State of Our Watersheds

The 2010 Watershed Conference for the Baltimore Region

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Baltimore DPW
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A. WATERSHEDS BACKGROUND

A watershed is an area of land in which all water, both above and below ground, drains to one location—either a stream, river, lake, bay, or ocean. Watersheds are bounded by hills or ridges. The streams within the watershed that are at the highest elevation are called the headwaters. The water from these headwater streams flow down through the rest of the watershed to larger streams and rivers, and eventually flow into a lake, bay, or ocean.

Baltimore County and Baltimore City have 14 major watersheds with numerous streams and rivers, all of which ultimately flow into the Chesapeake Bay. Four of the watersheds have portions in both Baltimore County and Baltimore City: the Gwynns Falls, Jones Falls, Back River, and Baltimore/Direct Harbor Watersheds. The remaining ten watersheds, while extending beyond Baltimore County, have portions in Baltimore County but not in Baltimore City: the Deer Creek, Prettyboy Reservoir, Loch Raven Reservoir, Lower Gunpowder Falls, Little Gunpowder Falls, Bird River, Gunpowder River, Middle River, Liberty Reservoir, and Patapsco River Watersheds. The Patapsco River Watershed has proportionally only a very small amount of drainage from Baltimore City and will be included with the ten watersheds outside the City for purposes of this report. The Lower Gunpowder Falls, Bird River, Gunpowder River, and Middle River Watersheds lie entirely within Baltimore County. The remaining County watersheds have portions beyond Baltimore County.

The water flowing through a watershed is greatly influenced by land-based activities within the watershed, such as agriculture, loss of trees, and urbanization. During development, land is cleared and paved, impacting local streams. These streams, which once flowed freely, may be lined with concrete or even buried underground. As a result, the watershed can be vastly altered. The health of the Chesapeake Bay is dependent upon the activities occurring within these 14 watersheds as well as the other watersheds within the Chesapeake Bay drainage. The Baltimore region is highly urbanized, with development extending well beyond the City limits. Much of the development in Baltimore County is constrained by the Urban-Rural Demarcation Line (URDL). Two thirds of the land in Baltimore County is outside the URDL, while only 10% of Baltimore County residents live outside the URDL. The URDL is instrumental in Baltimore County's growth patterns and protection of agricultural lands and reservoir watersheds. The Loch Raven, Prettyboy, and Liberty Reservoirs, which lie predominantly within Baltimore County, serve approximately 1.2 million people with drinking water. These reservoirs are owned by Baltimore City.

B. LAND USE AND WATERSHED HEALTH

Urbanization is the single most significant threat to the health of the Baltimore County and Baltimore City watersheds. Its effects are also under our control. To understand the threats to our local watersheds, we must first understand the threats posed by urbanization.

The drastic alterations of watersheds resulting from urbanization have many negative consequences for streams. Streams in urban areas placed into concrete channels or buried underground lose many of their natural ecosystem functions. These ecosystem functions include the processing of nutrients and pollutants and flood mitigation.

Pollutants can enter streams from several different pathways as a result of urbanization. Examples of these pathways include the direct discharge of industrial wastes or wastewater effluents to streams; the application of fertilizers, pesticides, and herbicides to land; and the

combustion of fossil fuels, which produces particulates that are suspended in the air and get washed out and into streams when it rains. Another predominant pathway in which pollutants can enter streams is through stormwater runoff. Urbanization causes much of the land to be covered by roads, parking lots, sidewalks, and buildings, which are called impervious surfaces. Rain flows over these impervious surfaces, picking up pollutants that have been deposited on the surfaces, and eventually flows into nearby streams. Stormwater runoff also poses threats to watersheds from its erosive velocities and potential to cause localized flooding and stream channel erosion.

In addition to urbanization, another threat to water quality is agriculture. Approximately two thirds of Baltimore County is rural. The main impact from agriculture is the increased input of nutrients to streams from fertilizers and livestock. Increased soil erosion from agricultural activity can also increase the amount of sediment and phosphorous entering streams. In some cases, forest cover may be cleared to make room for agriculture in the same manner it is cleared during urbanization.

Water Quality Stressors

Urbanization and agriculture are associated with many factors that put stress on streams and negatively affect the water quality. These water quality stressors may include impervious cover, nutrients, sediments, loss of riparian vegetation, loss of forest cover, road salt, and temperature. By monitoring these stressors within various streams throughout each watershed, we can assess the extent of damage urbanization and agriculture has caused to each watershed.

Impervious cover

Any surface through which water cannot penetrate would be considered an impervious surface; examples include roadways, parking lots, sidewalks, and buildings. Watersheds that are not impacted by development have very little, if any, impervious cover. However, as development increases, so does the impervious cover. When it rains, water will not be able to soak into the soil as it would on a natural landscape. When rainwater is allowed to soak into the earth, many pollutants that are carried with it are filtered by the soil. The rainwater recharges the groundwater supplies and is slowly fed back into the local streams. In the presence of impervious surfaces, however, rain flows into storm drains, which dump stormwater runoff directly into streams. This stormwater runoff washes pollutants off impervious surfaces and carries them into streams.

Nutrients

Nitrogen (N) and phosphorus (P) are considered essential nutrients for the life of any plant or animal. Natural, undisturbed streams have some amount of these nutrients dissolved in the water. However, urbanization causes the amounts of these nutrients in streams to increase, which is a process called eutrophication. The application of fertilizer is one of the biggest sources of increased N and P to streams. P tends to stick to soils, so any process that increases erosion and the delivery of soils (or sediments) to streams will also increase P levels. Stream bank erosion also increases the delivery of nutrients to streams. Another source of N to streams is the combustion of fossil fuels, which cause particulate forms of N to be emitted in exhaust of vehicles or through smokestacks of power plants and other industrial sources.

These particulate forms of N end up in the atmosphere or are deposited on surfaces. As it rains, the particulate N gets washed out of the atmosphere and off the surfaces and ends up in streams and rivers. Rural sources of nutrients to streams include agriculture and septic systems. Agricultural activity can increase the amount of N and P in streams due to application of fertilizers and soil erosion. Septic systems often leak nutrients, which are discharged to nearby streams. Additional sources of nutrients to streams include pet and livestock waste that is not disposed of properly.

Due to the limited size of streams within Baltimore County and City, which are mainly smaller than 5th order streams, nutrient impacts to these small streams are limited. However, the nutrients exported from all of these small streams collectively have a major impact on the receiving waters, such as reservoirs and tidal waters.

Sediments

As land is cleared for development, the soil is disturbed. Plants and trees that had previously held soil in place are removed. When it rains on land that has been cleared, the disturbed soil is washed into streams, where it is called sediment. Urbanization increases the amount of water that flows in streams because of increased stormwater runoff. Increased water volumes within the streams, along with the increased speed at which stormwater flows, cause the banks to erode, further increasing sediment loads. In addition, agricultural activity can increase the amount of sediments in streams due to soil erosion from fields. Sediments in the stream cause the water to appear cloudy or even muddy if large amounts of sediments reach the water. These sediments will eventually settle out of the water column onto the streambed. The major impact of sediments to streams is embeddedness, which refers to the degree to which larger particles such as boulders and cobbles are buried by finer sediments; this puts stress on benthic (bottom-dwelling) organisms.

Turbidity is a measurement of the amount of suspended solids, which include sediment, that are in the water. Natural, undisturbed larger streams and reservoirs have a certain level of turbidity that results from algae and suspended animals, called plankton, within the water column. However, as more land is disturbed for development or as the stream banks erode away, the turbidity will increase. Once the turbidity levels become too high, sunlight may not be able to penetrate the water and underwater plants, called submerged aquatic vegetation, or SAV, which require sunlight to grow, will struggle to survive. These impacts of sediment loading and turbidity are especially important in tidal waters, which have high amounts of SAV. These SAV are essential to the health of water bodies as they supply the dissolved oxygen and shelter necessary for many organisms such as fish and shellfish. Much of the sediment in turbid waters will also settle on the streambed, where it puts stress on the organisms that use the streambed for habitat or for laying their eggs.

Loss or Disconnection of Riparian Vegetation

Natural streams have trees and other vegetation along much of the banks. This vegetation, called riparian vegetation, provides benefits to the stream. Benefits include an uptake of nutrients that would otherwise end up in the water, shading of the stream to prevent water temperatures from becoming too hot, and trapping of soil to prevent sediment from entering the water. Riparian vegetation can filter out other pollutants in addition to nutrients before they reach the stream.

Urbanization and agricultural practices often result in the loss of this vegetation to make room for development, transportation, and agriculture. Another effect of urbanization is that the riparian vegetation can become disconnected from the stream. In a natural landscape, water flowing off land surfaces and from shallow subsurfaces into streams is filtered by riparian vegetation and their roots. However, as development occurs and runoff is put into pipes that dump directly into streams, the runoff will bypass the riparian vegetation and will not be filtered. Another way in which the stream can become disconnected from the riparian vegetation is the conversion of natural streambeds to concrete channels. The roots of the vegetation along the banks will no longer interact with the streamwater. Stream channels can become incised over time due to the erosive forces of stormwater runoff, which also disconnects the stream from the riparian vegetation.

Loss of Forest Cover

Forest cover throughout the watershed serves to limit nutrient export to streams because much of the available N and P is used for plant growth. Forest cover also helps to prevent sediments from eroding during storms. However, when portions of a watershed are cleared to make room for development during urbanization or for agricultural activity, there is an increase in the amount of nutrients and sediments that reach the streams. Forests use water from soils for plant growth in a process called evapotranspiration. Therefore, loss of forest cover also increases the amount of water that reaches the streams because less water is taken up when there are fewer trees in the watershed.

Road Salt

In the United States, road salt (sodium chloride) is applied to roads during the winter to melt snow and ice. Much of this road salt gets washed off and can eventually end up in streams, ponds, lakes and reservoirs and in the sediments of these water bodies. Because salt can build up in soils surrounding streams, remaining there for years, it can periodically flush into the streams when it rains. Excess salt can seep into groundwater and run into reservoirs affecting the taste of drinking water. Additionally, sodium chloride can exacerbate hypertension.

Temperature

Temperature is an important regulator of many biological functions. Reaction rates for biological processes of plants and organisms, such as metabolism and respiration, are increased by warmer temperatures. In natural streams, shading from riparian vegetation acts to maintain water temperatures within a certain range. If this vegetation is removed, temperatures will likely increase as a result of the increased sunlight hitting the water. Stream temperature can also be affected by the runoff that enters the streams from impervious surfaces. This runoff is often warmer than the stream water. In addition, industrial areas may discharge warmer waters directly to streams.

Temperatures above a certain range will put stress on the organisms within the stream, not just because of intolerance to higher temperatures, but also because of its affects on dissolved oxygen. Warmer waters are less capable of holding dissolved oxygen. In addition, as temperatures increase, algae and plants grow faster. However, they also die more quickly and consume oxygen as they decompose. High turbidity levels within the water can also cause an

increase in stream temperatures because the sediments in the water absorb more sunlight than clear water.

Water Management Programs for Developments/Redevelopments

Since the early 1980s, there have been a number of programs implemented in an attempt to manage stormwater runoff from development and redevelopment sites. The goal of these programs is to minimize the adverse impacts of development on water quality in streams and reservoirs. Some of these programs include:

- **Chesapeake Bay Critical Area Program**—The Critical Area Act of 1984 addresses the impacts of upland development on aquatic habitats and resources. The law identifies the "Critical Area" as all land within 1,000 feet of the Mean High Water Line of tidal waters or the landward edge of tidal wetlands and all waters of and lands under the Chesapeake Bay and its tributaries. The Act requires local jurisdictions to establish land use programs directed towards the Critical Area that meet the goals of minimizing adverse impacts on water quality resulting from direct (point source discharges) and indirect (surface runoff) pollution discharges; conserving fish, wildlife, and plant habitat; and establishing land use policies for development within the Critical Area. This program accommodates growth but also addresses the associated potential adverse environmental impacts associated with it.
- **Baltimore County Urban-Rural Demarcation Line (URDL), County Comprehensive Plan and County Master Plan**—Baltimore County established the URDL in 1967 to distinguish which areas were expected to require infrastructure development and which were expected to remain rural (and therefore development would be limited or discouraged). Some areas that were expected to require infrastructure development were established by the (1975) Baltimore County Comprehensive Plan. This required protection for the rural parts of the county, while improving efficiency of development in growth areas. Using the URDL and the established growth areas as guidelines, the Baltimore County Master Plan (1989-2000) created land management areas that include agricultural preservation areas and resource preservation areas. The Smart Growth Program, Rural Legacy Program, and Priority Funding Area Program were established in 1997 with objectives including the preservation of natural resources and encouragement of development within the urban and growth areas. The URDL is instrumental in planning for growth within Baltimore County while protecting agricultural lands and reservoir watersheds.
- **Sediment Control**—A statewide sediment control program was mandated in 1970 with the passage of the Sediment Control Law. The sediment control program requires an approved plan for any earth disturbance of 5,000 square feet or more and 100 cubic yards or more; plan approval exemptions include agricultural uses. The Erosion and Sediment Control regulations specify the general provisions for program implementation; provisions for delegation of enforcement authority; requirements for erosion and sediment control ordinances; exemptions from plan approval requirements; requirements for training and certification programs; criteria for plan submittal, review, and approval; procedures for inspection and enforcement; and applicant responsibilities. The Maryland Department of the Environment 1994 Standards and Specifications for Soil Erosion and Sediment Control establishes the minimum criteria for effective erosion and sediment control practices.
- **Maryland Stormwater Management Program**—The Storm Water Management (SWM) Act of 2007 requires that environmental site design (ESD), through the use of better site design

techniques, alternative surfaces, nonstructural techniques, and micro-scale practices, be implemented to the maximum extent practicable. Charged with implementing the Act, the Maryland Department of the Environment (MDE) has adopted new regulations and updated the Stormwater Design Manual. The Maryland Stormwater Management Regulations specify the minimum content of the county and municipal stormwater management ordinances, and the responsibilities of the MDE regarding the review of the county and municipal stormwater management programs.

- **Forest Conservation Program**—The Forest Conservation Act of 2002 requires counties to enact plans to protect and maintain forest resources by protecting and preserving trees and other natural vegetation. This legislation gives authorities the means to protect forests and sensitive areas from development.
- **Stream Buffer Requirements**—Baltimore County Department of Environmental Protection and Resource Management has established protection for buffers around streams, wetlands, and floodplains. Buffers prevent sediment and chemical pollutants from reaching area waterways.
- **Maryland's Greenway Program—**Baltimore County has a stream valley Greenway Program that aims to protect natural open space and wildlife corridors. These undisturbed areas around Baltimore County waterways serve as effective buffers from surface water runoff and sediment erosion.

