EXCELLENT PRESENTATION.  
AS YOU CAN SEE BY THE ENCLOSED LETTER I  
FULLY SUPPORT THE PLANNED ACTIVITY.

ALSO, I WOULD LIKE TO REMIND YOU OF  
THE POSSIBILITY OF A LEAKING SANITARY SEWER  
BEHIND 206 AND 208 CINDER RD. MANY YEARS  
AGO ERROSION ALLOWED THE STREAM BANK TO  
SLIP CAUSING THE SEWER PIPE TO SAG AND  
LEAK. THE BACK FILL AND RIP RAP FIX HAVE  
NOW SLIPPED AGAIN AND THERE IS OCCASIONAL  
EVIDENCE OF RAW SEWAGE LEAKING INTO THE  
STREAM.

PLEASE EXTEND MY THANKS TO THE  
TEAM AND CONGRATULATIONS ON A FINE  
PRESENTATION. I WISH YOU COMPLETE SUCCESS.

VERY TRULY YOURS,

J. R. Zarfoss, P.E.

J. R. ZARFOSS  
207 COLD BROOK RD  
TIMONIUM, MD 21093

U.S. ARMY CORPS. OF ENGINEERS, BALTO DISTRICT  
P.O. BOX 1715  
BALTIMORE MARYLAND 21203-1715

REFERENCE

SPRING BRANCH STREAM RESTORATION 96-61250-1  
ATTN: MR. D.W. ROESKE, CHIEF REGULATORY BRANCH

DEAR MR. ROESKE,

I ATTENDED A TEAM PRESENTATION OF THE PROJECT TO RESTORE SPRING BRANCH ON MARCH 27 AND WAS IMPRESSED BY THE THOROUGHNESS AND ATTENTION TO DETAIL. I HAVE LIVED ADJOINING THE STREAM FOR 38 YEARS AND THEIR DEFINITION OF THE PROBLEM APPEARS TO ME TO BE ON TARGET. THE EXAMPLES OF PRIOR WORK AND THEIR CONFIDENCE THAT THE PROPOSED SOLUTIONS ARE CORRECT FOR THIS SITUATION CONVINCED ME THAT THE PROJECT SHOULD RECEIVE THE SUPPORT OF THE COMMUNITY. I BELIEVE THE PROJECT IS WORTHY OF YOUR APPROVAL.

THANK YOU FOR YOUR CONSIDERATION.

J.R. Zarfoss, P.E.

C.C. C.Y. LIEN



March 11, 1997

The Honorable C.A. "Dutch" Ruppertsberger  
Baltimore County Executive  
400 Washington Avenue  
Towson, Maryland 21204

Dear Dutch:

Just wanted to let you know how thrilled I am with the outcome of Spring Branch so far and apologize for being so remiss in thanking you.

I really appreciate you getting the "ball rolling" last year I think everyone who has been involved has done a great job!

I would like to commend George Perdikakis, Candy Szabad, Tom Vidmar, and of course, Doug Riley, for all of the time and effort they have put into this restoration project of Spring Branch. They couldn't have been more helpful, cooperative and informative throughout these past few months. They are great people and I would think that you would be proud to know they are on your Baltimore County "team"!

I am really looking forward to the arrival of spring so I can the new trees and greenery on my new "waterfront property"!

I assume by now that you are off of the crutches and are moving along rather rapidly. Once again, thanks for your input and am looking forward to seeing you sometime in the near future.

Sincerely,



Mary Lee Sas

MLS:m

If you need any help when campaigning begins, do not hesitate to give me a call.

cc Tara Oursler  
Bob Barrett

March 28, 1996

Baltimore County  
Dept. of Environment Protection  
and Resource Management

Attn: Candace Szabad

Dear M's Szabad,

My wife and I attended the community meeting on March 27, at Dulaney High School, regarding the restoration of the Spring Branch tributary. I talked with other home owners after the meeting about the issue, and, with only one exception, heard only favorable comments for the plan. Additionally, everyone said the presentation was clearly made, easy to understand, and that the question and answer period went rather well, also.

Good Job.

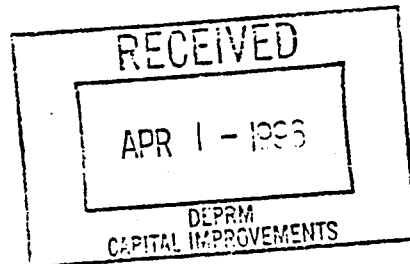
Now - let's get the bids in and move on this project

Yours truly,

*Bruce Numbers*

BRUCE NUMBERS  
217 COLDBROOK ROAD  
TIMONTUM, MD. 21093

BRUCE NUMBERS, M.S.  
SUITE 209C (410) 764-4210  
6776 REISTERSTOWN ROAD  
BALTIMORE, MD 21215



March 11, 1997

The Honorable C.A. "Dutch" Ruppertsberger  
Baltimore County Executive  
400 Washington Avenue  
Towson, Maryland 21204

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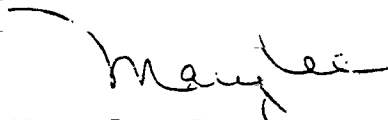
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Sincerely,



Mary Lee Sas

MLS:m

If you need any help when campaigning begins, do not hesitate to give me a call.

cc Tara Oursler  
Bob Barrett



FEB

THE COX COMPANY

Planners • Landscape Architects  
Civil Engineers • Urban Designers

January 27, 1997

Ms. Candace Szabad  
Baltimore County Department of Environmental Protection  
and Resource Management  
401 Bosley Avenue, Suite 416  
Towson, Maryland 21204

Dear Candace,

Thank you for your tour of the Spring Branch Stream Restoration Project this past Wednesday, and for fielding our inquiries related to stream restoration. The Spring Branch project was exemplary, and incorporated many of the bio-engineering techniques we had hoped to see. Having the opportunity to view a recent installation was important to our understanding of the construction details and their specific applications.

As we mentioned, the local restoration project we have undertaken has many streamside situations similar to Spring Branch, and we plan to incorporate bio-engineering techniques into the plan. We are convinced of their environmental suitability, and excited about the prospects for Rock Creek.

We would like to plan a visit to Spring Branch again once the installation has been through a growing season, and so will contact you perhaps in late summer. We would also be interested in the availability of the video being produced detailing the bio-engineering approach used for Spring Branch.

We wish you the best in your work on future projects, and thank you once again for meeting with us.

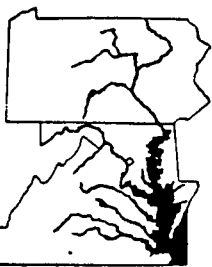
Sincerely,

A handwritten signature in cursive script, reading "Linda Winecoff".

Linda Winecoff

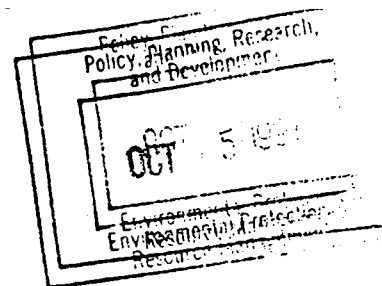
A handwritten signature in cursive script, reading "Fred Missel".

Fred Missel



# CHESAPEAKE BAY LOCAL GOVERNMENT ADVISORY COMMITTEE

416 GOLDSBOROUGH STREET  
EASTON, MARYLAND 21601-3611  
(410) 822-9630 (800) 446-5422  
(410) 820-5039 (Fax)



October 13, 1997

Mr. George Perdikakas  
Director, DEPRM  
401 Bosley Avenue, Suite 416  
Towson, MD 21204

Dear Mr. Perdikakas,

On behalf of the Chesapeake Bay Local Government Advisory Committee (LGAC), am pleased to inform you that Baltimore County is a 1997 recipient of a Local Government Advisory Committee's *Award for Community Innovation*. Congratulations! Your project indeed makes a worthwhile contribution to the protection and restoration of the Chesapeake Bay, its rivers, and streams.

This year, eight communities are receiving Awards:  
**Stormwater Management Program**, Hanover County, VA  
**Oyster Gardening**, Tidewater RC&D, VA  
**Targets of Opportunity**, City of Alexandria, VA  
**"Ecowise Program"**, Montgomery County, MD  
**Emergent Grass Re-Vegetation Program**, Anne Arundel County, MD  
**Spring Branch Restoration Project**, Baltimore County, MD  
**Spring Meadow Recreational Parcel**, South Middleton Township, PA  
**Lititz Run Watershed Alliance**, Lititz, PA

In recognition of your effort, I would like to invite a representative from your office to attend the next LGAC meeting at which time the award will be presented. The meeting will take place on November 20 in Annapolis, MD. Please contact LGAC staff at (800) 446-5422 with the name(s) of your representative and for information on the location of the meeting.

