# STRATEGY FOR SAWMILL CREEK RESTORATION

**A TARGETED WATERSHED PROJECT**

## April, 1992

## Prepared Cooperatively by:


Anne Arundel County
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Maryland Department of Environment
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Office of State Planning
Soil Conservation Service
Chesapeake Bay Foundation


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Although many people reviewed this document, any errors are the responsibility of the Project Leader and Project Coordinator.

## OVERVIEW

The cumulative effects of traditional suburban/urban development patterns are pervasive in the Sawmill Creek watershed. The environmental impacts are diverse in origin and synergistic in their effects. Several system-wide management issues must be resolved before most site-specific restoration projects can be implemented effectively.

The following points summarize problems to be addressed and the first steps to be taken to solve them. More details are provided in the report text.

A. **Water Quantity:** The natural hydrology of Sawmill Creek and its tributaries has been severely disturbed and needs to be rehabilitated to a more stable, natural stream condition. This should be the first priority of the restoration process.

1. **High flows** need to be controlled by the implementation of a regional stormwater management plan. A cooperativine demonstration project by state agencies on Muddy Bridge Branch is the first step.

2. **Baseflow** has been so severely reduced that parts of the stream have gone dry. State and county water supply agencies need to coordinate with living resource management agencies to develop a management plan that includes protection for stream biota.

B. **Water Quality:**

1. **Sediment** loading in the Sawmill Creek watershed is primarily a function of stream bed erosion. The stormwater management plan (A.1.) must focus on reducing erosive velocities within the stream channels.

2. **Nutrient** inputs are diverse and the relative contribution of nonpoint sources needs to clarified. The monitoring team studies should focus on the sources of nutrient and chemical contamination (B.3.).

3. **Chemical pollution** has a variety of sources, and some progress has been made on managing the largest known source. A special work group should be assigned to quantify and resolve the toxicity issues that have been raised by field investigations. NPDES permit monitoring and enforcement need to be upgraded.

C. **Habitat:** Riparian buffer protection and stream channel restoration are needed.

1. A **site-specific inventory of habitat problems** and habitat enhancement projects for the entire watershed is needed.
Citizen groups and the monitoring team could perform this task.

2. **Fish passage improvement, stream channel stabilization and stormwater management retrofits** are being incorporated into current State construction projects. These activities should be included in all new construction projects.

3. **County rules** protecting forests, streams and buffers could be **consolidated** into one document for easy reference. Currently they are dispersed throughout a number of pieces of legislation, laws and ordinances.

D. **Citizen involvement** needs to be increased. The recently formed public participation work group should focus on:

1. Park/trail linkages
2. Greenways program
3. Stewardship and public awareness

**Scope and Organization of the Report**

The purpose of this report is to provide an overview of existing environmental conditions in the watershed and to provide a strategy to prioritize the actions that can be taken to improve the water quality and the habitat conditions for living resources. The environmental problems facing this watershed are diverse in origin and synergistic in effect. The remediation of these problems will have to be accomplished by a number of different organizations and groups who must integrate these tasks into their existing programs. Details of specific restoration actions will be presented as a series of separate reports. These reports will be developed by work groups composed of specialists from the whole targeting team and other interested parties.

The description of the existing environmental conditions draws on the Sawmill Creek, Baseline Monitoring Report (Marshall, et al., 1992), a report that summarizes the data collected by the Targeted Watershed Project. Additional information about the environmental conditions in the watershed was provided by field observations made by the Team members and residents of the watershed. In 1986 Anne Arundel County commissioned a report on the Sawmill Creek watershed for the purpose of evaluating a park linkage system (Columbia Design Collective, Architects, Inc., December, 1986). Some of the information contained in that report was used as background for this document.

This report begins with a brief description of the Maryland Targeted Watershed Project. The second section contains a description of the geography, historic, current and anticipated future conditions of the whole watershed. The third section expands the description of the watershed, describes the subdivisions of the watershed as three major segments based on the predominant land use and presents the main environmental problems for each segment. The fourth section describes our communications and public information efforts. The fifth section summarizes what has been learned about the watershed and how the Targeted Watershed Project has evolved. The sixth section provides direction on how to resolve the environmental problems in the three segments.

The appendix of the report contains background on the overall Targeted Watershed Project and references to materials that are of project-specific and general interest.

# I. INTRODUCTION

## A. Maryland's Targeted Watershed Project Description

The Targeted Watershed Project provides an opportunity for Chesapeake Bay managers to develop, demonstrate and evaluate a coordinated approach to improving water quality and the habitat conditions for living resources in four small watersheds, called targeted watersheds (Figure 1). Through the implementation of various Bay cleanup activities in the targeted watersheds, the project will demonstrate and help evaluate the effectiveness of a number of the Chesapeake Bay Agreement commitments.