Additional water management programs that will assist in restoring watersheds that have been impacted by previous land development activity include:

- **Baltimore County Watershed Restoration Program**—The goal of Baltimore County's Watershed Restoration Program is to protect, enhance, and restore the water resources of Baltimore County. Program efforts include shoreline enhancement and restoration projects, SAV restoration, and retrofitting of communities that were developed prior to stormwater management requirements with stormwater best management practices (BMPs).
- **Reforestation Programs—**The Growing Home program is an innovative way homeowners can help increase the tree canopy in our region. It is a public-private partnership between Baltimore County, Baltimore City, Harford County, local retail nurseries, garden centers, and homeowners to encourage planting new trees on private residential land. The Maryland Department of Natural Resources' Tree-Mendous Maryland Program helps citizens restore tree cover on public lands, including parks, community open spaces, rights-of-ways, government facilities, and school grounds. The Baltimore County Department of Environmental Protection and Resource Management (DEPRM) received a grant, funded by the US Environmental Protection Agency and administered by the National Fish and Wildlife Foundation, under the 2004 Chesapeake Bay Small Watershed Grants program, to develop and pilot a project to educate smaller-lot (3-6 acres) rural residential landowners about their role as "managers" of common forest and stream systems and the importance of increasing forest area along streams and adjacent to existing forests.

Selecting Indicators for Water Quality

Indicators are often evaluated in an attempt to assess conditions within a stream or watershed. Indicators are parameters of stream and watershed function or water quality, such as

nutrients, impervious cover, and temperature, which can be readily measured—these data can then be used to track the health of a stream or watershed. Monitoring programs can be as simple as visual observations or as complex as a full analysis of the physical, chemical, and biological conditions of a stream or watershed. The design of a monitoring program should be driven by the desired outcome of the assessment. For example, stream restoration projects are often conducted in compliance with permits that require in-depth monitoring after completion of restoration efforts. Once the monitoring goals are set, it is important to gather site-specific background information about a variety of indicators of concern for the stream or watershed. The key is to select parameters from this background information than can be easily measured that directly relate to water quality and aquatic community health.

Commonly Used Indicators

There are many different indicators that can be monitored for assessing the health of a watershed. Some of those most commonly monitored include nutrients (N and P), conductivity, turbidity, ph, and temperature. In addition, other potential indicators include total suspended solids, bacteria, chloride, dissolved oxygen, chlorophyll content, and stream flow. More in depth monitoring programs might also include assessments of the benthic and fish communities in streams, an assessment of habitat conditions, an assessment of landscape conditions (such as percent impervious cover and percent forest cover), and an assessment of geomorphological conditions (such as stream bank stability).

C. WATERSHED HEALTH METRIC

Introduction

In order to assess the overall health of each of the 14 watersheds in Baltimore County and Baltimore City, a set of watershed health indicators were used to evaluate conditions within each watershed. The watershed health indicators used were nutrients, forest cover, presence of high value aquatic habitat, impervious cover, amount of impervious cover addressed by water quality improvement efforts, amount of degraded stream miles, and level of impairments. The nutrients indicator included a combination of nitrogen and phosphorus data. The presence of high value habitat indicator included a combination of data for the amount of each watershed that drains to Tier II waters and the percentage of watershed stream miles with trout present.

Scoring System

Each indicator was scored from one (unhealthy) to five (healthy). The scores were tallied for each watershed to develop an overall watershed health score. There were a total of six indicators included in this composite watershed health indicator, so the maximum number of points each watershed could receive was 30 points, except for the Gunpowder River and Middle River Watersheds. These two watersheds did not have data for nutrients or the amount of degraded stream miles, so the total possible points they could receive was 20. Each watershed's overall watershed health score was then calculated as a percentage of its total possible points. Scoring results for the overall watershed health were divided into four categories: very good (80%-100%), good (65% to <80%), fair (50% to <65%), and poor (<50%).

Impairments

What is Water Quality Impairment?

The state of Maryland reports on the status of surface water quality every other year, in the "Integrated Report of Surface Water Quality." This report identifies whether surface waters are impaired for a number of causes or pollutants including: nutrients, bacteria, sediment, biological community, and toxics. A water body is listed as impaired when it does not meet a water quality standard. When a water body is determined to be impaired, a Total Maximum Daily Load (TMDL) is developed or additional water quality monitoring data are reviewed and a Water Quality Analysis (WQA) report is prepared that will either result in delisting the water body for impairment or the development of a TMDL.

Note that a drinking water reservoir will have different water quality standards than a harbor. The standards protect for human health and aquatic life. For example, the water quality standards for the Baltimore/Direct Harbor Watershed may allow higher levels of certain pollutants than the Liberty Reservoir Watershed.

Why were impairments used as an indicator?

A water body is listed as impaired when it does not meet the water quality standards for nutrients, bacteria, sediment, biological community, and/or toxics for its designated use. The impairments within a watershed are measures of the overall water quality within that watershed.

How this map was created

The "Integrated Report," which is developed every two years, places surface waters into different categories, depending on whether they are considered to be meeting a given water quality criterion or whether they are impaired for that criterion. From the "Integrated Report," it was determined whether or not each of the 14 watersheds was impaired for each of the five possible impairments: nutrients, bacteria, sediment, biological community, and toxics. The score reflected the number of impairments for a given watershed.

Points :				
1	2	3	4	5
5	4	3	1 to 2	0

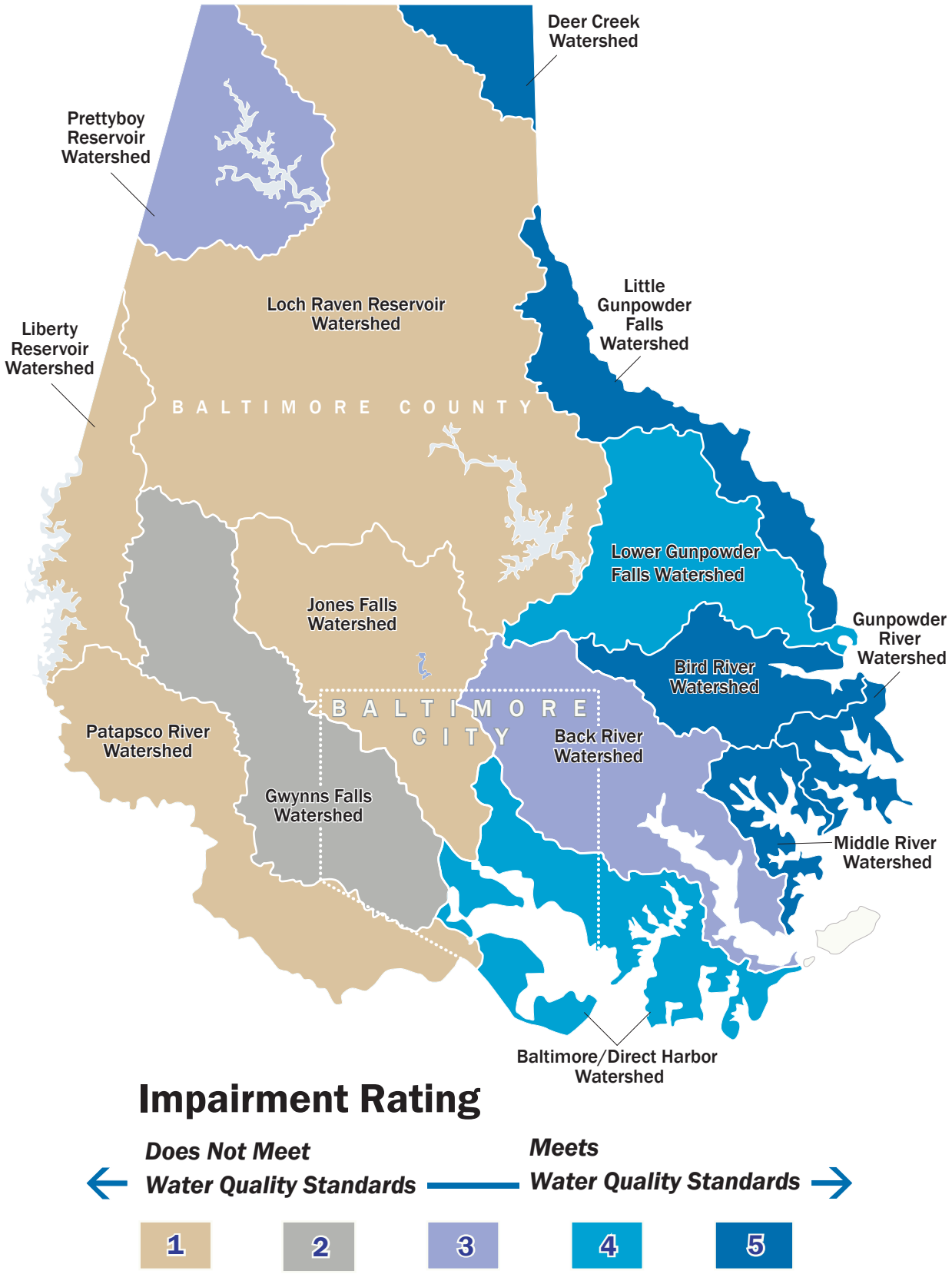
Causes of Impairments (from 0 to 5)

Rationale for Scoring Categories
Scoring categories roughly coincided with the number of possible impairments for a watershed.

Photo courtsey of Baltimore City

State of Our Watersheds

Map 1



Impervious Cover

What is Impervious Cover?

Any surface through which water cannot penetrate would be considered an impervious surface; examples typically include roadways, parking lots, sidewalks, and buildings. Watersheds that are not impacted by development have a low amount of impervious cover. As development increases, so does the impervious cover. With increased impervious cover, rainwater is unable to soak into the soil as it would on a natural landscape. Instead, this rainwater- called stormwater runoff- flows over the impervious surface, picking up pollutants, and often flows into storm drains. Impervious cover draining directly into storm drains is called directly connected impervious area. Eventually, the stormwater runoff and the pollutants it carries that reach the storm drains are discharged into streams. Rather than discharging directly to a storm sewer, runoff from impervious areas can be directed to stormwater management elements such as bioretention areas or infiltration devices that reduce discharges to storm sewers. These impervious areas are then referred to as not directly connected impervious areas.

Why was impervious cover used as an indicator?

Low levels of impervious cover are usually associated with healthier streams; watershed hydrology more closely resembles that of a pristine system.

How this map was created

Aerial photographs from the United States Geological Survey (2005 photos) were analyzed using Geographic Information System (GIS) techniques to extract the aerial extent of land uses (e.g. paved areas, roofs) that do not absorb water.

Points :				
1	2	3	4	5
>25%	15% to 25%	10% to <15%	5% to <10%	<5%

% Impervious Cover

Rationale for Scoring Categories
Scoring categories were based upon research on the impacts of impervious cover. A shift in impacts to watersheds is seen between 5% and 15% impervious cover. Watersheds with impervious cover less than 5% are considered relatively unimpacted and scored a 5. Watersheds with over 25% impervious cover are considered heavily impacted and scored a 1.

Photo courtesy of Chesapeake Bay Program

Photo courtesy of Baltimore City

State of Our Watersheds

Map 2

Impervious Cover Rating

← *High Impervious* — *Low Impervious* →

1 2 3 4 5

Forest Cover

What is Forest Cover?

By retaining stormwater runoff and using nutrients in stormwater runoff for growth, forests decrease nutrient export and surface runoff to streams. Forests also help to prevent soils from eroding and being discharged to streams during storms. Riparian vegetation, or forest cover next to streams, helps to stabilize stream banks and to regulate stream temperatures by shading the stream. As portions of a watershed are cleared for agriculture or to make room for development during urbanization, the amount of nutrients, sediments, and sunlight that reach streams increases. Loss of forest cover also increases the amount of water that reaches the stream because less water is taken up from the soil when there are fewer trees in the watershed.

Why was forest cover used as an indicator?

High levels of forest cover are associated with healthier streams because forests take up nutrients and minimize runoff, which limits erosion and sedimentation.

Points :				
1	2	3	4	5
<10%	10% to <25%	25% to <40%	40% to <50%	≥50%

% Forest Cover

Rationale for Scoring Categories
Given the land use patterns within the region, watersheds with 50% or more forest cover were considered to be the healthiest and scored a 5. Watersheds with less than 10% forest cover were considered to be most impacted and scored a 1.

Photo courtesy of Chesapeake Bay Program

Photo courtesy of Chesapeake Bay Program

How this map was created

Baltimore County forest cover data were obtained from the USGS National Land Cover Dataset 2001 (with Maryland Department of Planning 2005 updates). Baltimore City forest cover data were obtained from the Maryland Department of Planning 2007 Tree Canopy layer.

State of Our Watersheds

Map 3

Forest Cover Rating

← *Less Forest* — *More Forest* →

1 2 3 4 5

Presence of High Value Aquatic Communities

How were the High Value Communities assessed?

The presence of high value aquatic habitat was assessed on the basis of the percentage of the watershed that drains to Tier II waters and the percentage of stream miles with brook and/or brown trout present. Tier II waters are Maryland waters determined to be better than average, usually on the basis of benthic macroinvertebrate and fish community sampling conducted by the Maryland Department of Natural Resources (DNR) Maryland Biological Stream Survey (MBSS). The presence of trout within streams indicates that the stream may be of a higher quality than others where trout are not present.

Why was the presence of high value aquatic communities used as an indicator?

The presence of high value aquatic communities, such as Tier II waters and trout, indicate that these portions of the watershed may be functioning similarly to undisturbed, pristine watersheds.

Points :	1	2	3	4	5
% of Watershed Draining to Tier II Waters	0 %	>0% to 20%	>20% to 40%	>40% to 60%	≥60%

Points :	1	2	3	4	5
% of Stream Miles With Trout Present	0% to <5%	5% to <15%	15% to <25%	25% to <35%	≥35%

Rationale for Scoring Categories
There were two components to this indicator—drainage to Tier II waters and presence of trout. A watershed with 60% or more drainage to Tier II waters was considered healthiest and scored a 5. If there was no drainage to Tier II waters, the watershed scored a one. If trout were found in more than 35% of the watershed's stream miles, then that watershed scored a 5. The scores for Tier II drainage and trout presence were averaged together to obtain the high value aquatic communities rating.

Photo courtesy of Baltimore County

Photo courtesy of Baltimore County

How this map was created

The percentage of the watershed that drains to Tier II waters was calculated based on the location of Tier II water bodies (or lack thereof) within each watershed. Tier II water bodies were identified based on MBSS data. The percentage of stream miles with trout present was calculated for each watershed based on trout sampling conducted by DNR.

A Note about the Data
There may be additional Tier II locations that are currently not identified due to the nature of the random sampling utilized for Tier II streams. There also may be additional trout locations that are currently not identified due to lack of sampling, especially in locations accessed via private property.

State of Our Watersheds

Map 4

High Value Aquatic Communities Rating

← *Limited Aquatic Communities* — *Abundant Aquatic Communities* →

1	1.5	2	2.5	3	3.5	4	4.5	5

Nutrients

What is Nutrient Loading?

Nitrogen (N) and phosphorus (P) are nutrients that are essential to all living organisms and are naturally found in streamwater. However, development within a watershed can increase nutrients in streams. Sources of N to streams include application of fertilizers, sewage and septic leaks, pet waste, and atmospheric deposition of N released through combustion of fossil fuels. Application of fertilizers can also increase P in streams. P tends to stick to sediment, so any process that increases erosion and the delivery of sediments to streams will also increase P levels. Agricultural activities can also increase the amount of nutrients in streams through the use of fertilizers, planting of N-fixing crops, and livestock waste.

Why were nutrients used as an indicator?

High levels of nutrients within a watershed indicate that there may be substantial impacts on receiving water bodies, such as eutrophication within the Chesapeake Bay. Eutrophication leads to low levels of dissolved oxygen in the receiving water body, impacting aquatic life.