Congratulations and thank you for your involvement in the protection and restoration of the Chesapeake Bay! I look forward to presenting Baltimore County with its award on November 20.

With warm regards,

*Russell Pettyjohn*

Russell Pettyjohn, Chair  
Local Government Advisory Committee  
Mayor, Lititz Borough, PA

cc Eldon Gemmill

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Edward Sharp  
Mayor  
Takoma Park, MD

Harry Sikes  
Commissioner  
Adams County, PA

STAFF  
Tony Redman, Executive Director  
Kerry Hedeles

# SUMMARY SHEET

**Project:** Spring Branch Stream Restoration and Water Quality Retrofit

**Agency:** Baltimore County Department of Environmental Protection and Resource Management (DEPRM) - Director: George Perdikakas

**Objectives:** Create a stable flow regime; correct severe bank erosion and a stable, self sustaining stream channel; improve habitat and aquatic resources; reduce flooding, property damage and safety hazards; reduce pollutant loading to the reservoir and the Chesapeake Bay

**Project Management:** Candace Szabad-Project Manager; Chin Lien-Supervisor, Capital Improvements Section

**Location:** Timonium, Baltimore County, Maryland

**Watershed:** Loch Raven - Gunpowder Falls Watershed ; Tributary to Loch Raven Reservoir;

**Drainage Area:** 481 acres; Landuse is primarily small lot residential

A. 10,541 linear feet of stream restoration

B. Retrofit-creation of three shallow marsh basins, encasement of an exposed sanitary sewer line, removal of concrete channel bottom and realignment of storm drain outfall.

Stream Restoration: \$2.25 million

Water Quality Retrofits: \$208,000

**Funding:** Baltimore County Bonds, Maryland MDE Small Creeks & Estuaries Grant; MDE Stormwater cost share

**Time Lines:** Concept Plan: Spring 1992; Design 1994-1996; Construction: Fall 1996-Spring 1997; Monitoring: Five years planned beginning Fall 1997

**Status:** Construction -completed; monitoring - ongoing

## **Public Awareness & Education:**

SOS meeting & field tour; one large community meeting; one-on-one property owner visits; mailings; video; newspaper articles; homeowner survey

# Stream Restoration in Maryland Using Natural Geometry Approaches

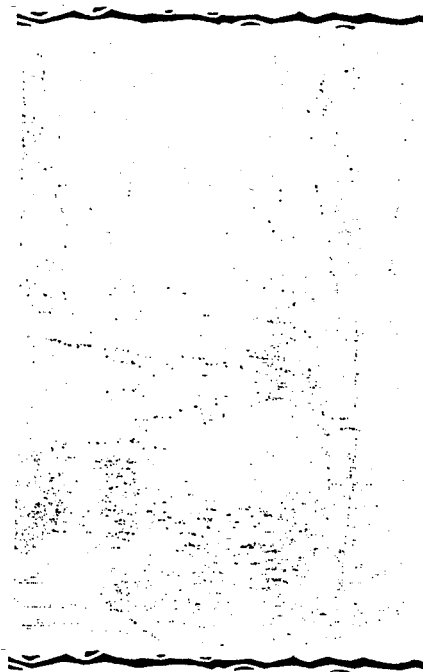
**Keith Bowers**

**Biohabitats, Inc., 15 West  
Aylesbury Road Timonium, MD  
(410-337-3659)  
Fax (410-583-5678)**

Urbanization, flood control, land clearing, and agricultural practices have extensively degraded and disturbed aquatic systems throughout the Northeast. In particular, urban development has a profound impact on stream hydrology, morphology, water quality, and biodiversity. The state of Maryland, recognizing the inseparable link between ecologically stable tributary streams and a healthy Chesapeake Bay, is striving for a comprehensive strategy to restore the tributaries of the Chesapeake Bay watershed.

Baltimore County has embarked on one of the most ambitious stream restoration programs in the Eastern U.S. to date. One of the highlights of their program is the restoration of Spring Branch which is located in the Piedmont Plateau physiographic province and drains nearly 500 acres to the Loch Raven Reservoir, a valuable drinking supply for the Baltimore Metropolitan Region. Over the last 50 years, the Spring Branch watershed has undergone intensive development. Today, the landscape is blanketed by many clone-like single-family homes on 1/4 to 1/2 acre lots serviced by standard curb and gutter roads. Impervious surfaces account for more than 50 percent of the watershed and due to the age of the development, stormwater management is absent, quite typical of the Northeastern suburban landscape.

Stormwater runoff is conveyed underground through storm drains, discharging directly into Spring Branch. On average, 25 percent of the area contributing stormwater runoff enters the stream via overland flow (non-point sources) and 75 percent via storm drain inputs (point sources). The large percentage attributable to point



sources suggests that the rate of storm runoff entering the stream channel can be generally described by short, rapid peak hydrographs. These commonly called "pulse inputs" tend to discharge storm water into the stream channel more rapidly and with a greater intensity than streams dominated by forested watersheds.

Anthropogenic influences in the watershed and to the channel are evident in the degraded physical appearance of the stream system. The channel has been enlarged through episodes of downcutting, lateral erosion, and aggradation. Both base and storm flows typically occur so as to maintain or reach an equilibrium that is in synchrony with watershed inputs.

The predominant component affecting channel morphology is the desynchronized, point source flow regime associated with seasonal storm events. Although not a direct influence on the existing channel structure, the broadened channel and eroding streambanks which are remnant features from earlier perturbations, inherently affect the overall stability of the stream system. Erosion from rushing storm water has carved a gorge 30 feet across

and up to 15 feet deep in Spring Branch. One long-time resident recently explained that twenty years ago, a person could "hop" across this channel.

Recognizing the need to protect water quality and aquatic biodiversity, Baltimore County retained Biohabitats to assess approximately two miles of Spring Branch and develop a management plan to restore a stable stream channel geometry, enhance water quality, and re-establish aquatic habitat.

In 1994, we began a two-year process of assessing the physical and biological conditions of Spring Branch. Using an applied fluvial geomorphological approach, Spring Branch was classified according to channel geometry relationships using the Rosgen Stream Classification system. This stream classification system establishes predictable, morphologic stream types based on the following variables: bankfull width to depth ratios, entrenchment, channel gradient, sinuosity, and sediment grain size. Stream classifications are predictable since these variables are interrelated; fluvial processes and channel morphology (i.e., pattern, profile, and dimension) evolve concurrently, resulting in a natural channel geometry that can be classified or recreated in restoration design. These components are integral to creating a stable stream channel in equilibrium with the surrounding lands, and facilitates the restoration of lotic aquatic life. This means of rehabilitation can be used on streams and rivers for various purposes, such as the stabilization of an eroding stream bank or a total channel and floodplain reconstruction.

From the classification information, Biohabitats then characterized stream channel cross sections, profile, and plan geometry. Stream substrate was characterized using the Wolman

(continued on page 3)

## SER Northeast Group Sponsoring Wetlands Restoration Conference

The SER's Northeast Group is supporting the Association of Massachusetts Wetland Scientists and New England Chapter of the Society for Wetland Scientists, together with the Rhode Island Association of Wetland Scientists, in holding a Wetland Restoration Conference focusing on forested wetlands, scheduled for March 15th. The conference agenda promises to be a very exciting day at the Holiday Inn in Foxborough, MA (northeastern MA, directly off I-495 and in close proximity to several ski areas) with a very reasonable registration fee which includes coffee, danish and a full lunch! The conference format and content will consist of specific topics, nuts and bolts discussions on vegetation, soils, microtopography, and hydrology in New England but applicable to other regions, too. The discussions will include information on both success and failures, providing insight on the dos and don'ts of restoration. Register early, as seating is limited! Please see the attached registration form on page 5 for further information. Hope to see you there!

## Rebounding Rockfish

Fish surveys conducted by Maryland's Department of Natural Resources (MDNR) of several major Chesapeake Bay rivers during 1996 have revealed record numbers of young-of-the-year (YOY) striped bass (*Morone americana*), signaling a continued successful restoration of this prized gamefish. Chesapeake Bay has long been known as a principal East Coast spawning and nursery area of the striped bass or rockfish", although Bay rockfish stocks plummeted during the late

(continued on page 6)

Pebble Count; streambank erosion was measured and rated; and dominant stream discharges were both field measured and collaborated with engineering hydrologic and hydraulic modeling performed by our sub-consultant KCI Technologies, Inc.