Current regulatory and management strategies address the impacts of individual projects. This project-by-project approach developed at a time when pressures on the Bay from human activities were far less significant. This approach is no longer adequate to protect or restore the tributaries or the Bay.

Many of the problems in the watersheds are from physical modifications to the landscape, aquatic habitat destruction, and nonpoint source pollution (NPS). NPS is the pollution carried to waterbodies by rain water runoff and atmospheric deposition. The programs to address these sources of nonpoint source pollution involve actions by both urban and agricultural organizations.

Inter-agency teams have determined the overall direction for the project work, based on policy direction from the members of the Bay Workgroup. (The Bay Workgroup is a committee of senior executives from environmental agencies.) Appendix One provides a description of the major tasks of the overall Targeted Watershed Project. Appendix Two contains a diagram of the project's organization.

## B. Organization of the Sawmill Creek Project

For the Sawmill Creek watershed, two inter-agency teams have been responsible for planning and conducting the monitoring and restoration work. After the state agencies began work on the Targeted Watershed Project, county and federal officials and representatives from non-governmental organizations joined the teams. Some individuals serve on both teams. Five departments in Anne Arundel County government have been involved in various capacities. Seven state departments are involved. Three federal agencies, five non-governmental organizations, several private citizens and local businesses have been involved. Appendix Three provides an abbreviated list of the individuals who have been involved with monitoring and restoration team work.