How this map was created

N and P data for Baltimore County were collected as baseflow samples every other year about eight times per year for each sampling site, between January 2003 and June 2009. N and P data for Baltimore City were collected as baseflow samples about 12 times per year for each sampling site, between January 2009 and January 2010. N and P data for each watershed were scored individually. Then the scores for N and P were averaged for each watershed to obtain one nutrients score.

Points :	1	2	3	4	5
Total Nitrogen (mg/L)	≥4.0	3.0 to <4.0	2.0 to <3.0	1.0 to <2.0	<1.0
Total Phosphorus (mg/L)	≥0.040	0.030 to <0.040	0.020 to <0.030	0.010 to <0.020	<0.010

Rationale for Scoring Categories
The nutrients indicator consisted of two components—N and P. Scoring categories for both N and P were based on Baltimore County's nutrient scoring system. N levels below 1.0 mg/L and P levels below 0.010 mg/L were considered healthiest and scored a 5. Scores for N and P were averaged together to obtain the nutrient load rating.

Photo courtesy of Baltimore County

Photo courtesy of Baltimore County

State of Our Watersheds

Map 5

Nutrient Load Rating

High Nutrient Load — *Low Nutrient Load*

1	1.5	2	2.5	3	3.5	4	4.5	5

Percentage of Degraded Stream Miles

How is the Percentage of Degraded Stream Miles Calculated?

The percentage of degraded stream miles was determined for each watershed on the basis of assessments of the biological condition of streams that were conducted by Maryland Department of Natural Resources (DNR). This indicator provides a quantification of the extent of degradation within each watershed.

Why was the percentage of degraded stream miles used as an indicator?

High amounts of degraded stream miles within a watershed indicate that land use activities are impacting aquatic communities.

Points :				
1	2	3	4	5
80% to 100%	60% to <80%	40% to <60%	20% to <40%	0% to <20%

% Degraded Stream Miles

Rationale for Scoring Categories
Scoring categories for percentage of degraded stream miles were divided into five even categories from 0% to 100%.

Photo courtesy of Chesapeake Bay Program

Photo courtesy of Baltimore City

How this map was created

The DNR Maryland Biological Stream Survey (MBSS) calculated benthic index of biotic integrity (BIBI) and fish index of biotic integrity (FIBI) scores (ranging from one to five, five being the best) for each stream sampled. Streams are considered degraded if the average of their BIBI and FIBI scores is below three. Using this cutoff, the percentage of degraded stream miles was calculated for each watershed. Higher scores represent watersheds with fewer degraded stream miles. No data are available for the Gunpowder River or Middle River Watersheds. There are no MBSS sampling sites in the Middle River Watershed, and only one in the Gunpowder River Watershed, which is not enough to calculate the percentage of degraded stream miles.

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Map 6

Degraded Stream Rating

← *High Percentage Degraded* — *Low Percentage Degraded* →

1 2 3 4 5

Amount of Impervious Cover Addressed by Water Quality Improvement Efforts

Points :				
1	2	3	4	5
<10%	10% to <15%	15% to <20%	20% to 30%	>30%

% of Impervious Cover Addressed by Water Quality Improvement Efforts

Rationale for Scoring Categories
Watersheds in which over 30% of the impervious area was addressed by water quality improvement efforts were considered to be receiving the most concentrated efforts by local governments and scored a 5. Watersheds with less than 10% of the impervious area addressed by water quality improvement efforts scored a 1.

A Note about This Indicator
The impervious area addressed by water quality improvement efforts indicator was not included in the overall watershed health composite indicator because it was not considered a representative indicator for all watersheds. For example, a watershed that had low impervious area could be penalized for not offsetting impacts that did not exist.

What have we done to reduce the effects of impervious cover?

Ongoing efforts to reduce the impacts of impervious cover on watersheds include those aimed at decreasing the amount of stormwater runoff (for example, asphalt removal and Best Management Practices such as stormwater ponds and infiltration devices) and others aimed at reducing the trash that gets into streams (for example, street sweeping and inlet cleaning). Additional broader efforts include restoration projects, reforestation projects, and other projects sponsored by Baltimore County, Baltimore City, and watershed associations.

Why was the amount of impervious cover addressed by water quality improvement efforts used as an indicator?

High amounts of impervious cover addressed by water quality improvement efforts represent an attempt to restore hydrologic conditions to a less-impacted condition.

Photo courtesy of Baltimore County

Photo courtesy of Baltimore County

How this map was created

Data were collected on the total acreage within each watershed that drains to some type of water quality improvement effort. In Baltimore City, these efforts include street sweeping, storm drain inlet cleaning, stream restoration, asphalt removal, and installation of volume control Best Management Practices (BMPs). In Baltimore County, these efforts include stormwater management, inlet cleaning, street sweeping, restoration projects, reforestation projects, and watershed association projects. In Baltimore County, the majority of these water quality improvement efforts are installations of stormwater management facilities, which are a result of more recent suburban development. In Baltimore City, the majority of these water quality improvement efforts are street sweeping.

State of Our Watersheds

Map 7

Water Quality Improvement Efforts Rating

← *Low Activity* — *High Activity* →

1 2 3 4 5

Overall Watershed Health

How was health calculated?

Six indicators were used to generate the overall watershed health composite indicator: impairments, impervious cover, forest cover, presence of high value aquatic communities, nutrients, and percentage of degraded stream miles. These scores indicate how well each watershed is functioning and can be used to compare watersheds. Due to the nature of cities and urbanization, the highly urban watersheds were expected to score lower, which was the case here.

Of the 4 watersheds with portions in both the county and city, the Jones Falls Watershed was the only one in the fair category; the other 3 were poor. The Jones Falls Watershed, which had a fair amount of rural land within the county portion of the watershed, had a low percentage of degraded stream miles. Little Gunpowder Falls was the only one of the 14 watersheds rated as very good; it had a low amount of impervious cover, a low percentage of degraded stream miles, and it scored well for impairments. The Patapsco River Watershed, considered for this report to fall solely within the county although a small portion is within the city borders, was the only county watershed in the poor category. This watershed had a high percentage of degraded stream miles, a low presence of high value aquatic communities, and scored poorly for impairments.

How this map was created

The individual indicator scores (from 1 to 5) were summed for each watershed. Final scores were determined for each watershed by dividing the total points achieved by the total number of points possible (30 for all watersheds except Gunpowder River and Middle River, which were 20). Final scores were broken into 4 categories: very good, good, fair, and poor.

Rating :			
POOR	FAIR	GOOD	VERY GOOD
0% to <50%	50% to <65%	65% to <80%	80% to 100%

Overall Watershed Health

Photo courtesy of Baltimore County

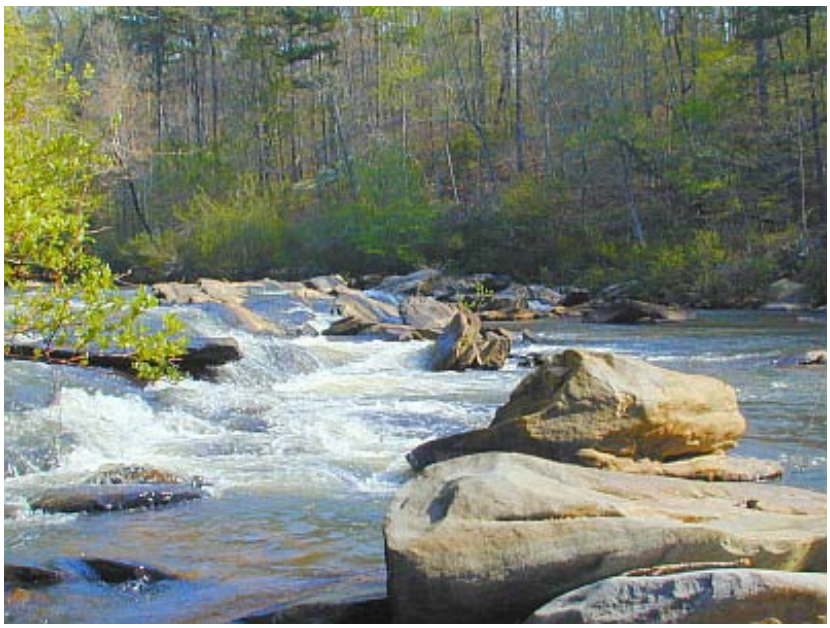

Photo courtesy of Baltimore County

State of Our Watersheds

Map 8

Watershed Health Rating

← *Poor* — *Very Good* →

POOR | FAIR | GOOD | VERY GOOD

Individual Indicator Scores

Watershed	Impairments	Impervious Cover	Forest Cover	Presence of High Value Aquatic Communities	Nutrients	Percentage of Degraded Stream Miles	Amount of Impervious Cover Addressed by Water Quality Improvement Efforts*	Overall Watershed Health	
Little Gunpowder Falls	5	5	3	3.5	3.0	5	2	82%	Very Good
Deer Creek	5	5	3	4.0	1.5	5	1	78%	Good
Gunpowder River	5	4	5	1.0	ND	ND	3	75%	Good
Prettyboy Reservoir	3	5	4	2.5	2.5	5	1	73%	Good
Liberty Reservoir	1	5	5	3.5	2.5	4	1	70%	Good
Loch Raven Reservoir	1	4	4	4.5	3.0	4	4	68%	Good
Lower Gunpowder Falls	4	4	3	2.0	2.5	3	5	62%	Fair
Middle River	5	2	3	1.0	ND	ND	3	55%	Fair
Jones Falls	1	2	3	3.0	2.5	4	4	52%	Fair
Bird River	5	2	3	1.0	3.0	1	5	50%	Fair
Patapsco River	1	3	3	1.0	3.0	2	4	43%	Poor
Gwynns Falls	2	1	2	3.0	2.5	2	4	42%	Poor
Baltimore/Direct Harbor	4	1	2	1.0	2.0	2	2	40%	Poor
Back River	3	1	3	1.0	2.5	1	4	38%	Poor

*This indicator was not included in the overall watershed health composite indicator because it was not considered a representative indicator for all watersheds.
ND=No Data

D. BALTIMORE COUNTY MONITORING

Introduction

Baltimore County has developed an integrated monitoring program to meet regulatory and non-regulatory program requirements, support watershed planning efforts, and to assess the effectiveness of restoration. Chemical, physical, and biological components of stream systems are each monitored. These components are monitored to fulfill regulatory requirements that include: the National Pollutant Discharge Elimination System (NPDES) – Municipal Stormwater Discharge Permit Program, the Total Maximum Daily Load (TMDL) Program, and stream restoration permit requirements. Non-regulatory programs for which data are collected include the Chesapeake Bay Tributary Strategy Program, Coastal Zone Management, and the Reservoir Management Program.

The monitoring programs provide information on the existing condition of stream water quality and channel stability, the status of biological resources, and provide the necessary data to determine trends over time. A brief description of each monitoring program element is provided below.

NPDES Permit Monitoring

Baltimore County is approaching the end of their third 5-year NPDES permit, which began on June 15, 2005 and will end on June 15, 2010. This permit requires monitoring to assess the effectiveness of stormwater management programs and watershed restoration projects, discussed in more detail below.

Long Term Monitoring Site – Scotts Level Branch

Scotts Level Branch is a stream in the Gwynns Falls watershed, which is a watershed that is on the 303(d) list as impaired for nutrients, sediments, and fecal coliform bacteria. In addition, Scotts Level Branch is listed as being impaired for biology. The Gwynns Falls watershed has a TMDL for N, P, bacteria, and a pending TMDL for sediment. The TMDLs require a 15% load reduction of N and P from urban non-point sources and a 98% load reduction of bacteria from human and domestic pet sources. Scotts Level Branch was chosen to undergo multiple stream restoration projects in an effort to help meet the Gwynns Falls TMDLs; therefore, long-term pre-restoration data are being collected as part of the NPDES permit requirements. A paired watershed monitoring approach is being used to eliminate climatic effects using Powder Mill Run (which has a similar size and land use), which is nearby and is also in the Gwynns Falls watershed. Chemistry, biology, geomorphology, and discharge are being monitored in both streams. A third subwatershed, Upper Gwynns Falls, was added due to the fact that Baltimore City will be doing stream restoration work in the Powder Mill subwatershed.

Chemical and Discharge Monitoring

Chemistry and discharge is monitored at the three US Geological Survey (USGS) gauges (Scotts Level Branch, Powder Mill Run, and Gwynns Falls near Delight) for both dry weather conditions (baseflow) and storm conditions. Additional baseflow monitoring is conducted at other selected sites on a monthly basis. For storms, grab samples are collected over a range of discharges to develop event mean concentrations (EMCs). These, when combined with

discharge, can calculate event and annual pollutant loads. Storm loads combined with baseflow loads will be used to calculate total loads for the watershed.

Geomorphological Monitoring

Thirty randomly selected permanent cross-sections are monitored on Scotts Level Branch and Powder Mill Run. The yearly data are plotted and overlaid with prior years to detect channel changes. Also, two longitudinal profiles are established and monitored yearly in Scotts Level Branch. Soil core samples are taken from the banks and bed in the vicinity of the cross-sections. Samples are analyzed for bulk density, particle size distribution, total nitrogen, and total phosphorus. These results are used to estimate annual sediment, nitrogen, and phosphorus load contributions which can be compared with the chemical sampling results.

Biological Monitoring

Benthic invertebrates, which are a group of aquatic invertebrates that live on or in the bottom of a stream, are sampled at eight cross-sections annually in the spring using Maryland Biological Stream Survey (MBSS) methodologies. Also, fish assemblages, which are groups of interacting fish populations comprised of various fish species, are sampled at the eight sites in the summer.

Stormwater Management Design Manual Effectiveness – Windlass Run

The NPDES permit requires monitoring of a subwatershed for geomorphologic impacts resulting from development, utilizing the revised Stormwater Management Design Manual (effective 2000). The results of a countywide screening for a suitable location, followed by field verification, led to the selection of Windlass Run as the monitoring subwatershed.

The Windlass Run subwatershed has the potential for a large area of future development. The level of imperviousness in the subwatershed is currently about 3%, and is expected to increase to over 20%. The extension of MD route 43 (White Marsh Boulevard) between US route 40 (Pulaski Highway) and MD route 150 (Eastern Boulevard) has opened this area to development. Without the use of stormwater controls, development in the Windlass Run subwatershed would have a severe impact on water quality and channel stability. Stormwater management for the development that will occur in this subwatershed will be designed in accordance with the 2000 Stormwater Management Design Manual and the new Environmental Site Design requirements developed in response to the Stormwater Act of 2007, which should serve to protect the stream system. This study will determine the level of protection that is provided by these requirements.

Six monitoring sites were established in 2002. The geomorphic monitoring consists of channel cross-section measurements, channel slope/profile measurements, and Wolman pebble counts, which is a technique used to provide a quantitative measurement of the texture of a streambed. Macroinvertebrates are monitored at five of the six cross-sections.

Illicit Connection Monitoring

The County is required to screen a minimum of 150 storm drain outfalls annually for the purposes of detecting and removing unpermitted discharges to the storm drain system. The Watershed Management and Monitoring Section of DEPRM is responsible for performing the outfall screenings, reporting screening data, and coordinating remedial actions. Specific

correction measures may be the responsibility of the Baltimore County Department of Public Works (DPW), DEPRM, or both, depending upon the nature and sources of detected discharges. If there are indications that existing permit limits are being exceeded, or that there are unpermitted discharges, the cases are referred to the Maryland Department of the Environment (MDE) for permitting or enforcement. Water main leaks are referred to Baltimore City DPW for correction. Because chlorine is extremely toxic to the fauna in a stream, it is of particular concern when leaks or discharges occur from the public water supply system. Sanitary sewer leaks are referred to Baltimore County Department of Public Works for correction.