After conducting the field and assessment phases of the project, we concluded that Spring Branch had desynchronized, point source flow regimes; severe bank instability and subsequent erosion; failing or threatened infrastructures; lack of a vegetated riparian buffer; and poor land use practices in and adjacent to the stream. Despite the urban nature of the watershed, we also predicted that the recovery potential for this system would be high if the stream was given some effective assistance. We recommended that restoration efforts focus on restoring a stable channel morphology and correcting bank erosion. A wide array of solutions and techniques was presented focusing on a comprehensive restoration approach that targeted overall stream health.

Because stream systems are so intimately tied to physical, biological, and chemical processes that occur throughout a watershed, stream restoration, defined as a return to an original condition, is a complex and difficult task. Most so-called "stream restoration" projects are more properly considered attempts to rehabilitate selected sections of riverine systems to a predetermined structure and function.

Past restoration efforts have often focused on enhancing aquatic habitat without significant regard to stream hydrology or morphology. The majority of these projects eventually fail and many do not function as originally intended. What is needed is a comprehensive, holistic approach to stream rehabilitation that incorporates fluvial geomorphologic principles, natural stream dynamics, and applied ecology. This holistic approach to stream restoration has many benefits, including replication of natural hydrologic and ecological cycles, enhancement of riparian and in-stream aquatic habitat,

improved aesthetics, long-term sustainability, and significant cost savings over most structural solutions.

Baltimore County agreed and approved work to begin preparation of final design and construction plans for the restoration of the entire two miles of Spring Branch study reach. In general, Biohabitats' approach to stream restoration combines the disciplines of fluvial geomorphology, civil engineering, and applied ecology. Our approach depends on accurate identification of stream classification type, an understanding of hydrologic actions within the watershed and their effects on a stream channel, and clearly defined restoration goals. Although we utilize accepted hydrologic and hydraulic models and equations to determine stream discharges, water surface profiles and shear stress, our experience shows that accurate field observations of channel characteristics are required to accurately calibrate and corroborate modeling output.

Conventional practice suggests that the critical discharge for re-establishing a stream channel is the bankfull discharge. This discharge at a 1 to 2-year recurrence interval will occur more frequently as the watershed becomes more urbanized with increased impervious area. Therefore, Biohabitats calibrates and corroborates hydrologic modeling outputs with field measurements to ensure that reliable channel conveyances are used to predict and design a restored channel geometry.

Using ratios and measurements from reference stable stream reaches, hydraulic and hydrologic modeling, and design parameters developed from years of research by Dave Rosgen from Colorado, we set out to meet our objectives. Our design was constrained by many factors, including a 50-foot wide easement, sanitary sewer lines running the length of the project, large trees, overhead electric, telephone and cable television wires, 16 storm drain outfalls, existing concrete lined channels, and a skeptical neighboring community.

(continued on page 4)



The best approach moderating the flow regime was to reduce velocity and time of concentration of storm flows delivered to the channel. The place to achieve these objectives is essentially throughout the watershed, however, due to the built-out nature of the watershed, this was infeasible without disrupting existing land use, roadway, and storm drain networks.

Although generally less effective, flow regimes were slightly moderated through retrofit activities in the stream valley and stream channel, including :

- Create A/B step pool morphologies as the outfall channel
- Create plunge pools below pipe outfalls
- Place rip-rap in outfall channels and downstream of culverts
- Create catch basins to attenuate flow

The other approach for ameliorating the storm flow pulse regime was to provide floodplain access for bankfull discharges. This approach involved creating flood prone areas in sections of the channel that are currently entrenched by altering channel geometry. Channel reconfiguration typically involves modifying the cross-sectional and meander geometry to provide a more stable, efficient morphology and maintain stream habitat. In some cases, reconfiguration may involve creating an entirely new morphology, or correcting specific variable(s) that may not be in balance with the operation of the channel and flow regime. Channel modifications must reflect and be consistent with valley features, watershed inputs, adjacent land uses, and base and storm flows. For Spring Branch, this generally involved changing overly widened and entrenched sections of the channel so that they would allow bankfull discharge to enter a floodplain area.

In many cases, channel modification design efforts consisted of "tweaking" various aspects of the current geometry in order to facilitate natural recovery

efforts already underway. In other locales, a new channel and floodplain were designed to efficiently transport bed load and sediment load, and withstand storm flows. Sinuosity, bankfull width and depth, and entrenchment relationships of stable step-pool and pool-riffle morphologies were used as design references.

Once a stream cross section, profile, and pattern were designed, our attention turned to developing stream stabilization measures that not only supported natural stream geometry objectives but also provided aquatic habitat benefits. The use of innovative soil bioengineering techniques for stream rehabilitation support and compliment a holistic restoration approach such as Spring Branch. Various soil bioengineering techniques were applied to stabilize streambanks, augment aquatic habitat, and enhance biodiversity in Spring Branch including vortex rock weirs, root wad revetments, gravel riffles, step pools, meander bend pools, live fascines, live brush mattresses, live branch layering, and live joint planting.

Several meetings were held with the neighborhood community to explain stream ecology, and restoration concepts, construction logistics, and maintenance activities. Additionally, we asked for community input for certain design parameters including selection of riparian plantings. These meetings turned out to be a great success and generated overwhelming community support. Similarly, both federal and state regulatory agencies gave full support to the efforts.

In the summer of 1996, work began on the Spring Branch restoration. Coastal Design and Construction from Norfolk, Virginia was the successful contractor. Biohabitats was retained to provide construction review and observation, inspection, troubleshooting, preparation of As-Built construction drawings, and survey permanent cross sections for long-term monitoring. Site construction is expected to be completed by the end of January 1997.

It is interesting to note that the project has undergone three "bankfull" rain events since September, truly testing the design. Even though these events slowed construction progress, the storms turned out to be very beneficial from a design standpoint. We were able to observe how the new stream channel functioned during high flow events and were able to modify certain construction techniques to improve the overall design.

Overall costs associated with the restoration effort were high due to limited construction access and tight working conditions. A composite cost including assessment, design, permitting, construction procurement, construction, and a one-year plant material warranty amounted to \$200 per linear foot. Other projects we have been working on range in cost between \$25 and \$150 per linear foot, depending on the extent of the restoration and site constraints.

Baltimore County has six similar projects in the design phase and expects stream restoration to be a major focus of its capital improvements budget for some time to come. Biohabitats is currently working on at least 16 stream restoration projects for local, state, and federal agencies throughout the Northeast and Ohio River Valley.

In conclusion, a holistic, ecologically sensitive approach to stream restoration has many benefits, including replication of the natural hydrological and ecological cycles, enhancement of riparian and in-stream aquatic habitat, improved aesthetics, and significant cost savings over structural solutions. Biohabitats' objective is to create a stream system that is hydrologically stable, ecologically dynamic, and biologically diverse.

# SPRING BRANCH VIDEO TEXT

*Title: "Spring Branch: Restoring a Neighborhood Stream"*

Introduction to Spring Branch  
Connection to Loch Raven Reservoir  
Problems and Causes  
Priority for Stream Restoration  
Goals  
Stream Restoration Approach  
Stream Restoration Design Plan  
Construction  
The Completed Project/Benefits Gained  
The Citizen's Role

## TEXT

Spring Branch is an urban stream which has experienced severe bank erosion and instability for many years.

Spring Branch is located in the Timonium area of Baltimore County flowing generally eastward 2.84 miles from Timonium to the Loch Raven Reservoir.

The Loch Raven Reservoir is a source of drinking water for 1.5 million people in the Baltimore metropolitan region and part of the Chesapeake Bay watershed.

Stream erosion and urban stormwater runoff in Spring Branch have contributed sediment and nutrient pollutants to Loch Raven.

Since Spring Branch drains to the Loch Raven Reservoir, it is a high priority for water quality improvements.

The watershed of Spring Branch consists of many land use types including residential homes, schools, stores and other businesses, industry, roads and parking lots

Stormwater runoff over these land use types carry nutrients, toxic materials and sediment into the stream.