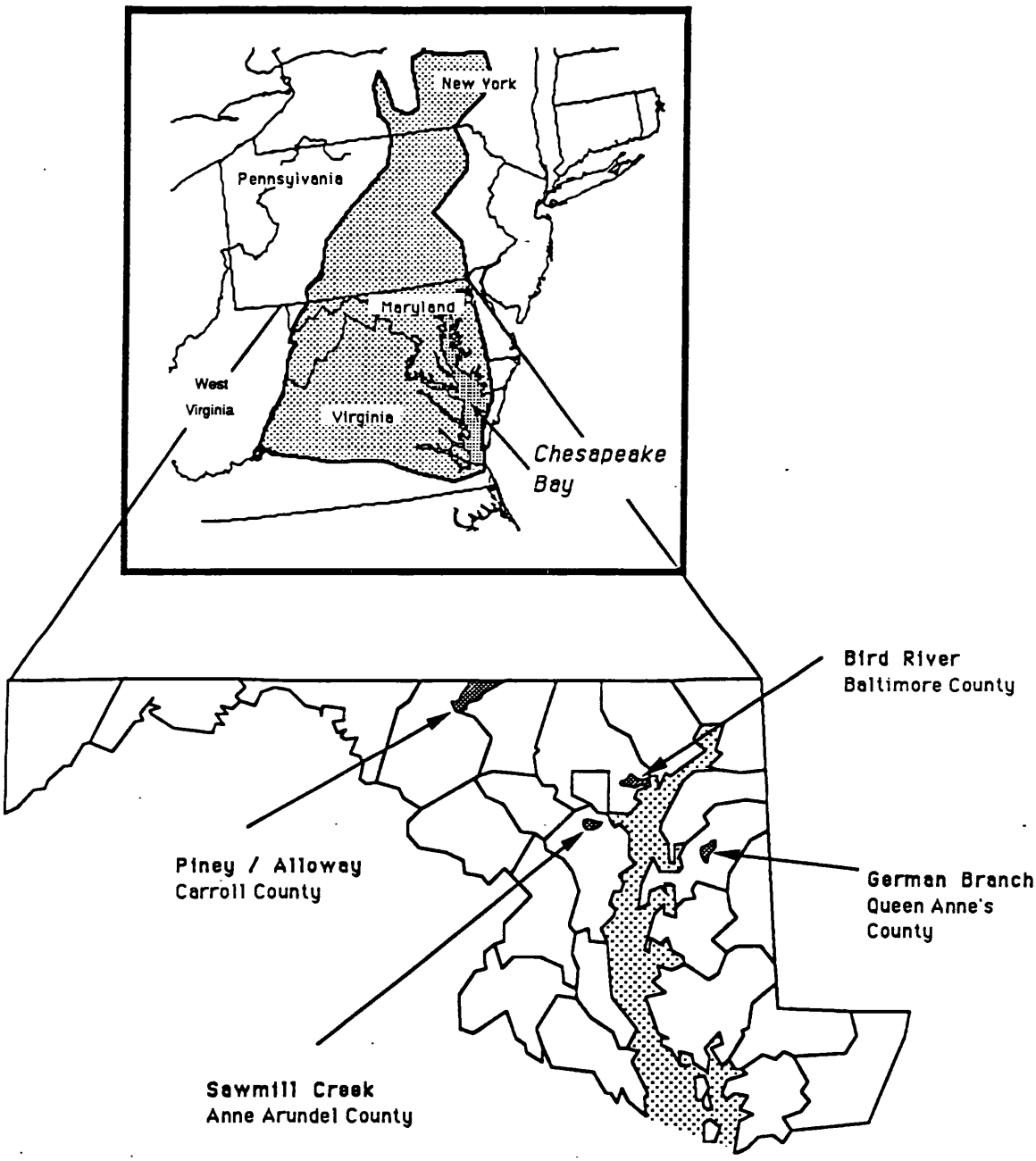



Figure 1

Map of Maryland's Four Targeted Watersheds

## C. Goal for the Sawmill Creek Watershed

The overall goal for Sawmill Creek is simple to conceive and difficult to achieve. The goal is to reverse the decline in water quality and the loss of habitat. The first step has been to understand the environmental conditions in the watershed and to identify the things that create specific problems. At present we have a good general understanding of both the conditions and the causes of the problems, and have begun to identify the important cause and effect relationships. The intent of the Targeted Watershed Project is to start now to create improvements in the watershed on the basis of existing information and our current understanding of the problem. As we proceed, we will continue to expand our understanding of causes and effects and use this knowledge to help prioritize restoration projects.

This document presents a synthesis of our analysis of the problems, an outline of the work that is necessary to correct existing problems, and management steps that are required to keep similar problems from being created by future development. Additional information is available from several sources, including the Sawmill Creek, Baseline Monitoring Report (Marshall, et al., 1992), the Project Leader's memos and reports on the project.