Chemical and Discharge Monitoring

Chemical monitoring provides a snapshot of the chemical condition of the streams within Baltimore County at the time of the sample collection. In association with the measurement of stream flow it is possible to calculate the pollutant loads for each of the measured chemicals. The chemical condition of the stream water is usually different between dry weather flow (baseflow) and storm flow. The programs described below are designed to measure water quality for both weather conditions. The data will allow a determination of current (ambient) water quality and, over time, any trends in water quality.

Baseflow Monitoring Program

Baltimore County began conducting baseflow monitoring since 1999. Baseflow monitoring results have been used in calibrating the Storm Water Management Model (SWMM) pollutant loads that were included in the Water Quality Management plans for various watersheds. In 2001, insufficient staff curtailed the continuance of the baseflow monitoring program until the spring of 2003, when a modified version of the original program resumed.

Baseflows are now monitored at approximately 31 sites in each of the six watersheds in the Patapsco/Back River Basin in odd-numbered years, while approximately 53 sites distributed over seven watersheds in the Gunpowder Basin/Deer Creek Basin are monitored in even-numbered years. The sites are normally monitored from six to eight times during the sampling year.

This design will allow the County to determine ambient water quality for major portions of each watershed. The two-year sampling cycle will also allow an analysis of baseflow water quality trends for the pollutant parameters analyzed.

Recreational Tidal Waters Monitoring Program

Baltimore County's tidal recreational water monitoring program has been operational since 1990. The program is administered by the Department of Environmental Protection and Resource Management – Environmental Health Section. The program historically focused on fecal coliform concentrations, but has since switched to enterococci as the bacteriological indicator. The beach swimming standard for enterococci of 35 mean probable number (MPN) is used for comparison purposes to assess the general bacteriological water quality. Surface water quality samples were collected at seven tidal water sites starting in 2002 and are now collected at ten sites. These sites represent the major tidal basins in Baltimore County.

Stream Geomorphological Monitoring

Geomorphological monitoring refers to the measurement of the physical characteristics of the stream (stream width, depth, bank stability, etc.) The data are used to determine the physical stability of the stream channel. The geomorphological monitoring program involves monitoring of stream restoration projects as well as conducting stream stability assessments to support preparation of the Small Watershed Action Plan.

Stream Restoration Geomorphological Monitoring

The stream restoration permit requirements by the U.S. Army Corps of Engineers and the Maryland Department of the Environment include post construction monitoring of each project. Monitoring is used to determine if the project met its goals. Post construction monitoring also provides feedback that enables improvement of subsequent project designs and construction approaches.

Post construction monitoring requires periodically collecting field data – usually annually for 2 to 5 years and occasionally additional monitoring after large storms. In most cases, channel cross-sections are surveyed at points along the length of the project. For multi-year surveys, plots are overlaid (current year over prior years) to detect any changes in morphology that may have occurred between these periods. Other components that may be included in the monitoring plan and report include: bed material characterization via the Wolman pebble count procedure, inspection of the condition of any riparian plantings, visual inspection of the degree of channel erosion or deposition, and photographing the channel and banks at key locations.

Biological Monitoring

In addition to the biological monitoring required at Scotts Level Branch under Baltimore County's NPDES permit, the County has four additional biological monitoring programs. These programs use the biological community to assess the ecological health of the streams within the County (Probabilistic Monitoring Program), assess the effectiveness of stream restoration projects (CIP Monitoring Program), provide data on the best streams in Baltimore County to serve as bench marks for other stream assessments (Reference Site Monitoring Program), and assess submerged aquatic vegetation (Submerged Aquatic Vegetation (SAV) Monitoring Program). The first three programs use assessments based on the benthic macroinvertebrate community and, in some cases, the fish assemblage. It is widely accepted that the biological community of streams is sensitive to anthropogenic disturbances. By monitoring the biological community, the County can assess the amount of change due to anthropogenic activities and the benefit of stream restoration to stream organisms. The SAV Monitoring Program provides an assessment of the coverage of SAV and progress made in meeting the new water quality standards for water clarity and SAV coverage in Baltimore County tidal waters.

Probabilistic Macroinvertebrate Monitoring – 100 Random Points

The County adopted the Maryland Biological Stream Survey (MBSS) methodologies; this will result in data that are directly comparable with State generated data and expand the data available for assessing county waters. Randomly selected sites for monitoring will support statistically valid assessments of County waters.

Each year a different basin in the County is sampled: the Patapsco/Back River basin is sampled in odd numbered years, and the Gunpowder River Basin and Deer Creek watershed is monitored in even numbered years. One hundred sites are selected at random for each year's sampling efforts. These 100 sites are sampled for macroinvertebrates during the spring index period, March 1 to April 30, using the MBSS protocols. A Benthic Index of Biotic Integrity (BIBI) is calculated to describe the condition of the biological community in county streams.

Capital Improvement Projects Monitoring

Baltimore County uses benthic macroinvertebrates to monitor several capital improvement stream restoration projects. Monitoring is performed in the stream segments where the restoration takes place. The segments are monitored pre- and post-construction to document any change in the biological community.

Starting in spring of 2003, sampling protocols were changed from kick-net sampling, as per U. S. Environmental Protection Agency (USEPA) Rapid Bioassessment Protocols II (RBP II), to d-net sampling, as per MBSS. Samples are taken during the spring index period, March 1 to April 30.

The permits for a number of stream restoration projects require biological monitoring for both benthic macroinvertebrates and fish. Current projects with these requirements are the Minebank Run Phase II and Woodvalley stream restorations. Both the Minebank Run and Woodvalley stream restorations were completed in 2005 and post-restoration data have been collected at both sites since then.

Reference Site Monitoring

Baltimore County has been monitoring eight reference sites in the county since spring of 2001. The County's Geographic Information System (GIS) was used to identify watersheds within the County that contained greater than 50% forested land use and less than 20% urban land use. Based on the GIS data, 21 sites met the land use criteria and were selected for chemical and physical habitat analysis. Using criteria based on the physical habitat and chemical results, thirteen of the sites were eliminated.

The remaining eight sites are sampled annually for benthic macroinvertebrates in the spring index period. Sampling was initially performed according to USEPA RBP II protocols, but was switched to Maryland Biological Stream Survey (MBSS) protocols in 2003.

Habitat – Submerged Aquatic Vegetation

Submerged Aquatic Vegetation (SAV) is found in the shallow waters of the Chesapeake Bay. In Baltimore County, these plants commonly include *Vallisneria americana* (wild celery), *Myriophyllum spicatum* (Eurasian watermilfoil) and *Elodea canadensis* (common waterweed), among others. SAV are indicators of good water quality. They provide critical food, shelter, and nursery grounds for many species of shellfish, finfish, waterfowl, and other organisms. These grasses also stabilize the sediments and incorporate oxygen into the water. SAV is sensitive to pollution, especially suspended sediments that reduce sunlight needed for photosynthesis. High nutrient levels can also reduce light penetration when they stimulate dense phytoplankton blooms that block sunlight.

SAV density and distribution are monitored by Baltimore County in its tidewater areas in the spring and summer of each year. The presence or absence and density of SAV are determined

by several methods. Visually, the presence or absence of SAV can be observed on the bottom in shallow water or in areas where the tops of plants are near the surface. In waters from 5 to 7 feet deep, a long handled rake is used to rake 2 to 4 square foot areas in random grid patterns. In waters deeper than 3 feet, a tethered rake is frequently towed along the bottom. The shoreline and creek surface is also monitored for floating pieces of SAV, an indication of SAV presence, although not necessarily from the specific area. SAV densities are recorded based on the Virginia Institute of Marine Science (VIMS) Annual Distribution Studies measurement system. Density is estimated based on crown cover.

Special case monitoring

Status of Brook Trout

In 2008, the Prettyboy Reservoir Watershed Restoration Action Strategy (WRAS) was completed. The WRAS was a cooperative effort among citizen-based organizations and state and local government agencies. The outcome of the WRAS was a plan of action that promotes the overall (aquatic and terrestrial) ecological health of the Prettyboy Watershed.

A key goal of the WRAS is to assess the current extent of native brook trout in the Prettyboy Reservoir Watershed. The Prettyboy Watershed has numbers of brook trout comparable to those in western Maryland streams. Brook trout population data, water temperature data, and physical habitat data will be used to establish fixed sampling stations where the variability/long-term stability of brook trout populations may be evaluated. Physical habitat and riparian zone conditions will be examined to isolate streams where habitat improvement measures may bolster brook trout populations. Therefore, the objectives of the study are to (1) determine brook trout distribution and abundance, (2) measure air and water temperature regimes, (3) assess physical habitat quality, and (4) document brook trout spawning activity.

Red Run

In June 2009, Baltimore County began a yearlong study of Red Run in Owings Mills, MD. Data collection is based on a 1987 study and includes chemistry, baseflow discharge, biology, stream corridor assessment, and habitat surveys. The data will be compared to that of the 1987 study, after which the effects of more than twenty years of development in the watershed can be analyzed.

E. BALTIMORE CITY MONITORING

Introduction

Baltimore City has two separate water quality monitoring programs: source water monitoring in the watersheds of the water supply reservoirs, and monitoring related to Baltimore City's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System Discharge Permit. These are both long-term monitoring efforts. Data collected by this monitoring are used to look for trends over time in addition to its use in the assessment of current water quality.

Source Water Monitoring

Liberty, Loch Raven, and Prettyboy Reservoirs In-Lake Monitoring

Sampling of these reservoirs serves many purposes. The main purpose is to identify water quality problems. Another purpose is to monitor trends related to restoration and/or perturbations, such as development or drought, in the watershed. Sampling these reservoirs also allows for a better understanding of the environmental conditions that result in algal blooms, which cause taste and odor problems in the water supply and cause higher levels of disinfection byproducts. A final purpose in sampling the reservoirs is to determine the relationship between in-lake stations and raw water at the treatment plants.

There are 12 in-lake reservoir monitoring stations distributed among these three reservoirs. At each of these stations, a vertical series of samples and field measurements are taken at discrete depths in the water column. Some stations, including the primary sampling stations located near the raw water withdrawal intakes, are sampled in all seasons. The primary stations are sampled more frequently than the other stations. Baltimore City maintains a database of the sample results going back as far as 1981.

Reservoir Tributary Monitoring

Baltimore City samples at 16 stations on tributaries to these reservoirs in order to monitor trends in nutrient and sediment loadings, to relate these trends to activities in the watershed (drought, development, restoration), to relate tributary loadings to receiving water data, and to identify pollutant sources. Baltimore City partially funds the U.S. Geological Survey to maintain flow gauging stations at 11 of these stations. Each month, during dry weather, a baseflow sample is collected at each station. In addition, whenever possible, stormwater samples are collected at 6 of these stations using automated samplers. Baltimore City maintains a database of the sample results going back as far as 1982.

Monitoring Related to NPDES Stormwater Permit

Stream Restoration Monitoring

Moores Run Long-term Discharge Characterization

Chemical Monitoring

Baltimore City began sampling and the U.S. Geological Survey began measuring flows at the stream station at Moores Run at Radecke Avenue and the nested station at Hamilton (Todd) Avenue in 1995. The goal is to monitor at least 12 storm events per year at both stations. Automated samplers are used to collect discrete samples and samples are selected to represent the ascending, peak and descending limbs of the storm. Event mean concentrations (EMCs) are calculated using the flow data and the discrete sample results. In addition to the storm samples, baseflow (dry weather) samples are collected monthly. These data are used to characterize runoff, estimate annual pollutant loads, and monitor trends in loadings and relate these to changes in the watershed (e.g., development, restoration).

Biological Monitoring

Annual fish and benthic invertebrate sampling is conducted at 4 stations that are associated with the long-term discharge characterization monitoring at the Hamilton Avenue and Radecke Avenue stations.

Physical Monitoring

This includes geomorphologic stream assessment and stream habitat assessment. The City contracted with the U.S. Fish and Wildlife Service (USF&W) to conduct a detailed geomorphologic stream assessment of the Moores Run upstream of the monitoring station at Radecke Avenue, and to develop standard operating procedures for conducting similar assessments in future years. USF&W completed its first geomorphologic survey in October 2003. In May 2004, USF&W published the physical monitoring standard operating procedures they developed for Baltimore City. The USF&W conducted a second geomorphologic survey of the Moores Run in the summer of 2005. Baltimore City conducts an annual habitat assessment survey of the upper Moores Run watershed. The survey area covers Moores Run from the quadruple cell outfall at Hamilton Avenue downstream to Radecke Avenue, and the Moores Run tributary at Todd Avenue.

Biddison Run

Approximately 1,500 feet of the Biddison Run, from Moravia Road to its confluence with Herring Run, was restored to protect the Bowley's Lane landfill on both of its banks. The construction began in the late summer of 2005 and was completed in March 2006. Baltimore City collects monthly baseflow (dry weather) samples and annual fish and benthic invertebrate samples at two Biddison Run stations. Water quality sampling began at these stations in October 2002; fish sampling also began in 2002; and benthic invertebrate sampling began in 2003.

Stony Run

In June 2005 the City established the Linkwood stormwater monitoring station on Stony Run in the Jones Falls watershed to use for assessing restoration in Stony Run, and for the monitoring that the City is required to do for the Maryland Stormwater Design Manual. In December 2005, the City decided to use its Powder Mill Stream Impact Sampling (SIS) station located in the Gwynns Falls watershed as the control in this study. The USGS provides flow monitoring at both the Linkwood (USGS station ID 01589464) and the Powder Mill (USGS station ID 01589305) stations.

Watershed 263

Watershed 263 is an ultra-urban 930-acre area in southwest Baltimore City that is drained entirely by underground storm drains. Baltimore City established two monitoring stations at Lanvale Street and Baltimore Street and began collecting storm composite samples and bi-weekly grab (mostly dry weather) samples in September 2004. Initially, these stations were established as part a collaborative study on street sweeping and inlet cleaning practices. This study was headed by the Center for Watershed Protection, and the final report- *Deriving Reliable Pollutant Removal Rates for Municipal Street Sweeping and Storm Drain Cleanout Programs in the Chesapeake Bay Basin*- was published in September 2008. Baltimore City

decided to continue water quality monitoring at the two Watershed 263 stations to possibly use the data for studying the effectiveness of new stormwater best management practices (BMPs) that Baltimore City planned to install in this watershed. The first six practices were installed in the summer of 2009. More information on these BMPs can be found in Section H "Baltimore City Capital Improvement Program". Unfortunately, during storms in the summer of 2009, the automated stormwater sampling equipment used at these stations was once again damaged, and Baltimore City decided to end stormwater sampling at these two stations. Currently, Baltimore City is investigating new stormwater sampling designs for inlets in this area to use instead.

Biological Monitoring

Baltimore City conducts sampling for fish and benthic invertebrates within three of the four major watersheds- Gwynns Falls, Jones Falls and Herring Run- using a combination of random and fixed site sampling. Each year one major watershed is chosen for the random sampling- between 10 and 20 random stations are chosen for benthic invertebrate sampling, and between 5 and 15 random sites are selected for fish sampling. The purpose of this program is to monitor trends in fish and benthic invertebrate communities in Baltimore City streams associated with restoration and/or environmental perturbation, and to measure the health of living resources for targeting restoration.