The following stream problems are found in many urban/suburban stream settings:

- Streambank and channel erosion. Sediment entering the stream increases turbidity, decreases reservoir water storage capacity, and smothers animal life
- Degraded water quality. Nutrients and toxins wash off lawns and home landscapes and into local streams. Water flowing over paved walkways, driveways and parking lots carries pollutants. Runoff carries loose soil, fertilizer, pesticides and oily residues into storm drains and streams. Grass clippings and other yard wastes wash into storm drains, drainage ditches, and streams adding too many nutrients and toxins to the water. Toxins kill fish and other life. Nutrient over-enrichment promotes the over-growth of algae, resulting in unpleasant odors in drinking water. As algae die and decay, water is robbed of vital dissolved oxygen, causing a dieback of life in the water.

Stressed streamside ecosystem. There is no vegetated streamside protective buffer zone and no tree cover. Grass is mowed up to the edge of the stream.

These problems are caused by:

- Actions on the land that contribute pollutants (nutrients, sediment, and toxins) to the water. People do not know how everyday actions at home affect the water in the neighborhood stream.
- Uncontrolled stormwater runoff from the large amount of paved surfaces in the watershed.

Baltimore County has designated the tributaries of Loch Raven, including Spring Branch, as a priority for stream restoration.

This priority is an overall commitment to protect water quality in the streams feeding the drinking water reservoir.

Baltimore County's goals in the stream restoration of Spring Branch were to stabilize the channel and reduce erosion, which will result in the improvement of water quality, and habitat.

To reach these goals, Baltimore County selected an approach that attempted to restore a natural stream channel by using native and natural materials such as tree root wads, logs, boulders, and live branch cuttings.

Native trees, shrubs, and ground covers were selected to establish a protective stream buffer on the land adjacent to the stream. The stream and buffer areas were surveyed and a detailed engineering plan was developed.

Community meetings were held to inform and educate the citizens living in the watershed.

Several property owners adjacent to the stream were contacted to cooperate in allowing construction equipment across their property in order to reach the stream

Once design plans were completed and permitted by the Federal, State and Local agencies, the County advertised for construction bids.

After an approved construction firm was selected, the project was underway.

The construction crews began the project in September of 1996.

The first task was to build the access roads to allow equipment to reach the stream.

During construction, the water flowing in the stream was pumped around the work area.

The crews then built the new channel as the equipment worked its way upstream or downstream.

The equipment operators and construction crews reconfigured the channel shape and size and installed the required bank protection measures and slope control features.

Pools and riffles were built in the new streambed. These features, in several locations replaced concrete channels that had been constructed years ago.

The rebuilt stream consist of a combination of sinuous or curved channels and rock step pools

Once the proper shape, size and pattern was constructed, the bank protection measures were installed.

To prevent streambank erosion and provide aquatic habitat benefits, the following measures were used in Spring Branch

**Root Wads** - Root wads are the root fan of a tree with approximately 10' to 12' of the trunk attached. The trunk is inserted into the bank so the fan is against the streambank. Root wads protect the streambank from erosion while providing habitat for fish and other riparian critters. Once the streambanks are planted with riparian vegetation, the root wads blend in with the vegetation and provide a very natural looking stable streambank. In several places root wads could not be used due to the proximity of utility lines. In these instances, rock boulders were placed along the streambank to provide erosion protection.

**Vortex Rock Weirs** - This structure is installed to create grade control and prevent the stream from downcutting. The weirs also increase the depth of the stream which provided for an efficient transport of sediments. The structure is designed to allow the energy from the stream flow to be concentrated in the center of the stream. This keeps the stress off of the banks which will prevent erosion.

2 **Step Pools** - Step pools are rock structures that were placed in the steeper sections of Spring Branch. These structures dissipate energy from stormwater runoff as the water cascades over the rocks.

3 **Bioengineering** - Various soil bioengineering techniques were applied to stabilize the streambanks. These include live fascines, live brush mattresses, and live branch layering

The live fascines consist of Willow and Dogwood stems and branches. They were tied together in long bundles and placed along the toe of the streambank.

Live fascines provide excellent erosion control protection.

The live brush mattresses also consist of Willow and Dogwood stem and branches, but are placed in a crisscross pattern on the slope of the streambank to provide erosion protection from stormwater runoff.

The live branch layering was used on the streambanks in several locations to provide erosion control

The live plantings are an excellent stabilization technique along streambanks. Slopes are stabilized quickly and the vegetation provides a cost effective approach while providing a natural and pleasing appearance.

4. **Riparian Buffer Plantings** - The area adjacent to the stream was planted with trees and shrubs and a mix of forbs and grasses. All of the vegetation utilized is native to the region and this particular watershed

The vegetation selected is primarily drought tolerant and disease resistant. Vegetation was planted on County property approximately 25 feet on both sides of the stream. This vegetated buffer is critical to the success of the stream restoration project.

Stream buffers provide significant water quality and wildlife benefits, as well as enhance the natural features of the community. The root system of the vegetation will assist in controlling streambank erosion, stormwater runoff and will reduce the amount of sediments and nutrients entering the stream.

The benefits of the Spring Branch project are many.

- Reduce nutrient and sediment loads to the Loch Raven Reservoir.
- A stable stream channel
- Restore eroded stream banks
- Protect adjacent property
- Increase riparian habitat
- Improve aesthetics - A natural looking environment
- Improve water quality in our drinking water supply.
- Improve aquatic life

The actions of the citizens is very important to the future success of the project.

- Keep trash and grass clippings and yard waste out of the stream
- Don't use pesticides and fertilize within 75' of the stream
- Don't mow the vegetated stream side buffer zone
- Don't over fertilize
- Plant more trees, shrubs and ground cover
- Divert downspouts to vegetated areas so the water can infiltrate into the ground.

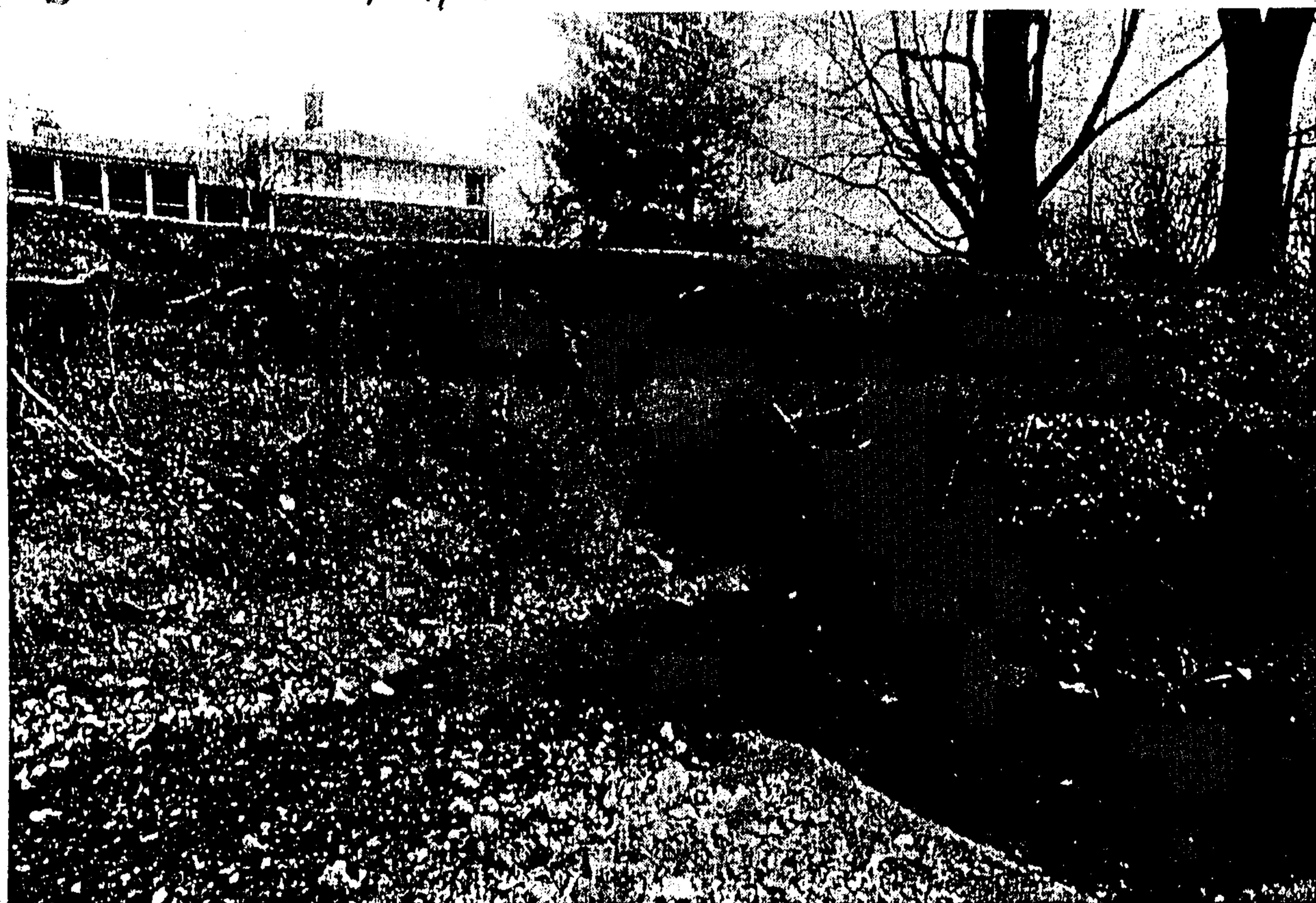


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KIM HAIRSTON: SUN STAFF

**Growing gap:** Surging water at the junction of Spring Branch and a tributary has caused serious erosion of lawns at Springside Drive. A meeting tonight will discuss a plan to re-create a natural meandering.