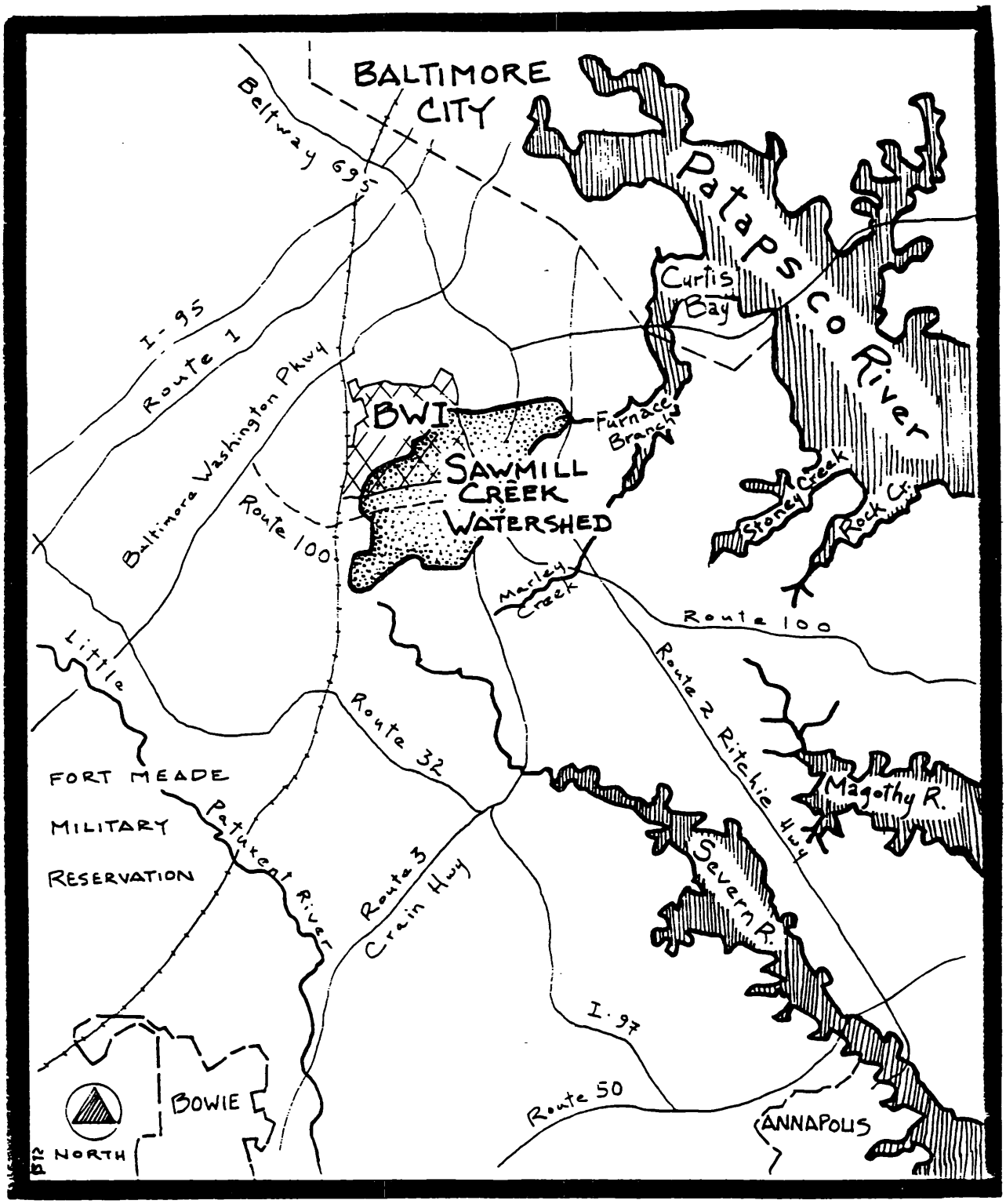



Figure 2

Location Map of the Sawmill Creek Watershed

## II. DESCRIPTION OF SAWMILL CREEK WATERSHED

### A. Geography

Sawmill Creek is a Coastal Plain watershed that drains approximately 5,000 acres, or 8.4 square miles. Sawmill Creek is a freshwater stream located in the northeastern part of Anne Arundel County. The highest point in the watershed is near Severn Danza Park at the intersection of Donaldson Avenue and Old Telegraph Road. The creek flows in a northeasterly direction for about 5 miles until it joins Furnace Branch. The Furnace Branch is an estuary that empties into Curtis Bay near the mouth on the Patapsco River. A location map of the Sawmill Creek watershed is presented in Figure 2.

The soils in the watershed are sandy, highly permeable and very erodible. This is an area of significant ground water recharge even though man made impervious surfaces, plus the rapid elimination of surface runoff through storm drains has reduced total ground water recharge within the watershed. Much of the rain that falls on this watershed infiltrates to the ground water table and this water contributes to the baseflow of Sawmill Creek. However, in recent years, ground water pumping has removed large amounts of ground water from the watershed and baseflows have decreased substantially. Formerly, this creek had one of the highest baseflows per square mile of drainage area of any stream in the region (U.S.G.S., 1973).

### B. Whole Watershed Overview

The health of any stream is determined by the activities on the surrounding land that comprises the watershed. Over the years the land uses in the Sawmill Creek watershed have changed from forest to agrarian to urban.

#### 1. Historic Conditions

The Creek derives its name from a water-driven sawmill that began operating in the 1700s. At that time mills were usually built close to the source of lumber. The remnants of the sawmill dam are on the upstream end of the box culvert that carries 8th Avenue over the creek. The impoundment created by this dam is known locally as Wagner's Pond.

Transportation corridors have played a major role in the development of this watershed (Figure 3). This region was a very productive fruit and vegetable farming area with roads and rail lines providing easy access to the markets. Most of the produce was sold in Baltimore, which is one of the older port cities on the east coast. During the early 1900s the local farms and industries relied on itinerant workers who had recently arrived in Baltimore from Europe (Jacques, 1989).