Dry Weather Monitoring

Baltimore City conducts two types of dry weather chemical screening surveys: stream impact sampling (SIS) and ammonia screening (AS). SIS began in May 1997, and AS began in September 1998. The data from these surveys are used primarily for the detection of illicit discharges. The data are also used for trends over time analyses and to look for changes in ambient water quality associated with changes in the watershed (e.g., restoration).

Currently there are 32 SIS stations and 46 AS stations (31 stations are visited for both SIS and AS). SIS surveys are done once per month and AS surveys are done three to four times per month. For both surveys, field measurements are taken of ammonia, chlorine, conductivity, dissolved oxygen, pH, and water temperature. For SIS, a stream sample is also collected and is analyzed by the labs for 15 parameters, including nitrogen, phosphorus, metals and fecal coliform counts. During 2008, Baltimore City made 1,875 station visits for a total of 15,668 water quality parameter measurements.

When the survey results point to a possible illicit discharge, a Pollution Source Tracking (PST) investigation is begun. Occasionally, PST investigations are generated by citizen complaints. It should be noted that some investigations are discontinued because the pollution trail is lost or becomes indeterminate. Often this is due to the intermittent nature of the pollution source.

Exterior Lead Paint Removal Waste Control Program

Baltimore City requires a permit for exterior lead paint removal work. In 2004 fines were increased for working without a permit. In addition, language was added to the City's Building Code that requires a minimum bond posting when obtaining a permit. During 2009, 189 sites were permitted. Baltimore City conducted 120 site inspections that resulted in 25 stop work notices and the documentation of 7 illegal discharges. There were sufficient grounds to warrant the assessment of civil penalties to the companies involved in three of the seven illegal

discharges. In the four remaining cases, the companies were issued a notice of violation requiring a response that detailed corrective actions to be taken to avoid future violations.

Partnerships with Volunteer Organizations

During 2009, Baltimore City partnered with the Baltimore Harbor Waterkeeper to collect enterococci (bacteria) samples in the Middle Branch and Baltimore Harbor. Waterkeeper staff collected water samples at 20 stations twice per month from May through December 2009. Baltimore City paid for the laboratory services. The purpose of the sampling was to get a better indication of the heath risk associated with water contact in the Harbor by comparing the enterococci bacteria counts to standards set by the State of Maryland. Currently, the Baltimore City Heath Department considers it unsafe for contact with any surface waters within Baltimore City. More information from the Health Department can be found at this web address: http://www.baltimorehealth.org/water.html.

F. VOLUNTEER MONITORING

Baltimore Sewer Coalition

The Baltimore Sewer Coalition is a group of affiliated watershed groups and environmentalists that each year since 2002 has put together a report about the city's sewer problems. They check outfalls and stacks for sewage leaks and report them to Baltimore City and Maryland Department of the Environment.

Stream Watch/Adopt-a-Stream

Stream Watch is a partnership program between local watershed associations and Baltimore County's Department of Environmental Protection and Resource Management. Stream Watch allows the community to learn more about their local streams while simultaneously assisting local governments with extra observers for stream impacts.

Volunteers typically adopt one-quarter mile or less of a stream in their neighborhood or backyard. There are several levels of adoption—Stream Cleaners, Stream Walkers, and Stream Watchers. Stream Cleaners are responsible for removing trash from their adopted section on a quarterly basis. Removing trash in and around streams will not only create a more beautiful area, but will also improve the overall health of the stream. Stream Walkers, in addition to the Stream Cleaner responsibilities, complete a once-yearly visual stream assessment designed to collect information on the overall health of a stream and its riparian area. Stream Watcher is the most involved level of adoption; in addition to the Stream Cleaner and Stream Walker responsibilities, the Stream Watcher will also collect specific information on stream impacts and identify specific restoration opportunities within the stream.

Maryland Department of Natural Resources Volunteer Opportunities

The Maryland Department of Natural Resources (DNR) conducts a volunteer biological monitoring program called Maryland Stream Waders. The goals of this program are to increase the number of sampling sites used for stream quality assessments; to educate the community about the relationship between land use and stream quality; to provide quality assured information on stream quality to state, local, and federal agencies, environmental

organizations, and others; to improve stream stewardship ethics; and encourage local action to improve watershed management.

In order to become part of the program, volunteers participate in a one day training session and then spend two more days collecting aquatic invertebrate samples from stream beds. Volunteers can either return their samples to DNR or bring them to the group collection generally held the first weekend of May. Samples are sent to DNR for "bug identification" and analysis.

G. PUBLIC EDUCATION AND INVOLVEMENT

Baltimore County

In 2008, a total of 86 education events for residents were held throughout Baltimore County. A total of 683 presentations and events were given, with an estimated 352,419 participants involved and 52,197 pieces of literature distributed.

Recent progress has increased the number of local and regional partnerships, targeted specific populations, and expanded cooperation with local watershed organizations. Baltimore County has developed over 60 partnerships with local and regional groups and organizations, including Baltimore County and City schools, Comcast Cable, Maryland Public Television, many local and regional watershed associations, and several local nature centers.

The *Baltimore Watershed Agreement*, first signed in 2002, has fostered the extension of education programs between Baltimore County and Baltimore City. Baltimore County and Baltimore City public schools actively support the Maryland Green School award program. Staff participates on the State Green School Committee and engages schools in activities that support the goals of this program. As of June 2009, Baltimore County had 44 Green Schools, 7 of which were added in 2008 and 10 of which were added in 2009. Baltimore City had 14 Green Schools, 4 of which were added in 2009, 2 of which were recertified in 2008 and 3 of which were recertified in 2009. Baltimore County has the highest number of Green School among all Maryland counties. Baltimore County had 3 Maryland Green Centers, 1 of which was added in 2008, and Baltimore City had 4 Maryland Green Centers, 1 of which was added in 2008 and 1 of which was recertified in 2009. The total number of participants in Baltimore County Green Schools and Green Centers, including students, school staff, and volunteers, was estimated to be nearly 16,000. These Green Schools and Green Centers serve as models to the community for environmental awareness and community stewardship.

Baltimore County and Baltimore City both support local watershed associations, which provide outreach to the public and engage volunteers in restoration activities. Numerous restoration projects are completed throughout the Baltimore region because of the efforts of these non-profit groups. These organizations are listed in Section I of this report.

Baltimore City

Baltimore City started the *Cleaner Greener Baltimore* program in 2007, which campaigns for educating the public, planting trees, improving parks, reducing litter, and increasing recycling. More information about this program can be found through Baltimore City's website (http://www.cleanergreenerbaltimore.org/cleaner/publicWorks.aspx).

In 2008 the Mayor's Initiative for a Cleaner Baltimore launched a comprehensive multi-media anti-littering campaign. Part of this effort included the broadcasting of different commercials on the local television networks. A component of this public and private sector partnership unveiled a new storm drain marker graphic for many of the city's 30,000 storm drain inlets.

Baltimore City has posted signs along streams warning of the potential risk of water contact recreation.

The City continues to support the environmental organizations throughout the city with small grants. In 2008 a $24,900 grant was given to the Baltimore Harbor Watershed Association to develop a watershed management plan for the Harris Creek watershed. The City is also partnering with the Herring Run Watershed Association and Center for Watershed Protection in developing a rooftop disconnection project.

In the fall of 2008, and more recently on April 27, 2009, DPW hosted "environmental roundtables" that were attended by over a dozen different environmental organizations. At the roundtables, DPW presented information about several projects and provided updates on activities such as the Total Maximum Daily Loads, MS4 permit status, stormwater management regulations and sanitary sewer overflows. The roundtables will be held quarterly.

Joint Efforts between Baltimore County and Baltimore City

One of the main goals of the Baltimore Watershed Agreement (BWA) is to foster joint activities between Baltimore County, Baltimore City, and the watershed groups in improving the state of our watersheds. This past year the County and City and other stakeholders have developed an Action Plan to implement the goals of the five targeted areas (development, stormwater, community greening, trash, and public health) under the BWA. One of the overarching goal areas identified in the Action Plan is outreach and awareness. The action items under this category include:

- Establishing and conducting joint public relations efforts;
- Establish a BWA web-based program to disseminate and update information;
- Create a branded environmental awareness campaign; and
- Organize, advertise and conduct one-day awareness blitz programs.
- Ensure that BWA actions are incorporated into school curriculum;
- Expand water quality education covering the impacts of water quality on public health in school curricula; and
- Increase the number of schools achieving green school status.

Baltimore County and Baltimore City will work together to develop specific implementation plans for these items in the coming year.

As a pilot project, in conjunction with volunteers from the Jones Falls Watershed Association, the Department of Public Works (DPW) will place storm drain markers on 1,500 storm drains within the Jones Falls watershed. About 1000 markers have been placed so far and consideration is being given to doing other watersheds throughout the Baltimore region.

H. ENVIRONMENTAL RESTORATION PROGRAMS

Baltimore County Waterway Improvement Program

In 1987 DEPRM implemented a capital program for the assessment and identification of water quality problems and implementation of design and construction of watershed restoration projects, including preparation of watershed management plans, stormwater conversions and retrofits, stream and wetland restoration, shore erosion control, and waterway dredging. Restoration is especially important in communities built prior to environmental regulatory programs. The program seeks to protect, restore and improve the water resources of the County. The program structure is based on the County's fourteen (14) major watersheds in order to provide a comprehensive framework of protection and restoration of the County's natural resources. Projects are prioritized in part based on opportunities identified in watershed management plans. Project funding is supported primarily by County General Obligation Bonds and supplemented by State funds from the Maryland Departments of the Environment and Natural Resources through the Storm Water Pollution Control, Small Creeks and Estuaries, and Waterway Improvement cost-share programs. The Waterway Improvement Program funds the following types of projects:

Stormwater Conversion Projects

These projects involve the conversion of existing stormwater detention (dry) ponds to extended-detention with shallow marsh or retention (wet) pond facilities that provide water quality benefits in addition to runoff volume control. These projects are often constructed in conjunction with stream channel restoration. As of January 1, 2009, 11 conversion projects treating 593 acres of drainage area had been constructed.

Stormwater Retrofit Projects

These projects involve the installation of new stormwater best management practices (BMPs) facilities in communities developed prior to stormwater management requirements. Types of BMPs include extended-detention water quality ponds, bio-retention, stormwater wetlands and marshes, end-of-pipe storm drain outfall plunge pools, and water quality inlets. As of January 1, 2009, 33 retrofit projects treating 1964 acres of drainage area had been constructed and3 projects are under design.

Stream Restoration Projects

These projects restore highly degraded urban channels and enhance riparian ecosystems. The stream restoration projects utilize state-of-the-art techniques based on applied fluvial morphological principles and engineering hydraulics to restore and provide natural stream functions. Primary goals of these stream restoration projects are to reduce excess sediments by creating stream channel equilibrium and to enhance natural riparian and aquatic habitats by utilizing bioengineering techniques and natural materials. Projects have included removal of deteriorating concrete channels followed by replacement with boulders and vegetative devices to emulate natural step pools and meanders for stream stability and velocity control. For some projects, detailed water quality, habitat, and geomorphologic monitoring is performed to assess the effectiveness of the project. DEPRM has completed 42 projects to date with many

projects in design, permitting, or construction. As of January 1, 2009, a total of 16.1 linear miles of streams had been restored with 3.7 miles under design.

Shore Erosion Control Projects

These projects stabilize eroding shorelines and create tidal habitat. Since program inception, nearly 15,000 feet of shoreline has been protected at numerous County waterfront parks and Hart-Miller Island Park. Shoreline projects consist primarily of establishing shoreline vegetation and providing ancillary revetments or offshore structural protection, if appropriate, through gapped breakwaters.

Waterway Dredging Projects

DEPRM has an ongoing program to restore navigation channels for recreational boating access while protecting and enhancing aquatic habitat of the Chesapeake Bay and its tributaries. The projects include providing a channel in the center of a creek as well as individual spur channels connecting piers to the main channels. Dredging projects have companion projects in the watershed for the reduction of nutrient and sediment loading to the dredged channel. Baltimore County also collects submerged aquatic vegetation (SAV) data for all creeks that have been or are proposed to be dredged. SAV is considered a key indicator of the general health of a waterway. SAV growth has rebounded in many of the County's waterways and the County has been documenting and mapping these trends since 1989. These data provide the necessary information to satisfy state and federal permit requirements and to better understand the limiting factors for SAV growth.

In 2004, the County completed a study on the effects of dredging on SAV. This study documented the resurgence of SAV after dredging in Chesapeake Bay tributaries in Baltimore County, Maryland. Results from five waterways over a five-year period utilizing pre- and post-dredge SAV surveys were presented. Comparisons to five reference sites and overall SAV trends were also evaluated. All five case study waterways were typical of Baltimore County—each required dredging of accumulated sediment runoff to restore active recreational boating access and to minimize sediment re-suspension from prop wash. Specific SAV/dredging relationships, if any, were masked by variables such as climate, boating, and land use. For example, during this retrospective study period an extended period of drought and severe summer heat in 2002 was followed by the wettest year on record in 2003. These climate events masked relationships between SAV and dredging; the SAV beds were observed to be under stress and dying back. However, this study demonstrates an apparent improvement in SAV habitat following well planned and implemented dredging. Avoidance and minimization of direct SAV disturbance should be pursued and balanced with providing adequate channelways for active boating that are terraced and narrowed to complement natural conditions as much as possible.

Community Reforestation Program

In April 1999, DEPRM formally established the Community Reforestation Program (CRP), a continuing program of reforestation plantings that include establishing riparian and shoreline forest buffers, as well as forest connections between existing, isolated forest patches. The Program is implemented by DEPRM, utilizing funds derived primarily from fees-in-lieu of mitigation collected by Baltimore County under the Forest Conservation Act. Other County

funding and support services for the program are contributed by DEPRM and the Department of Recreation and Parks through both operating and capital fund sources. The CRP provides an efficient mechanism for restoring forest cover to sensitive areas at reasonable cost by operating an in-house, four member reforestation crew, trained in proper planting techniques and critical monitoring and maintenance activities for newly planted forests, and in operating a growing out nursery of forest tree species in a range of sizes to suit individual site conditions.

Currently, this program reflects just the latest stage in a continuum of lessons learned since the plantings were begun in 1996, when DEPRM contracted individually with landscaping and environmental restoration firms for reforestation projects. When a 1998 review of the quality and costs of the projects revealed problems with meeting objectives within the range of the mitigation fees collected, DEPRM contracted with Civic Works, Inc., a Baltimore-based non-profit youth service organization affiliated with the federal AmeriCorps program and chartered through the Governor's Office on Service and Volunteerism. Although this innovative partnership brought relief to the cost component of the program, the talents and skills needed to maintain high survival in the reforestation plantings were difficult to achieve and maintain because of rapid turnover in the corps member team composition. The benefit of having a dedicated, in-house reforestation crew has allowed DEPRM to improve planting and maintenance techniques, and to develop, test, and select machinery and materials to improve efficiency and project survival. As of January 1, 2009, the program has successfully completed 32 reforestation projects on approximately 155 acres of riparian sites, old agricultural fields, and pastures, primarily within county and state parks.