## Effort launched to tame stream in Timonium, restore meandering

Patchwork straightening of Spring Branch leads to destructive torrents

By SHERIDAN LYONS  
SUN STAFF

Residents along a Timonium stream are skeptical — but hopeful — that a trickle-turned-torrent behind their homes can be tamed by an ambitious plan to restore it to a natural state.

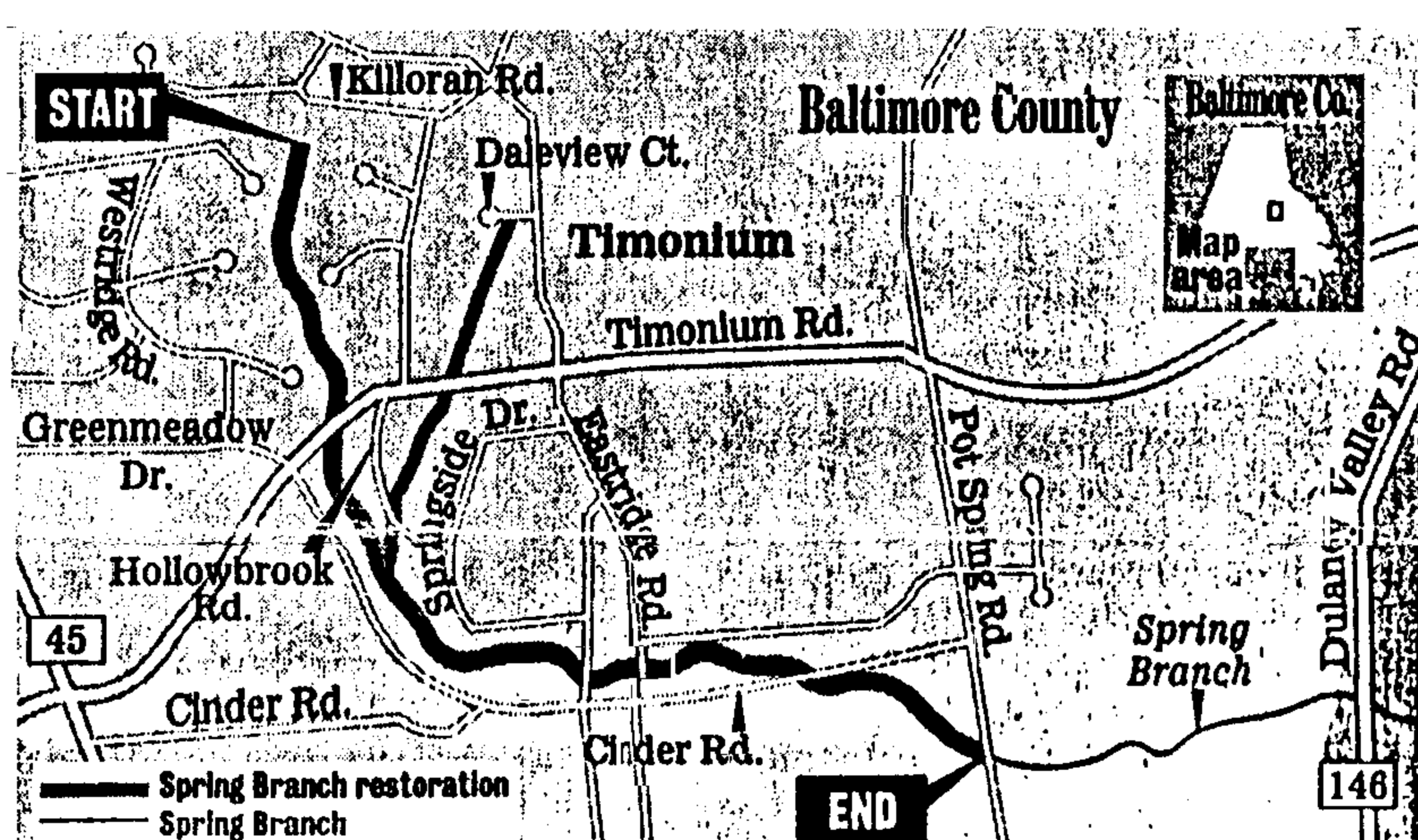
In a \$500,000 project jointly funded by the state and county, the natural meander of Spring Branch would be restored. Boulders and tree stumps would replace concrete chutes and years of patchwork repairs along a two-mile section.

Plans for the stream — which begins north of Timonium Road and flows south, then east beside Cinder Road and into Loch Raven Reservoir — will be explained at a meeting at 7:30 tonight at Dulaney High School held by the county Department of Environmental Protection and Resource Management.

The four-month project, planned to start in June, would begin near Killoran Road and end at Pot Spring Road and Deer Fox Lane, passing about 150 homes along Spring Branch and an unnamed tributary. These two streams meet south of Hollowbrook Road, between Springside and Greenmeadow drives — creating the most troublesome section.

At this junction, erosion from rushing storm water has carved a gorge about 10 feet deep and 15 feet across, and torn away chunks of lawn — along with shrubs and trees. Pieces of fence and oil drums lie among chunks of concrete that bear witness to previous, unsuccessful repairs.

On Springside Drive, Chandler and Betty Freund and Richard and Mary Ann Brown recalled



SUN STAFF

moving in about 30 years ago, when their children could walk down a gradual slope at the rear of their properties and hop across the creek.

"It was a trickle, less than 1 foot wide and 6 inches deep, when we moved here — 33 years ago this April," Mrs. Freund said.

Daniel Freeman, an engineer who moved in about three years ago, expressed concern about safety because water undercuts the stream bank behind his property, leaving dangerous overhangs.

"Our bank's probably the worst one," Mr. Freeman said. "A few years ago, we had a 6- to 8-foot section drop all at once off the yard."

Mr. Brown met John J. Smialkowski Sr. of Greenmeadow Drive as they commiserated over the widening gap between their two back yards, and tried to get the county to act. Mr. Smialkowski has been writing to his councilman since 1991 and went door to door with a petition about the problem several years ago.

Although reluctant to get his hopes up, Mr. Smialkowski said, "It's gotten worse. Whatever they can do to prevent it, I'm for it. I think it's a good idea not to use concrete, to keep the regular habitat."

Candace L. Szabad, a county natural resources specialist, said several concrete specialists would be removed in an attempt to get the streambed's depth and width back to a natural proportion. Storm water drains from as far north as Padonia Road, she explained, "and when it rains and all that water hits that concrete, it's like a flume there where it hits that bend."

She explained that the artificial straightening of the stream in years past increased the velocity of the water, unlike "a natural meander which slows the stream," she said.

In addition to restoring that meander, she said, a series of step pools will be created for the water flowing down the slope, and trees and shrubs will be planted to help stabilize the banks.

One who disagrees with the plan is Robert Johnson, who has lived for 25 years north of Hollowbrook Road, where manicured lawns slope gradually to one of the straight concrete chutes. He said he plans to attend the meeting and denounce the plan as "a waste of money."

Ms. Szabad said six similar projects are in the design stage. The most ambitious is White Marsh Run, including the main, north and south forks.

## Delegates reject bill to incinerator

Move is victory of Pulaski facility measure is per

By THOMAS W. WATSON  
AND C. FRASER SMITH  
SUN STAFF

In a victory for the incinerator owner, a House of Delegates committee yesterday that would have more to ban new trash incinerators.