Baltimore City Capital Improvement Program

The Capital Improvement Program (CIP) maps out the implementation phase of the watershed restoration plans. A list of the capital projects, organized by major watershed, with description and status for each project is listed below.

Gwynns Falls Watershed Capital Improvements

Powder Mill Environmental Restoration Project 1

Design Cost: approximately $339,247

Construction Cost: approximately $1,500,000

Status: The design was initiated in the winter of 2008 under an existing on-call agreement with the E.A. Engineering. The Concept design was completed in the fall of 2008. The project was delayed for several months because of objections from the City's Department of Recreation and Parks regarding the number of trees that would have to be removed by the project. After several in-field meetings, a compromise was reached on the stream alignment, and design work is proceeding.

Description: The City plans to assess, analyze, and restore an approximately 2,500-foot section of East Powder Mill Run, located along Northern Parkway, just north of Liberty Road and east of Northern Parkway in City property. The purpose of the stream restoration project is to stabilize an unstable stream reach, reduce bank erosion (and the resulting nutrient discharge that impacts the Chesapeake Bay), and protect sanitary sewer lines along the stream. This

project will be complemented by Baltimore County's efforts to improve water quality in the west branch of Powder Mill Run.

The conceptual design will result in the creation of wetlands that will connect the stream channel to the floodplain. The stream will be allowed to overflow into the wetlands during large storm events, enhancing the nutrient reduction benefits.

Dr. Art Parola from the University of Louisville will be using dendrochronology to get a better estimate of the amount of fine sediments that have been eroded. Dendochronology is a method that uses the amount of tree root exposure adjacent to stream channels to determine the erosion rates. This, coupled with the installation of a stormwater monitoring station on one of the major outfalls to the stream, will improve our ability to estimate the anticipated sediment and nutrient load reductions from the project.

Gwynns Falls Habitat Improvement: Maidens Choice Stream #1

Design Cost: $154,000

Construction Cost: $1,700,000

Status: The Army Corps of Engineers (ACE) completed construction in October 2009.

Description: The project site is located near Beechfield Elementary School on the Maidens Choice Run. The upstream drainage area is 2.9 square miles and the length of stream being restored is 2,700 feet. A wetland is proposed next to the school. A portion of storm drain will be removed to recreate the natural stream. Part of the school parking lot will be investigated for removal. The wetland will treat runoff from both the storm drain and the school parking lot nearby. Also, a portion of Maidens Choice Run at this location will be stabilized.

Jones Falls Watershed Capital Improvements

Western Run Stream Restoration Project 1

Design Cost: $235,776

Construction Cost: $3,000,000

Status: Design of the project is complete, and a contract has been awarded. Notice to proceed was issued to the contractor on December 15, 2009. Construction is currently on hold, but expected to begin on June 16, 2010.

This project is being funded by the Maryland Port Administration (MPA) as mitigation for the Masonville Dredge Spoil site. The City and MPA have completed an agreement that secured the funding. The initial plan was for mitigation funds to cover several of the reaches identified in the Western Run Stream Assessment completed in 2004; however, because of higher than expected costs for this section of Western Run, there are only enough mitigation funds to cover this project.

Description: The City has retained Parsons Brinckerhoff Quade & Douglas, Inc., to prepare a stabilization design for approximately 2,100 feet of stream reach on the main stem of Western Run, in the vicinity of Greenspring Avenue and Pimlico Road, and along Cross Country Boulevard. The stream reaches within this project were recommended in the Western Run Assessment Report as some of the highest ranked reaches for stabilization and improvements.

Given the proximity of the existing sanitary sewers within the stream channel, this stream project will also provide additional protection for the sanitary sewer line.

Open Channel Improvements- Lower Stony Run

Design Cost: $200,000

Construction Cost: $1,000,000

Status: Construction was completed in January 2010.

Description: This project begins below the culvert under Coldspring Lane and continues through Linkwood Park down to Ridgemead Road. Work continues just below University Parkway for another 1,400 feet. The project length is approximately 4,300 feet, although a portion of the stream system flows through underground culverts. The upstream drainage area is 2,700 acres. The section immediately below Coldspring Lane is severely entrenched, with limited floodplain area, failing gabions and concrete channels throughout. The natural channel design approach may not be applicable above University Parkway. The project will try to stabilize the substrate and remove potential fish blockages.

Open Channel Improvements- East Stony Run Phase I and II

Design Cost: $400,000

Construction Cost: $4,000,000

Status: The Charles Street culvert project has to be finished before work can proceed on the stream restoration. The culvert project was advertised for construction in April 2009. Since it will take approximately one year to complete the culvert construction, the stream restoration project will be delayed at least until summer of 2010.

Description: The design will use the principles outlined by the Rosgen (Natural Channel Design) approach where possible to stabilize the stream channel and embankments. The Phase I project will have to convey the flow from a historic stone channel through the Evergreen Property and realign the stream so that it enters the re-engineered culvert entrance under Charles Street. Currently the stream channel approaches the culvert entrance from almost a 180-degree angle. The Phase II project will investigate the elimination of an existing stormwater management pond in the floodplain which causes a pinch-point in the stream channel. Allowing the stream to meander in the area where the pond now occupies will address the design issues that contributed to earlier delays on this project.

Herring Run Watershed Capital Improvements

Moores Run Wetland

Design Cost: $186,000

Construction Cost: $3,200,000

Status: The project was delayed so that construction could be timed to receive Fiscal Year 2011 grant funds from the Chesapeake Bay Trust implementation grant. A $2.7 million grant was awarded from MDE, but put on hold until 2011 (and possibly later) because of the current

budget crisis. In January 2010, the City learned that this project could qualify for Federal Stimulus II funding.

Description: The Moores Run Wetland at Frankford Neighborhood project is located east of Denview Way between Relcrest Road and Force Drive and west of Moores Run. The facility will improve stream water quality by diverting storm flows into the facility, storing this volume for an extended time period before slowly releasing back to Moores Run. The facility itself is comprised of an excavated pond with a stamped concrete control structure located near the lower end of the pond. At the upper end a concrete U-shaped stamped concrete channel will be located in Moores Run. This channel will divert the first storm flows into the facility while still maintaining a base flow in the stream channel. Trash and debris will be collected by a series of trash collection bags that will be frequently replaced as part of a maintenance program. Since a portion of the bottom of the facility is designed to contain a pool of water between 6 and 18 inches deep, wetland plants will be placed within these limits. In addition the area adjacent to the pond will be landscaped and a walking path added to the top of the pond. The facility is designed so that high frequency storm events will be diverted into the Moores Run facility. However, as the storm volume increases, less of the storm flow will be diverted into the facility and more flows will remain in the stream. The less frequent, high volume storms will actually fully fill the facility and overtop the facility along Moores Run.

Yorkwood Elementary School Greening Project

Design Cost: $30,000

Construction Cost: $150,000

Status: The design phase was initiated in the fall of 2008 under an existing on-call agreement. As of February 2010, the design plans are being reviewed by the City's erosion control engineers. Construction is anticipated for the spring of 2010.

Description: The Department of Public Works is working with the Baltimore City Public School System to convert unused impervious surfaces (e.g., asphalt playgrounds and parking areas) into environmentally friendly landscaping areas. This project has been ongoing for several years and described in previous annual reports. Funding is from a variety of sources, including the City's Capital Improvements Projects budget. Yorkwood Elementary School was selected for greening, in Fiscal Year 2009, due to the vast area of asphalt to be removed, and the project's advocacy by the school's administration and its teachers.

The City plans to incorporate a soil treatment technique under a research grant with the University of Maryland Baltimore County. The treatment technique is called "deep tilling", and the purpose is to increase the infiltration rate of the soils after the asphalt is removed. Typically, soils under impervious cover are compacted and not conducive to infiltration.

Harbor Watershed Capital Improvements

Bush Street Trash-Debris Collector

Design Cost: $81,000

Construction Cost: $520,000

Status: A proposal was submitted by one of the City's on-call design firms to design an off-line underground structure in the City's Carroll Park. It will take approximately three months to process the paperwork to authorize the design, and another year to complete the design once approval is granted.

Description: This project is designed to complement the other debris collector projects in the Middle Branch. The site is adjacent to the proposed Alluvion Street debris collector being designed by the Army Corps of Engineers. The Bush Street storm drain outfall drains the heavily urbanized 900 acre Watershed 263. The previous design was a floating netting system at the confluence of the Middle Branch and the Bush Street storm drain. The alternate underground system was selected due to concerns from the development community over the potential unsightliness of a "floating system". This project is a candidate mitigation project that will be funded by MPA. In addition to the underground system, the City will consider testing two additional proprietary trash collection devices on some of the smaller storm drain systems in the watershed.

Watershed 263 Ultra-Urban BMP Pilot and Theme Park

Design Cost: $140,000

Construction Cost: $250,000

Status: Construction was completed in the summer of 2009 for the initial 6 projects. The City received another grant, and is in the design phase for another 4 projects.

Description: The Department of Public Works is partnering with the Center for Watershed Protection (CWP) and Parks and People Foundation (PPF) to construct 6 ultra-urban best management practices (BMPs) in Catchment "O" of Watershed 263. The project was awarded a Pioneer Grant of $100,000 by the Chesapeake Bay Trust and a Stormwater Cost-share grant of $75,000 from MDE. The 6 BMPs were identified in the "Stormwater Management Strategy for Catchment O" that was developed by CWP under a Pioneer Grant awarded to the PPF in 2004. The strategy was based on a systematic physical survey of the 38-acre Pioneer drainage area, and includes municipal and community stewardship projects and suggested priorities.

While numerous "small" practices have already been installed under this strategy, the six BMPs under construction will be featured in a web-based "virtual ultra-urban BMP theme park" created and hosted by the CWP. These BMPs will consist of designs that have not been implemented in highly urban watersheds in the Chesapeake Bay region previously, and include: one bio-retention project, three curb extension projects, one Filterra tree pit project, and one impervious removal project.

Although the practices are different, there are similarities as to how they function. All of these BMPs slow and treat stormwater runoff. The stormwater is directed into the BMP, and then is treated by various processes. For example, the runoff will go through vegetative plantings/landscaping that will allow for infiltration of pollutants into the soil, causing cleaner water to exit the BMP; flow returns to the gutter that directs it to a nearby inlet, where it enters the storm drain system.

I. VOLUNTEER ORGANIZATIONS

Alliance for the Chesapeake Bay

www.AllianceChesBay.org

The Alliance for the Chesapeake Bay is a regional nonprofit organization that builds and fosters partnerships to restore the Bay and its rivers. Known as "The Voice of the Bay", the Alliance is respected as a source of unbiased information and as a neutral party on all Bay watershed issues. Through partnership building and regional cooperation, the Alliance is a coalition of educators, scientists, farmers, recreationists, environmentalists, businesses, government officials, and citizens across the Chesapeake Bay Watershed. Historically, the Alliance has been a leader in facilitating groups to come to consensus on programs that help to protect the Chesapeake Bay. Founded in 1971, the Alliance is funded by individuals, corporations, governments, and foundations. The Alliance maintains staff and offices in Baltimore, Maryland; Annapolis, Maryland; Camp Hill, Pennsylvania; and Richmond, Virginia. The Alliance also conducts related projects that extend our connections with Chesapeake Bay stakeholder groups, as well as increase our competence in habitat restoration, stewardship, citizen engagement, environmentally sound landscaping and development practices, restoration training, and river sojourns.

Through the H2O – Helping to Organize program, designed to mesh with the individual needs of watershed groups to build their capacity to undertake restoration, the Alliance is working or has worked with many of Baltimore City and County's watershed groups. Through these partnerships, the Alliance has helped plant trees in stream valleys, designed and installed urban BayScape gardens, implemented maintenance programs on restoration sites and been a part of several "Watershed Snapshots," an annual picture of the water quality in a watershed that is taken by volunteers across the entire watershed.

Project Clean Stream is a coordinated effort by the Alliance and partners to clean trash, tires and other discarded items from area streams, stream valleys, and nearby roadsides. Project Clean Stream is the area's largest one-day stream and watershed clean up effort. In 2005, 1,300 volunteers cleaned over 90 sites in Central Maryland and the Eastern Shore and recovered nearly 63,000 pounds of trash. Partners include local watershed associations and local city and county government.

In 2005, the Alliance partnered with Baltimore County, the Center for Watershed Protection, the Homebuilders Association of Maryland, and several funding organizations to implement "Builders for the Bay." Builders is a local, roundtable process designed to address obstacles in the current building codes to undertake environmentally sound development.

Currently, the Alliance is involved in a three year Urban Tree Canopy Initiative in which numerous trees will be planted on private and public properties through 2012. This initiative is funded by Constellation Energy and in partnership with Baltimore City and the local Baltimore area watershed groups.

Back River Restoration Committee

www.savebackriver.org

The Back River Restoration Committee (BRRC) is a non-profit, 501(c)3 organization dedicated to restoring the health of the tidal portion of the Back River Watershed. The BRRC has a hands-on approach to tackling issues facing the Back River, and has a strong volunteer base ready to join the fight. Over 800 volunteers participated in the first year of operation.

One of the main issues facing the Back River is trash, and the BRRC is meeting that challenge head on. Herring Run, Red House Run, and Stemmers Run empty into the Back River. Each of these streams travel through some of the most urbanized and industrialized sections of Baltimore City and County. Trash from each of these streams, carried by storm water generated by the vast expanse of impervious surface in the region, eventually makes it to the Back River. In 2009, the BRRC collected over 1000 tires and 40-by-40 cubic yard dumpsters of trash and debris. These numbers, while impressive, have not yet solved the problem. The BRRC looks forward to the installation of a trash boom at the exit of Herring Run, and hopes this will move a continual problem into a maintenance situation that will enable the BRRC to focus on other issues facing the watershed.

This spring, the BRRC anticipates a series of clean ups, community outreach programs, and a variety of other actions identified in the newly developed Tidal Back River Small Watershed Action Plan (SWAP). The plan takes a comprehensive look at the communities surrounding the river and provides a variety of activities that can assist in reviving the Back River. It is a goal of the BRRC to engage the citizens of the region, local businesses operating in the watershed, and county government in actively revitalizing this resource in our community. The BRRC will be expanding their organization and growing their membership during 2010 to maintain focus on their main objective of restoring the Back River.

Baltimore Harbor WATERKEEPER

www.baltimorewaterkeeper.org

The mission of Baltimore Harbor WATERKEEPER is to protect and restore Baltimore Harbor and the greater Patapsco River and its tributaries through enforcement, fieldwork, and citizen action in order to make the river suitable for recreation, including fishing and swimming; to improve public health; and to improve the health of the river ecosystem. Baltimore Harbor WATERKEEPER is a member of the Waterkeeper Alliance (www.waterkeeper.org) and Waterkeepers Chesapeake.

What is a WATERKEEPER?

- the eyes and ears of the waterbody;
- a physical presence on the water via boat patrol;
- a full-time paid public advocate for the waterbody; and
- an independent non-profit organization.

Each Waterkeeper program, including Baltimore Harbor WATERKEEPER, reflects the needs of the waterbody and community it represents. The common thread for each Waterkeeper program is a full-time person who serves as the Waterkeeper, the public advocate for that body of water.