The vote by the Environmental Matters Committee kills the bill for the legislature's session with proponents of a Senate bill that is "I'm very disappointed," Del. Peter A. Harrelson, a Democrat, said of the bill. "This operation having another incinerator in Baltimore City bringing the entire East Coast.

The House bill, which would ban the three delegates includes the Pulaski County Incinerator, would have given the city the right to ban the building of incinerators. The measure would have been passed in a January decision by the more County Circuit Court, which held that state law precluded the city from imposing such a ban.

The measure received 13 votes in the Environmental Matters Committee, two more than the number needed to pass. Nine delegates voted against the bill and two were absent.

The bill was sponsored by Mr. Hackerman, a Pulaski County Incinerator, and by the consulting firm of Turner & Associates. Lobbyist James J. Haney also was involved in the effort to ban shortsighted.

Baltimore County Commissioner Perry Sikas, who sponsored the measure, said that Hackerman wants to build a million East Baltimore incinerator, "large enough to burn trash from across the state will disrupt neighborhood and will add to the city's pollution, he said.

But Mr. Doyle said that he never really considered where he finalized the plan to do at the Pulaski County Incinerator to retrofit it with the latest technology and to waste-burning, or incineration.

Mr. Doyle added that the county does would have to meet all laws and regulations. Mr. Hackerman said that the Pulaski County Incinerator was built in 1981. The plant closed because the cost of operating to meet environmental standards would have been too high.

Though Mr. Doyle said that the city's disposal needs under its contract with the county recovery and energy company, Mr. Doyle said that it has sufficient capacity for the long term.

"The solid waste problem is no longer every year, but it's a constant effort by the city to deal with year waste disposal," he said. "The issue is whether we can handle it."

During committee hearings, Del. J. Anita Harrelson said that the issue was less than one of government. "The issue is whether we can handle it," she said.

Incinerators are a controversial issue in the city. The city's waste disposal plan for the next 20 years includes Pulaski County Incinerator.

During committee hearings, Del. J. Anita Harrelson said that the issue was less than one of government. "The issue is whether we can handle it," she said.

Incinerators are a controversial issue in the city. The city's waste disposal plan for the next 20 years includes Pulaski County Incinerator.

## Lawsuits allege builders deny access to disabled

Housing laws ignored in area, Balto. group says

By DENNIS O'BRIEN  
SUN STAFF

tion of the finer points of the fair housing law to know that this is a problem," said Mr. Levy as his wheelchair rested in the street, several steps below the Lions Gate sales office.

Mr. Levy said amendments to

by county building officials, who enforce housing codes.

"If the builder's architect and the county inspector review the plans and agree they're in compliance, we're not in a position to dispute that," said Steven Karen, de-

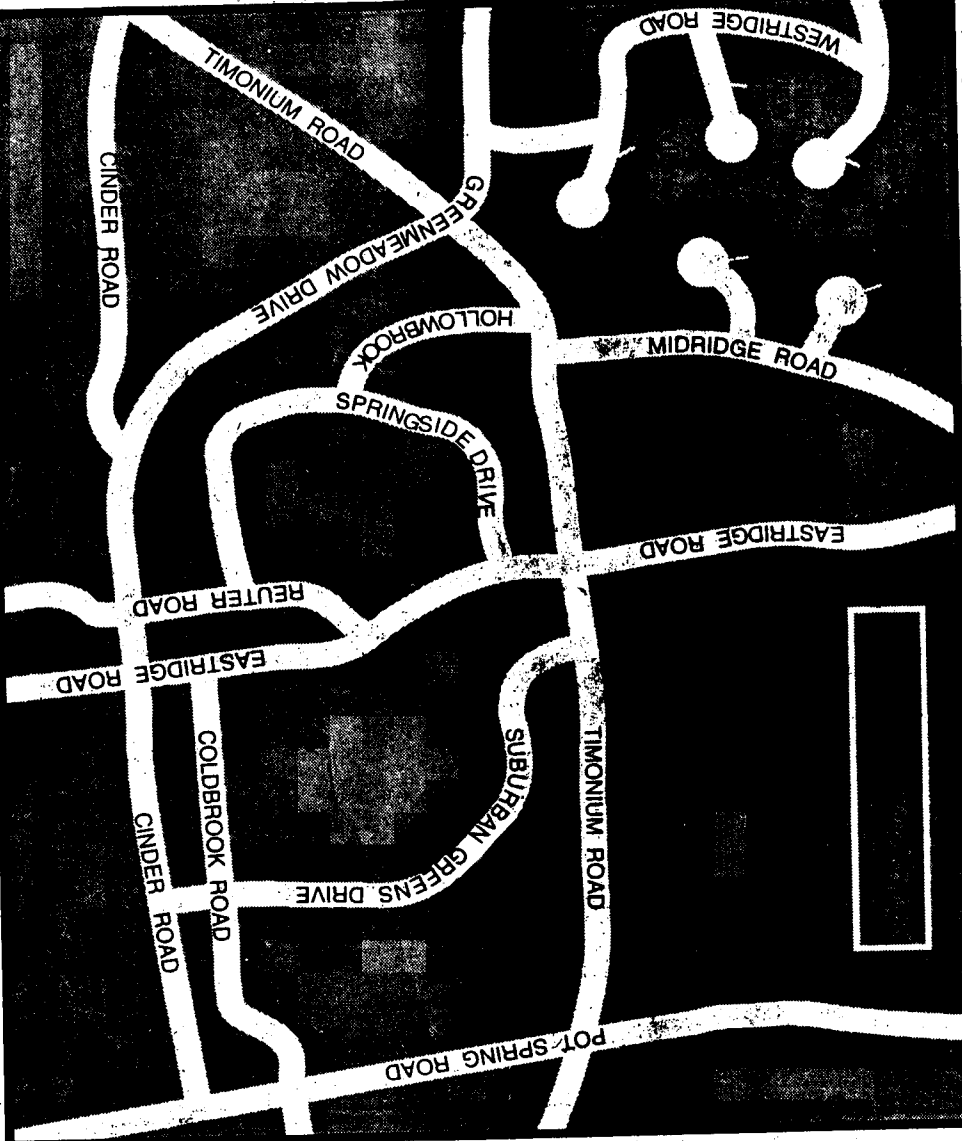
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# SPRING CLEANING

Spring Branch, a Loch Raven Reservoir tributary, runs through Timonium



SOURCE: BALTIMORE COUNTY DEPARTMENT OF ENVIRONMENTAL MANAGEMENT & REC. RCE PROTECTION

INFOGRAPHIC BY EILEEN STRAM

## County planning to restore stream

BY LONI INGRAHAM

Spring is a time of restoration but the restoration of Spring Branch won't begin until mid-June.

Meanwhile, Baltimore County's Department of Environmental Protection and Resource Management is asking for cooperation from adjacent property owners to get the job done more efficiently, quickly and cheaply.

Time and circumstance have forced this Timonium tributary of Loch Raven Reservoir to wander from its original course to the point where it is eating away adjacent private properties, according to DEPRM.

"There are 10-foot vertical undercuts in some places," says Chin Lien, supervisor for the department's capital improvements section.

The branch is a hodgepodge of temporary repairs and measures that have caused problems rather than solved them.

The Spring Branch project, which will cost at least \$500,000 and take at least four months, will begin in mid-June, assuming the county can get the permits required by the state and federal government, Lien says.

The work, which involves a two-

mile stretch of the branch from just below between Killoran Road to the culvert crossing for Pot Spring Road, should restore the branch to its original channel.

The result should be a stream that can handle the flow of water as well as support a wildlife habitat, he says.

During a public meeting Wednesday, March 27 at 7:30 p.m. in the Dulaney High School cafeteria, DEPRM officials will present their plan for the restoration in detail.

They are hoping that residents who live next to the stream will attend because they want residents will to the contractor permission to gain access to the stream bed via private property.

They are also seeking easements for grading, for the planting of trees — "for whatever needs to be done," says Lien.

The job still can be done without the permission of adjacent property owners, "but we prefer to have their permission," says Lien. "Without it, the work could be more difficult. I will take more time and escalate the cost."

For further information, call DEPRM on 887-2904.

3/20/96 Towson Times

# GAZETTE

Lutherville • Timonium • Texas • Cockeysville • Hunt Valley

Vol. 21, No. 5

November 1992

## Spring Branch Creek Is Headache For Neighbors

by Diane Carliner

To hear Dorothy and John Smailkowski tell it, what once were the bonnie banks of Spring Branch Creek in the Yorkshire section of Timonium have become a raging headache.