Baltimore Harbor WATERKEEPER uses the law as its primary tool in protecting our local waterways. The focus is on the primary issues affecting the Patapsco River and its tributaries: stormwater, sewage, and toxic pollution. Below are a few examples of recent actions.

- (December 2009) Waterkeepers Chesapeake, which includes Baltimore Harbor WATERKEEPER, together with Waterkeeper Alliance, filed a petition to the U.S. Environmental Protection Agency (EPA). The petition calls for EPA to revoke Maryland[1]s delegated authority to administer the Clean Water Act's permitting program unless the State takes the necessary corrective action to improve its performance.
- (May 2009) The Chesapeake Bay Foundation and Baltimore Harbor WATERKEEPER announced that they have notified EPA, the Maryland Department of the Environment (MDE), and the current and former owners of the Sparrows Point steel plant of their intention to sue them in federal court to force a clean-up of pollution flowing from the plant site, to conduct an adequate assessment of risks to human health and the nearby ecology, and to address other violations of the law.
- (May 2009) Culminating a year-long effort, WATERKEEPERS Chesapeake, which includes Baltimore Harbor WATERKEEPER, and the Waterkeeper Alliance reached an agreement with MDE resolving the legal challenge to MDE's general stormwater permit for construction sites. As a result of this agreement, MDE has committed to making significant changes to the way it requires developers to prevent polluted runoff caused when rain washes sediment and other pollutants from these exposed areas. In addition, MDE was able to secure ten additional staff to support their permitting program.

Get the Dirt Out Chesapeake is region-wide program conducted by Waterkeepers Chesapeake to train citizen volunteers to identify and report construction pollution. Baltimore Harbor WATERKEEPER is working to train citizen volunteers as well as work with developers and contractors to reduce construction stormwater pollution.

Waterkeepers Chesapeake is a coalition of sixteen independent Waterkeeper programs working to protect and restore the Chesapeake and Coastal Bays and their tributaries. Waterkeepers Chesapeake works locally, using grassroots action and advocacy to protect their communities and their waters. They also work regionally to share resources and leverage their individual strengths to expand each Waterkeepers' capacity for on-the-water, citizen-based enforcement of environmental laws in the Chesapeake region. They patrol thousands of miles of tributaries and shorelines throughout the Chesapeake and Coastal Bays and are at the forefront of enforcement efforts.

Baltimore Harbor Watershed Association

www.baltimorewaters.org

Baltimore Harbor Watershed Association (BHWA) is a 501(c)3 non-profit organization representing individuals, businesses, government agencies, and other non-profit organizations with an interest in promoting and helping to establish a better quality of life in and around the Harbor. The mission is to improve and protect the environmental quality and natural beauty of the Baltimore Harbor and its tributaries. Since its inception in 2004, the BHWA has concentrated on changing or creating policies that would impact the Harbor and its tributaries. The BHWA's goals are to address water quality issues, public health impacts, trash reduction in

the harbor, watershed plan development, public outreach, and shoreline conservation and restoration.

The BHWA has initiated or participated in the following projects to address these goals:

- worked with the City and the Abel foundation for the trash collection system installations in the Jones Falls and Harris Creek;
- in 2008, obtained trash impairment designation (TMDL) for the Baltimore Harbor and Middle Branch; partnered with the Baltimore Harbor Waterkeeper;
- in 2009, established a bacteria monitoring program to obtain a bacteria impairment designation (TMDL) for the Baltimore Harbor and Middle Branch; partnered with the Baltimore Harbor Waterkeeper;
- initiated state legislation for a bottle bill (bottle deposits) in 2007, 2008, 2009 and 2010;
- initiated the preparation of the Middle Branch Master Plan to insure that future development would be environmentally sensitive;
- held the conservation easement to protect the view corridors for waterfront housing development;
- organized citizen and business groups to clean the harbor;
- managed Harris Creek Park improvements to include eradication of phragmites and the creation of new gardens; and
- worked to improve the quality of the environment and the quality of life in a diverse 1,300 acre Harris Creek Watershed, known as Watershed 246; partnered with the City and Chesapeake Bay Trust.

Dundalk Renaissance Corporation - Greening of Dundalk

www.dundalkusa.org

The Dundalk Renaissance Corporation (DRC) revived the Greening of Dundalk program in 2008. At its first inception, the Greening of Dundalk had promoted and sponsored community tree plantings throughout the Dundalk area. The all-volunteer group's activities dwindled with time, but at its twentieth anniversary the DRC saw an opportunity to add greening to its portfolio of programs to address community revitalization.

The Greening program at the DRC is volunteer-based. Community members volunteer to pick-up litter along streets and in parks during occasional community clean-up events. Between the fall of 2008 and 2009, volunteers planted more than 125 trees throughout Dundalk. The main focus of tree planting initiatives has been to increase Dundalk's urban tree canopy, focusing plantings in neighborhoods and along the Historic Main Street. Additionally, in May of 2008, the DRC partnered with the Ateaze Senior Center in Dundalk to install a rain garden that catches and filters rain water from the center's roof.

The Greening of Dundalk at the DRC also has provided educational opportunities to community members to increase their environmental awareness. This winter, the DRC partnered with the Southeast Community Development Corporation and their newly formed Green Southeast program to host a free environmental speaker series. The DRC also works to provide programming that supports Dundalk-area schools in receiving and sustaining the Maryland Green School Award.

Although all of the work of the DRC is done through the lens of community development, the greening program has provided an additional means of such development. Through the program, the DRC is able to provide residents with a way of building a sense of community—working alongside neighbors for the benefit of the greater community. The Greening program strives to engage the Dundalk community in projects that beautify the community while promoting environmental stewardship.

Friends of the Patapsco Valley and Heritage Greenway

www.patapscoheritagegreenway.org

The Friends of Patapsco Valley and Heritage Greenway (FPVHG) is a non-profit, 501(c)3 organization of volunteers who are dedicated to preserving, protecting, interpreting and restoring the environment, history, and culture of the Valley. This mission has two primary goals: 1) telling the story of the valley and 2) protecting the valley. FPVHG encourages the positive management of the Patapsco Valley, including the Patapsco State Park and the surrounding communities. The organization is actively involved in developing educational materials about the environment and the history of the valley, and interpreting its story.

In support of the environmental mission, the tenth annual "Garlic Mustard Challenge" was held on May 1, 2009. FPVHG utilizes the Garlic Mustard Challenge to educate the community about the importance of understanding the balance of nature. Garlic Mustard is a native plant of Europe and was first recorded in the United States about 1868 in Long Island, New York. Settlers probably introduced it for food and medicinal purposes. Garlic Mustard, like other "invasives," poses a severe threat to native plants and animals in forest communities in much of the eastern United States. To date, volunteers have picked over 12,882 pounds of Garlic Mustard. To peak interest and make a fun event, FPVHG hosts a cooking contest open to amateur adult and child chefs. Everyone gets to taste the food, which is excellent especially with the backdrop of live music from a local musician. Prizes are given to those who pick the most as well as to the winning recipes. The positive educational exposure has grown exponentially each year.

Also in support of its environmental mission, FPVHG sponsors stream and watershed cleanups throughout the year. In the past four years, as a result of its successful stream watch program in the Patapsco River watershed, FPVHG has:

- removed over 131 tons (262,141 pounds) of trash, debris, tires, appliances, and salvaged metal;
- planted 241 trees (over 2 1/2 acres)—the latest tree planting was a new grove of the dwindling American Chestnut tree species (near historic Belmont in Elkridge);
- removed over 4 tons (8,128 pounds) of invasive garlic mustard; and
- monitored 63 streams (or sections of the Patapsco River), adopted by stream watch volunteers.

In support of its historical mission, FPVHG sells Professor Henry Sharp's book, *The Patapsco River Valley: Cradle of the Industrial Revolution in Maryland*. It is a wonderful, descriptive book about the Patapsco Valley. FPVHG was responsible for funding Dr. Sharp's initial research as well as helping him write the manuscript in preparation for the publication of the book by the Maryland Historical Society.

In addition, the organization has sponsored several informal history talks, developed a new Patapsco Heritage Map, and guided hikes, bike rides, and kayak/canoe tours in the Patapsco River.

We are working with local organizations to showcase sites and activities in Elkridge, Ellicott City, Hanover, Linthicum, Arbutus, Catonsville, Halethorpe, and Oella within the Patapsco River Valley.

Gunpowder Valley Conservancy

www.gunpowderfalls.org

The mission of the Gunpowder Valley Conservancy (GVC) is to mobilize people and resources to care for the lands, waters and character of the Gunpowder Watershed. The GVC's emphasis is twofold: environmental education and restoration, and land and historic preservation.

The GVC has achieved 20 years of success building a community of dedicated volunteers to realize its mission, with measurable outcomes in land preservation, environmental restoration, and environmental education.

The dedication and hard work of the GVC has paid off. Since 1989, the GVC has maintained conservation easements on over 1,400 acres of land, planted more than 18,350 trees on 90 acres, given hundreds of educational presentations, coordinated the adoption and clean up of more than 50 streams and, most importantly, recruited more than 10,000 dedicated volunteers to protect and restore the lands and waters of the Gunpowder Watershed.

Gwynns Falls Watershed Association

www.gwynnsfalls.net

The Gwynns Falls Watershed Association, (GFWA) is a non-profit volunteer organization dedicated to the protection and restoration of the Gwynns Falls Watershed as a community resource for the people of Baltimore City and County. Since its formation in 1997, the organization has worked with community groups to identify degraded streams, create awareness of the benefits of clean water and riparian buffers, and conduct restoration activities within the 65 square mile watershed.

Memberships, donations, and fundraising have enabled the organization to implement stream restoration and outreach activities. Thousands of volunteer hours have been donated for these activities. Examples of these activities include stream cleanups (which have picked up thousands of pounds of trash), planting acres of trees, and creating greater public awareness of the streams within the Gwynns Falls Watershed. The GFWA created a Stream Watch program, through which volunteer teams are trained to monitor and report on the condition of their adopted streams.

During the past year, the GFWA has begun a stormwater initiative with a goal of decreasing the amount of pollutants running into streams. Through this initiative it has worked with schools and community groups to create rain gardens and bioretention areas.

Last year, GFWA partnered with Irvine Nature Center and Thomas Jefferson Elementary School/Middle School (TJ School) to build a rain garden on their campus in west Baltimore. On "Green Thumb Day", every student in the school came out to dig, plant, and mulch the garden.

This year they will partner again with TJ School and the local community to build the TJ Nature Trail. The trail will provide easy and safe access to Leakin Park and the Gwynns Falls Trail for environmental education opportunities.

The GFWA has also begun working with faith groups in the interdenominational "Care for Creation" program. They support The Samaritan Women, a women's recovery program in west Baltimore, in the development of their 21 acre campus by implementing a large and highly visible rain garden. Partnering with the Jewish Community Center in Owings Mills, the watershed association plans to reforest a 2 acre section of their campus and restore an eroding culvert.

Herring Run Watershed Organization

www.herringrun.org

The Herring Run Watershed Association (HRWA) is a grassroots, volunteer-based watershed organization active in the Herring Run Watershed within Baltimore City and Baltimore County. The Herring Run Watershed covers 31 square miles in NE Baltimore, draining into the Back River and ultimately the Chesapeake Bay. The watershed is highly urbanized with degraded streams flowing through more industrial and denser development as it flows downstream.

HRWA's mission is to improve the environmental and aesthetic quality of the Herring Run Watershed by conducting stewardship and education programs, and by mobilizing volunteers for monitoring, restoration, and advocacy. Their main focus has been reducing stormwater and sewage in streams, increasing urban tree canopy, and changing homeowner behaviors to improve stream health. HRWA regularly engages in hands-on projects that take people to the stream and show them the problems and opportunities. Below is a list of some of our activities.

Conservation landscaping to reduce runoff:

- HRWA maintains its own native tree and shrub nursery for planting projects throughout the watershed, and for sale to the public. In 2009, they planted over 1,100 trees and potted 3,550 seedlings for future reforestation efforts.
- HRWA has a new fee-for-service conservation landscaping program designed to assist homeowners and businesses in creating low-cost, low-maintenance, environmentally beneficial landscapes.

Taking action to reduce stormwater runoff from homes:

- HRWA has recently started a free downspout disconnection program to reduce stormwater runoff from residential properties.
- HRWA holds monthly rain barrel building, education, and outreach workshops where homeowners can learn about the damage caused by stormwater and how rain barrels can help. To date they have given away or sold over 500 rain barrels.

Developing watershed plans:

- HRWA is partnering with Baltimore City and County on the Herring Run portion of Upper Back River Small Watershed Action Plan (SWAP), a comprehensive plan designed to identify the primary sources of water pollution and prioritize restoration opportunities.

Monitoring streams for sewer overflows:

- HRWA supports and helps organize members of the community to advocate for the cleanup of the sewer system. Through their Adopt-a-Stream program, volunteers are trained to identify and report sewer and other stream problems and engage in regular clean up efforts. The watershed association also participates in the Baltimore Sanitary Sewer Oversight Committee, a coalition of advocates whose mission is to ensure that cleanup of the sewers results in the least environmental damage.

Creating a green urban watershed center:

- In the fall of 2008, HRWA moved into its new headquarters, the Herring Run Watershed Center. Originally an old dilapidated bakery, the building was transformed over three years of visioning and construction into a model of green building. Regular tours are given of the new facilities, which are certified LEED Gold NC by the U.S. Green Building Council, to show people how sustainable design directly contributes to a healthier environment. The Herring Run Watershed Center received special recognition at the 2009 Maryland Green Building Council Awards Ceremony.

Collaboration with Baltimore's Watershed Groups:

- In 2008, the HRWA entered into discussions on strategic restructuring with the Baltimore Harbor Watershed Association, the Gwynns Falls Watershed Association, the Jones Falls Watershed Association, and the Baltimore Harbor Waterkeeper. By the end of 2009, all parties signed resolutions signaling their intent to merge.
- The HRWA is confident that this restructuring will benefit its: capability to accomplish a common mission, chance to be heard and change public policy, ability to attract and retain quality staff, collective program effectiveness, administrative efficiency, capacity to lead, sustainability, and true impact on Baltimore waterways.

Irvine Nature Center

www.explorenature.org

Irvine Nature Center is a non-profit environmental education organization whose mission is to inspire appreciation and respect for the natural world, to increase awareness of environmental issues, and to encourage individuals to sustain Earth's ecosystem. Since its inception thirty-five years ago, Irvine Nature Center has provided environmental education programs and community outreach activities to engage people in sharing nature's wonder.

As the only private non-profit nature center in the region, Irvine's programs include school field trips; Schoolyard Discovery Urban Education Program; installing schoolyard habitats; a variety of natural history public programs for children, families, and adults; nature-themed summer camps; scout programs; volunteer naturalist training; Habitat Stewards training; and special events such as PumpkinFest, Bird-A-Thon, Native Plant Seminar and Sale, and Project Clean Stream.

Now in its 34th year, Project Clean Stream is a coordinated effort by Irvine and many partner organizations to clean trash, tires, and other discarded items from area streams and nearby roadsides. Project Clean Stream is the region's largest, and oldest, one-day stream and watershed cleanup effort, and in 2004 Irvine turned the helm over to the Alliance for the

Chesapeake Bay with the intention that the event will continue to grow in size to incorporate more of Maryland's imperiled watersheds. In 2009, 2,718 volunteers removed 322,635 pounds of trash from 156 sites around Maryland.

On its stunning 116-acre natural site in Owings Mills, the Center also features a natural history museum with live animals and hands-on exhibits, demonstration gardens, self-guided nature trail, and a fabulous nature store. The Center is free and open to the general public seven days a week, year round, except for major holidays.

Jones Falls Watershed Association

www.jonesfalls.org

The Jones Falls Watershed Association (JFWA) is a volunteer-driven grassroots organization started in 1997 to protect and restore the Jones Falls and its tributaries. The mission of the Jones Falls Watershed Association is to protect and restore the health and beauty of the Jones Falls watershed through restoration, monitoring, advocacy, and citizen awareness. The organization is credited with bringing attention back to the river and building awareness of the stream and stream valley as natural resource assets for the community.

The Jones Falls watershed encompasses 58 square miles including rural segments of Baltimore County at its upper reaches. The stream meanders through increasing levels of development until it emerges from a tunnel at Baltimore City's Inner Harbor.

The JFWA is a primary partner with Baltimore City on the Jones Falls Trail. The trail route will eventually connect Baltimore's Inner Harbor with Robert E. Lee Park and Lake Roland. The JFWA is assisting with signs, promotion, and other trail enhancements. The watershed association also sponsors canoeing/kayaking events. Volunteer activities include stream cleanups, water quality monitoring, and native tree and shrub buffer plantings.

Middle River Watershed Community Action Coalition

www.chesapeakebaymemories.org

Over the past six years, Eastern Baltimore County based Chesapeake Bay Memories Charities has engaged over 10,300 Baltimore County residents in Chesapeake Bay stewardship education and restoration activities with an emphasis on encouraging and monitoring water quality improvement.

People who learn, live, work, and play in the Middle River watershed want a more focused collaborative water quality improvement effort. To effectively address implementation of this effort, the Charity established the Middle River Watershed Community Action Coalition.

Middle River Watershed Community Action Coalition's mission is to make measurable progress in restoring Middle River Watershed water quality by actively reaching, educating, organizing, and engaging the Middle River Watershed community in the following:

- local watershed issues identification, prioritization, and development of action plans to address them; and
- water quality improvement and potential restoration project identification, information gathering, planning, implementation, and monitoring.

Over a three-year period, since its inception, the coalition has become expanded into a community-wide effort. It has increased stakeholder awareness, action, ownership, and pride in local level Chesapeake Bay stewardship and connections to regional efforts.

Parks & People Foundation

www.parksandpeople.org

www.beslter.org

www.gwynnsfallstrail.org

www.watershed263.org

www.urbanecologycollaborative.org

The Parks & People Foundation is dedicated to supporting a wide range of recreational and educational opportunities, creating and sustaining beautiful and lively parks, and promoting a healthy natural environment for all. Established in 1984, the Parks & People Foundation is a non-profit organization that strives to improve the quality of life for all people in the Baltimore area through educational and recreational programs that motivate young people and through partnerships that create and sustain green spaces.

The foundation's staff, partners, and community volunteers have developed innovative solutions to issues facing Baltimore including the restoration of neighborhoods and their natural resources as well as the academic enrichment and motivation of children. In order to realize its vision of a healthy environment where people live, work, learn, and play, they have formed a strategy targeting two major fields of endeavor:

- great Parks, Clean Streams & Green Communities - Helping to improve the physical, social, and environmental quality of neighborhoods through greening activities and forming networks among communities to sustain natural resources; and
- motivating Youth - Programs nurturing children and supporting communities by working together to provide enriching activities for youth.

The foundation is proud of its efforts to develop incredible parks and trails, such as the Gwynns Falls Trail and Greenway. The greening programs also include community greening stewardship, tree planting, as well as vacant lot, schoolyard and watershed restoration supported by U.S. Forest Service, Maryland Forest Service, Chesapeake Bay Trust, and many others. They also work closely with other organizations on projects that increase recreational opportunities and protect Baltimore's natural resources including the Urban Resources Initiative, Park Partnership Program, and Baltimore Track FAC with Baltimore City Department of Recreation and Parks, as well as Baltimore/Chesapeake Bay Outward Bound Program, Baltimore Ecosystem Study, Baltimore Alliance for Recreation and Parks, and nationally, the Alliance for Community Trees, City Parks Alliance, and the Urban Ecology Collaborative.

In urban areas across the country, trees and grass have been replaced with too much asphalt and concrete. Storm water runoff from impervious surfaces in cities can carry harmful substances such as gasoline, oil, heavy metals, bacteria, and trash to our streams and bays. In Baltimore City, Parks & People Foundation, Baltimore City Department of Public Works, U.S. Forest Service, Baltimore Ecosystem Study, and many other partners have joined forces to clean up the runoff flowing into the harbor and into the Chesapeake Bay from Watershed 263,

one of 355 storm drain watersheds in the city. Watershed 263 is a 930-acre area in west and southwest Baltimore City that encompasses 12 urban neighborhoods. Surface water that collects on streets in Watershed 263 flows untreated into the Baltimore Harbor after traveling through a 43-mile storm drain system (underground river system) that converges into one outfall pipe near the mouth of Gwynns Falls, in the Middle Branch. Water quality in the Chesapeake Bay is adversely affected by urban areas such as Watershed 263. Project partners are all making unique contributions to the common goal of measurably improving water quality and quality of life in this particular watershed area in Baltimore City. To hear the story of Watershed 263 go to http://www.talesfromurbanforests.org/.

The foundation recently began a process to transfer their experience in Watershed 263 to the eastside of Baltimore City in Watershed 246 (Harris Creek) and Westport along the Middle Branch of the Patapsco River.

Prettyboy Watershed Alliance

www.prettyboywatershed.org

The Prettyboy Watershed Alliance (PWA) is a volunteer-driven grassroots organization that serves the 80 square mile area that drains to the Prettyboy Reservoir. Approximately half the land area is in northwestern Baltimore County and the other half is in northeastern Carroll County. PWA's ongoing efforts include: (1) participation in DNR's Stream Wader program that assesses the macro-invertebrate population in our streams and also promotes stewardship and awareness in the community, (2) planting native trees and shrubs on local landowners property, (3) implementation of a Stream Watch program in which local volunteers adopt and monitor a stream of their choice, (4) participation in Project Clean Stream, (5) participation in the Growing Native project in which seeds from native hardwoods are collected, and (6) provide a residents' voice to governmental agencies with jurisdictional responsibility for the watershed.

J. RESOURCE LIST

Organization	*Support*
The Alliance for the Chesapeake Bay Lou Etgen, Associate Director Phone: 410-377-6270 www.acb-online.org/ letgen@acb-online.org	Project Tech Support Watershed Awareness Information BayScaping
Baltimore City Bill Stack Surface Water Management Division Department of Public Works Phone: 410-396-0732 Bill.stack@baltimorecity.gov	Regional Watershed Coordination City Data Greening Schools Program
Baltimore City Department of Recreation and Parks Dwayne B. Thomas, Ph.D., Interim Director Phone: 410-396-7900 baltimorecity.gov/Government/AgenciesDepartments/RecreationandParks.aspx bcrpgeninfo1@baltimorecity.gov	Nature Centers Trail Systems
Baltimore County Department of Environmental Protection and Resource Management (DEPRM) Phone: 410-887-3733 www.baltimorecountymd.gov/Agencies/environment/index.html deprm@baltimorecountymd.gov	Local Regulations Green Schools Program Capital Projects Regional Watershed Coordination
Baltimore County Department of Public Works Edward C. Adams, Jr., Director Phone: 410-887-2000 www.baltimorecountymd.gov/Agencies/publicworks/index.html publicworks@co.ba.md.us	Solid Waste Management Recycling Education
Baltimore County Department of Recreation and Parks Robert J. Barrett, Director Phone: 410-887-3871 *Fax: 410-825-3305* www.baltimorecountymd.gov/Agencies/recreation/index.html recparks@baltimorecountymd.gov	Nature Centers – Oregon Ridge, Marshy Point, Days Cove, Cromwell Valley Education Programs Natural History
Baltimore County DNR Forester Rob Prenger Cub Hill Ranger Station Phone: 410-665-5820 rprenger@dnr.state.md.us	Community Greening Committee Right-of-Way Planting Permits

Organization	***Support***
Baltimore County Forestry Board Melvin Noland Phone: 410-665-5820 www.bcfb.sailorsite.net/ mlnoland@bcpl.net	Tree Planting Projects Schoolyard Reforestation Wildlife Habitat Program Schoolyard Assessment Teacher Training
Baltimore County Public Schools C. David Copenhaver, Science Coordinator Phone: 410-887-2063 www.bcps.org ccopenhaver@bcps.org	Administration – Baltimore County Public Schools
Baltimore Harbor Waterkeeper Phone: 410-366-3038 www.baltimorewaterkeeper.org eliza@harborwaterkeeper.org	
Baltimore Harbor Watershed Association Phone: 410-563-7300 www.baltimorewaters.org dkirsh@baltimorewaters.org	
Businesses for the Bay MDE Laura Armstrong 410-537-4119 Mary Lynn Wilhere 410-377-6270 www.acb-online.org/b4b/index.cfm larmstrong@mde.state.md.us	Pollution Prevention Program for Businesses Recognition Program
Center for Watershed Protection *Hye Yeong Kwon, Executive Director* *Phone: 410-461-8323* www.cwp.org center@cwp.org	Watershed Data Presentations Workshops and Training Technical Assistance Water Quality Information
Chesapeake Bay Foundation (CBF) Philip Merrill Environmental Center Phone: 410-268-8816 www.cbf.org Chesapeake@cbf.org	Raingardens Manual School Programs Demonstration Sites
Chesapeake Bay Program 410 Severn Avenue / Suite 109 Annapolis, MD 21403 Phone: 1-800-YOUR-BAY Fax: 410-267-5777 www.chesapeakebay.net	Bay Program Publications Meeting Minutes Calendar of Events Grants and RFPs
Chesapeake Bay Trust Allen Hance, Ph.D., Executive Director Phone: 410-974-2941 www.chesapeakebaytrust.org ahance@cbtrust.org	Grant Funding

Organization	***Support***
Environmental Concerns Diane Miller, Wetland Restoration Specialist Phone: 410-745-9620 www.wetland.org/ restoration@wetland.org	POW guide (Planning of Wetlands) Training Workshops
Friends of the Patapsco Valley and Heritage Greenway Betsy McMillion Phone: 410-480-0824 www.patapscoheritagegreenway.org patapscofriend@gmail.com	Coordination of Local Watershed Activities
Gunpowder Valley Conservancy Peggy Perry Phone: 410-668-0118 www.gunpowderfalls.org little-owl@msn.com	Coordination of Local Watershed Activities
Gwynns Falls Watershed Association Scott Pelton, Program Director Phone: 410-945-3996 www.gwynnsfalls.net info@gwynnsfalls.net	Coordination of Local Watershed Activities
Herring Run Watershed Association Mary Robe, Executive Director Phone: 410-254-1577 ext 101 www.herringrun.org mroby@herringrun.org	Coordination of Local Watershed Activities
Irvine Nature Center Peggy F. O'Neill, Executive Director Phone: 443-738-9200 www.explorenature.org/ info@explorenature.org	Project Tech Support Habitat Stewards Training School Programs Native Plant Sales Annual Conference
Jones Falls Watershed Association Halle Vander Gaag, Executive Director Phone: 410-366-3036 www.jonesfalls.org hvandergaag@jonesfalls.org	Community Organizing Volunteering Events Planning and Coordination Landscape Assessment
Living Classroom Foundation Scott Raymond, V.P. of Education Phone: 410-685-0295 x217 www.livingclassrooms.org Scott@livingclassrooms.org	Educational Programs Teacher Training Staff Development

Organization	*Support*
MD Association of Environmental and Outdoor Education (MAEOE) Bronwyn Mitchell, Executive Director Phone: 443-733-1220 ext 114 www.maeoe.org director@maeoe.org	Green Schools Program Annual Conference Schoolyard Habitat Partners Environmental Education Training
Maryland Biological Stream Survey Paul Kazyak Phone: 410-260-8607 www.dnr.state.md.us/streams/mbss/ Stream Waders: www.dnr.state.md.us/streams/mbss/mbss_volun.html	Biological Data County Technical Reports Publications Stream Waders Citizen Program
MD Cooperative Extension Baltimore County Office David Martin, Director Phone: 410-666-1022 http://extension.umd.edu/ dmartin@umd.edu	Information BayWise Landscaping Yardstick Program Pest Management
MD Department of Agriculture Fred Samadani, Nutrient Management Program Phone: 410-841-5959 http://www.mda.state.md.us/ samadaf@mda.state.md.us	Guidelines: Urban Nutrient Management Plans Training
MD Department of Natural Resources Cindy Etgen Phone: 1-877-620-8DNR www.dnr.state.md.us cetgen@dnr.state.md.us	Green Schools Program Tree-Mendous MD Storm Drain Stenciling Grant Funding
MD Department of the Environment Phone: 410-537-3000 www.mde.state.md.us webmaster@mde.state.md.us	Businesses for the Bay Program Funding Hazardous Waste Issues
MD Native Plant Society www.mdflora.org *info@mdflora.org*	Native Plants Invasive Species Plant Lists
MD State Department of Education Phone: 410-767-0100 www.msde.state.md.us	Environmental Education
Middle River Watershed Community Action Coalition Penny Soteria Phone: 410-918-2225 www.chesapeakebaymemories.org penny@chesapeakebaymemories.org	Volunteer Training Workshops Presentations Coordination of Local Watershed Activities

Organization	***Support***
Parks and People Foundation Guy Hager 410-448-5663x101 www.parksandpeople.org guy.hager@parksandpeople.org info@parksandpeople.org	Watershed Organizing & Restoration Urban forestry and Greening Stewardship Small grants Park Partnerships Surveys and Planning Ecosystem Research
Prettyboy Watershed Alliance Phone: 410-239-0640 http://prettyboywatershed.org prettyboywatershed@gmail.com	Coordination of Local Watershed Activities Presentations Workshops and Training Volunteer Training
Soil Conservation Service District Office Agricultural Building Phone: 410-666-1188 www.mascd.net/BCSCD/ jim.ensor@md.nacdnet.net	Nutrient Management Program
Total Maximum Daily Load (TMDL) Maryland: www.mde.state.md.us/Programs/WaterPrograms/TMDL/index.asp US EPA National: http://www.epa.gov/OWOW/tmdl/index.html US EPA Region 3 (Mid-Atlantic): http://www.epa.gov/reg3wapd/tmdl/index.htm	Total Maximum Daily Load Information
Towson University Jane Wolfson, Environmental Science and Studies Program Phone: 410-704-4920 Jwolfson@towson.edu	University Contact
Tree-Mendous MD Program Terry Galloway Phone: 410-260-8517 www.dnr.state.md.us/forests/Treemendous/ Tgalloway@dnr.state.md.us	Native Plants
UMBC – Baltimore Ecosystem Study (BES) Ken Belt Phone 410-455-8011 www.beslter.org belt@umbc.edu	Research
US Fish and Wildlife Service Phone: 410-573-4500 www.fws.gov	BayScaping Wetlands and Ponds Schoolyard Habitat Program

Organization	***Support***
Valleys Planning Council Teresa Moore, Executive Director Phone: 410-337-6877 www.thevpc.org moorevpc@comcast.net	Community Stewardship Land Preservation