"It used to be a little leap," said Dorothy, as she looked down upon the rims of earth that have separated to a distance of eight feet over 15 or 20 years.

Dorothy also said that the creek, which flows past her backyard, "sounds like a river" in a hard rain. She described the problem a neighbor had when his basement flooded six times. Then she pointed to the runoff ditch, constructed by the county at the edge of her property, which contributes to the overflow of the creek by funneling to it water collected from the street.

"I'm afraid my grandchildren can fall in," said her husband John, who is known as an activist on the subject of the stream.

"What concerns the neighborhood," he said, "is that the monies were there. No one knew the money was taken for other projects. The stream is above the Loch Raven Reservoir and contaminates it. What could be a more important priority?"

Both Smailkowski and Harold Thompson, VP of the Yorkshire Community Association, said that through the years, there has been a lot of passing the buck. If a tree fell, the county would say it was the responsibility of the Balto. Gas and Electric Co. BG&E said the cable company should take care of it, and the cable company said the county should take care of it.



(photo courtesy of John Smailkowski)

*Flooding in Spring Branch Creek causes erosion. Here a bankside tree has fallen into a resident's fence.*

According to the sanitary conditions, and Smailkowskis, neighbors have floodwaters that almost reach sighted large rodents, an infestation of insects caused by un-

### What's Inside?

**Know Your Council District.** See Maps and Comments on page 4

**Curious Camera** interviews. See page 5

**When Confederate Cavalry Thundered Along York Road** See page 6

**GAZing At Kathleen Beadell** See page 7

**Singles Scene** happenings on page 8. Also see **Singles Personal Ads** on page 22

**Dinner Theatre Review of 'The King & I'** see page 9



## Creek (continued from p. 1)

"I haven't had much to do with politics, but I'm getting a taste of it," said John. He added that it was "highly unusual" and welcome when he

called the county last month to complain about a fallen tree and someone came to remove it within a week.

### Funding

Thompson also said he was curious about where the money went that was allocated for correcting erosion, flooding, and pest problems caused by the creek in its present condition. He said that 40 to 45 homes have been affected, and that although there has been a lot of talk and sympathy coming from the county, he is still waiting for action.

Both Smialkowski and Thompson are aware that the difficulties existed long before the current budget crunch. Problems with the creek continued to build through the low-keyed Donald P. Hutchinson administration and the extravagant years of 1986-90 when former County Executive Dennis F. Rasmussen spent millions refurbishing the county courthouse, including sandblasting, tearing out grey marble walls and replacing them with red marble, digging up the courthouse lawn three times, curving straight cement walkways, and ordering the planting of exotic and expensive blooms.

Although the county now has severe financial constraints due to the cutoff of large amounts of state funding, Councilman Doug Riley (R4), who was first elected to the County Council two years ago, said, "I'd really like to do something about it [the creek]. There is still money for this project."

### Work Planned

Donald Outen, Bureau Chief of Water Quality and Resource Management, said that work should begin on the project no later than June of

1993, and that a very rough advance notice cost estimate would be \$1/2 million. The project will take two to three years to complete.

"I hope the restoration of Spring Branch Creek will be a prime example of the new methods of stream restoration. As the county is at the leading edge of new technology concerning waterway improvement programs, we are proceeding in the most effective manner.

"To be most effective, the work on the Essex creeks, which lead into the Chesapeake Bay and which were started some time ago, must be completed in sequence before we can start work on Spring Branch Creek. Approximately 37% cutbacks in state funding both this year and last have contributed to delays, and we want to make sure that when using the new, environmentally sensitive, more natural, more ecological and more cost-effective methods, that everything is done properly," said Outen.

Both Kathleen Beadell, President of the Yorkshire Community Assoc., and Harold Thompson, VP, warn neighbors not to put any grass clippings, leaves, branches, or anything into the stream, as dumping will cause jamming, flooding, and ultimately more erosion.

"I believe Roger Hayden and the county Dept. of Environmental Protection and Resource Management (DEPRM), truly care about this issue and will do whatever they can to help," said Beadell. "I hope Councilman Riley and DEPRM officials will come to our meeting on Nov. 17." #

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## ABSTRACT

### Major Points of Interest

- Urban stream restoration using natural stream geometry approaches
- soil bioengineering to stabilize stream banks
- design issues in an urban environment
- construction management
- post construction monitoring

Please consider this paper for the planned technical session on River Restoration; Rehabilitation of Urban Rivers, Streams, and Waterways

### **Spring Branch Stream Restoration - Using Natural Stream Geometry**

**Approaches** (Maryland), J. Keith Bowers, Biohabitats, Inc., 15 W. Aylesbury Road, Timonium, Maryland, 21093 (410)337-3659 e-mail: biohabitat.com

Urbanization, flood control, land clearing, and agriculture practices have extensively degraded and disturbed aquatic systems throughout the Northeast. In particular, urban development profoundly impacts the hydrology, morphology, water quality, and biodiversity of streams. Maryland, recognizing the connection between healthy streams and a healthy Chesapeake Bay, developed a comprehensive strategy to restore the tributaries of the Chesapeake Bay watershed.

Baltimore County has embarked on one of the most ambitious stream restoration programs to date. The restoration of Spring Branch is a hallmark of their program. Located in the piedmont plateau physiographic province, Spring Branch drains approximately 489 acres to the Loch Raven reservoir, one of several drinking supply reservoirs for the Baltimore metropolitan region.

Recognizing the need to protect water quality and aquatic biodiversity, Baltimore County retained Biohabitats to assess approximately two miles of Spring Branch and develop a plan to restore a stable stream channel geometry, enhance water quality, and reestablish an aquatic habitat. In 1994, we began a two-year process of assessing the physical and biological conditions of Spring Branch. Using an applied fluvial geomorphologic approach, we classified Spring Branch according to channel geometry relationships (Rosgen Stream Classification system). After conducting the field and assessment phases of the project, we concluded that Spring Branch had desynchronized, point source flow regimes; severe bank instability and subsequent erosion; failing or threatened infrastructures; lack of a riparian buffer; and poor land use practices in and adjacent to the stream. Despite the urban nature of the watershed, we believed that the recovery potential for this system was high, if the stream was given some assistance. We recommended that restoration efforts focus on restoring a stable channel morphology and correcting bank erosion. We presented a wide array of solutions and techniques, however, a comprehensive restoration approach that targeted the overall health of the stream system was selected as the preferred restoration strategy. In general, our approach to stream restoration combines the disciplines of fluvial geomorphology, civil engineering, and applied ecology. Using ratios and measurements

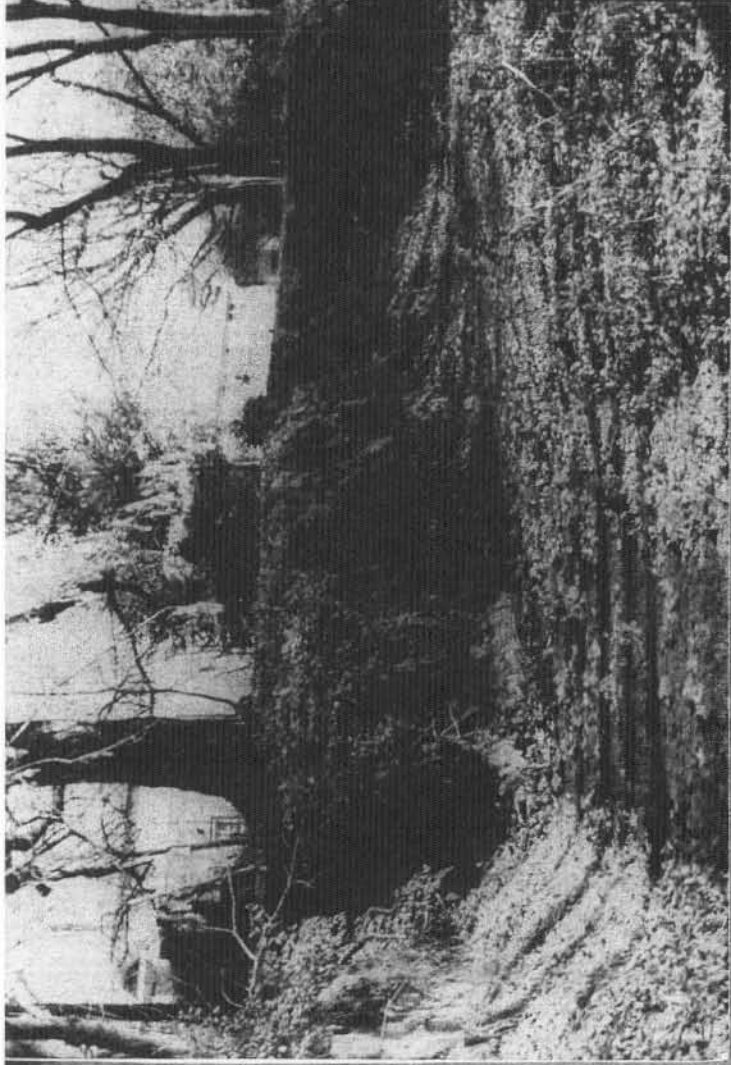
from reference stable stream reaches, hydraulic and hydrologic modeling, and design parameters developed from years of research, principles, and theories reported by Ingles, 1942; Leopold and Wolman, 1957; Langbein and Leopold, 1966; Leopold, Wolman, and Miller, 1964; and Rosgen, 1994 among others, we set out to meet our objectives. .

Once a stable stream cross section, profile, and pattern were designed, our attention turned toward developing stream stabilization measures that not only supported natural stream geometry objectives but also provided aquatic habitat benefits. The use of innovative soil bioengineering techniques for stream rehabilitation support and compliment a holistic restoration approach such as Spring Branch.

A holistic, ecologically sensitive approach to stream restoration has many benefits, including replication of natural hydrological and ecological cycles, enhancement of riparian and in-stream aquatic habitat, improved aesthetics, and significant cost savings over structural solutions. Our objective is to create a stream system that is hydrologically stable, ecologically dynamic, and biologically diverse.

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# SPRING BRANCH

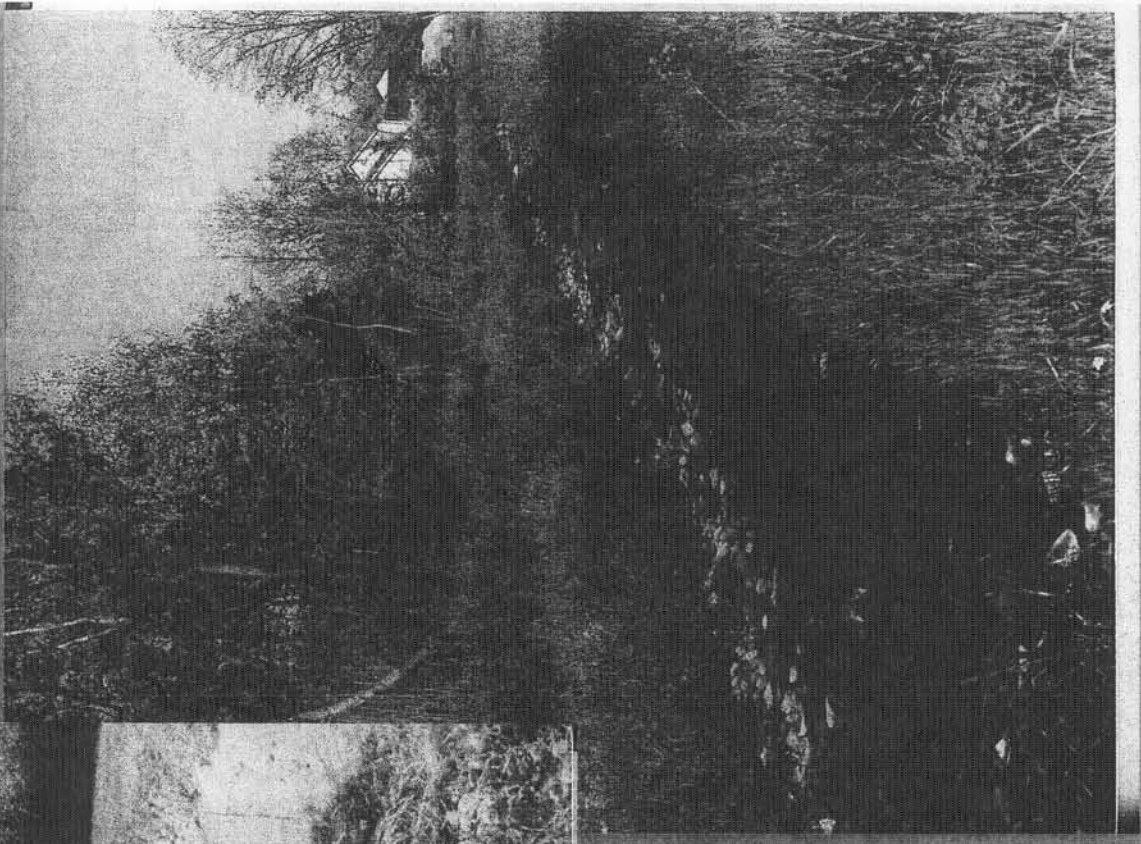


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BEFORE AND AFTER



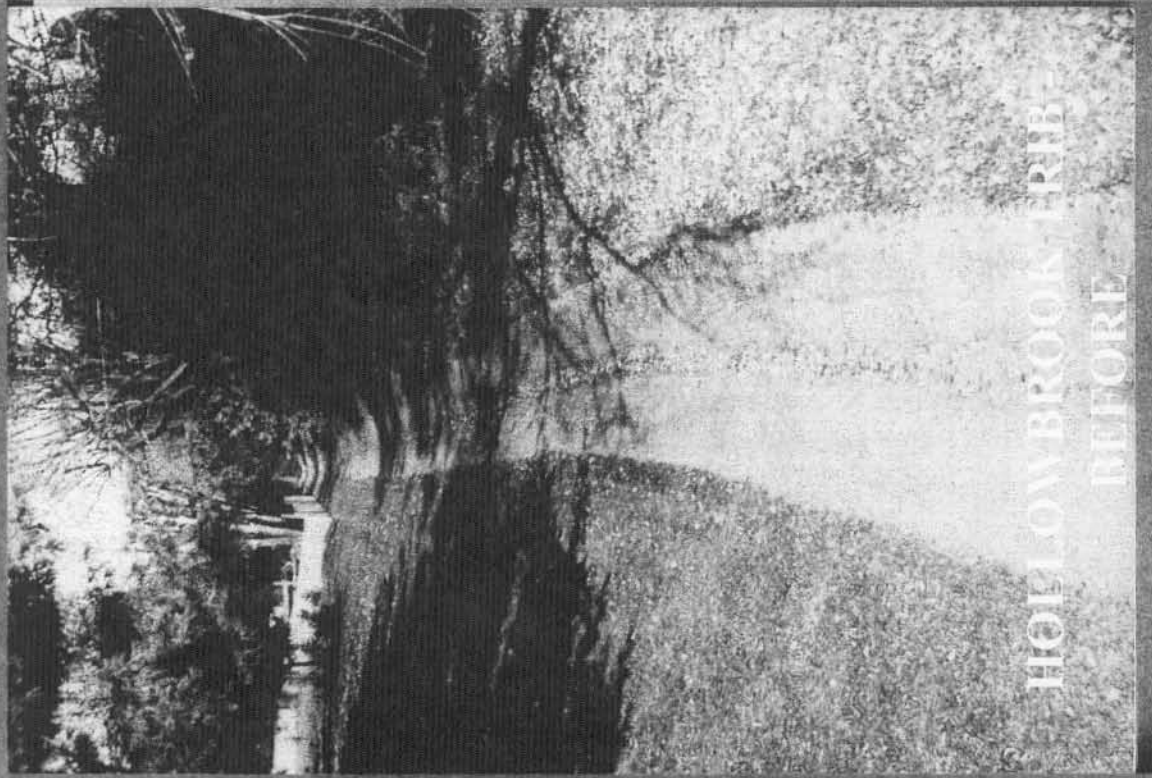
## SPRING BRANCH



MAIN STEM AT POT  
SPRING ROAD  
BEFORE AND AFTER



## SPRING BRANCH



**APPENDIX C**

**CHESAPEAKE BAY PROGRAM POLLUTANT LOAD  
REDUCTION EFFICIENCIES**

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

<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.

<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.

<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.

<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%
<b><i>Urban and Mixed Open BMPs (continued)</i></b>	<b><i>How Credited</i></b>	<b><i>TN Reduction</i></b>	<b><i>TP Reduction</i></b>	<b><i>SED Reduction</i></b>

<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.

		<i>Efficiency</i>	<i>Efficiency</i>	<i>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



<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
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