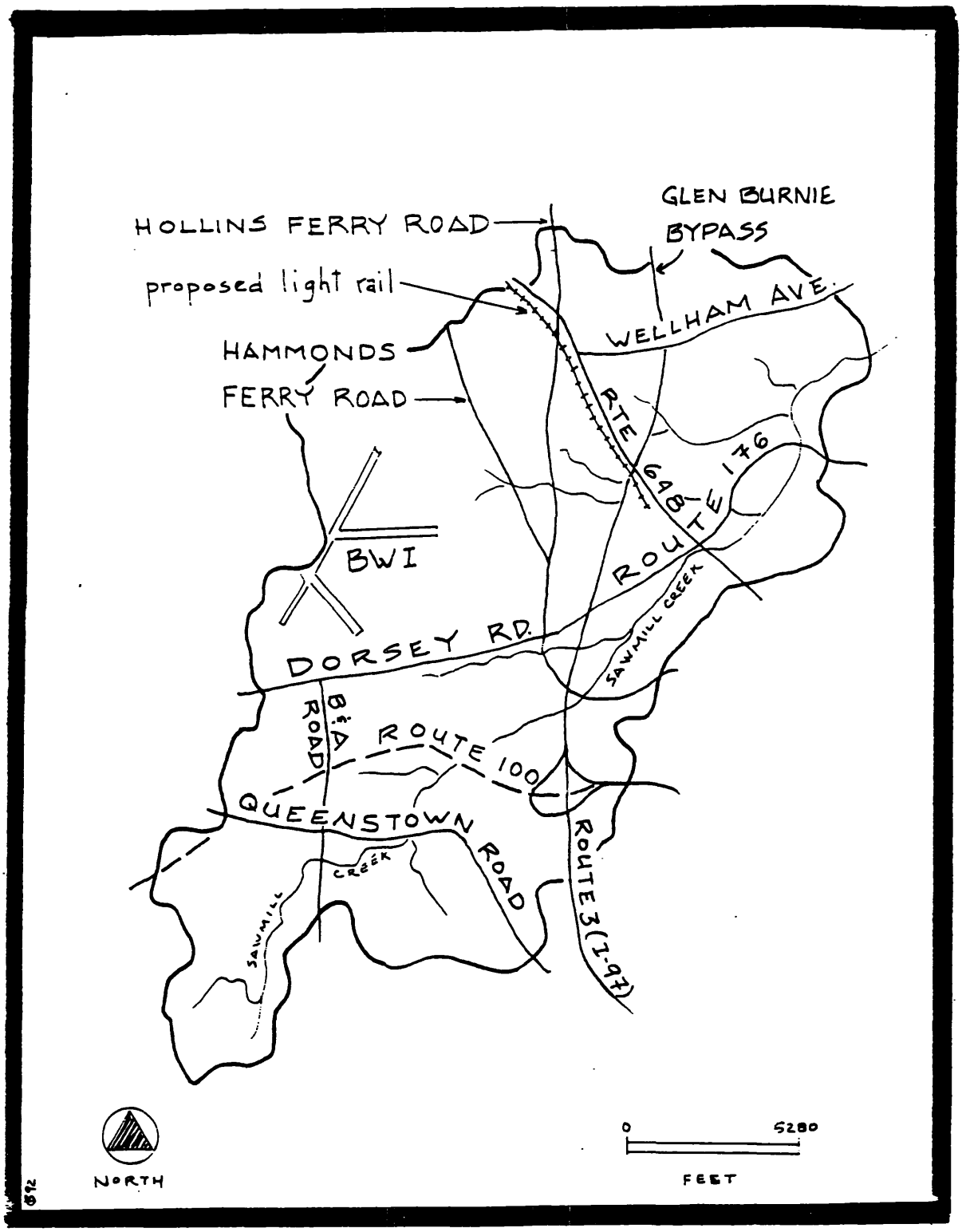



Figure 3

Transportation Corridors in the Sawmill Creek Watershed

In addition to links with Curtis Bay and the port of Baltimore, there were a number of roads and railroads that connected Baltimore with points to the south. The precursors of Mountain Road (now Route 100), Baltimore Annapolis Boulevard (Route 648) and Crain Highway (Route 3) all converge in a part of the watershed that was known as Wellham's Cross Roads in 1878. This is in the vicinity of Baltimore Washington International airport (BWI). Trout were stocked in Sawmill Creek during the 1930s and 40s, because there was a light rail commuter line that made Glen Burnie accessible to urban fishing enthusiasts (Sunpaper, 1943).

Friendship Airport, now BWI, was built in the late 1940s. The airport was named after the Friendship Methodist Church it replaced. The church had been located on the highest place with relatively flat land close to the city and the port. At about the same time, large scale subdivisions began to appear along Ritchie Highway as city workers began to move away from the inner city. High density residential development has continued to fill in the open land in Glen Burnie and Ferndale.

Regional ground water withdrawals increased approximately 300% between 1965 and 1985. This was done to supply water to the growing population in northern Anne Arundel County. As part of this new growth, pumpage was increased in several well fields near the mainstem of Sawmill Creek. During the same period the baseflow in Sawmill Creek declined from 7.4 cubic feet per second (cfs) to 0.98 cfs (Achmad, 1991).

2. Current Population, Land Uses and Land Cover

Initial estimates from the 1990 Census indicate that there are approximately 17,000 people living in the watershed. Certain tracts within this area have experienced growth rates as high as 37% within the last 10 years. Based on historic growth patterns and current zoning, the watershed can be divided into three general land use categories. These are described briefly starting with the headwaters section and moving downstream (Figure 4 and Table 1).

Most of the headwaters region of the creek, segment #1, is presently in rural and low density residential uses. Almost the entire area is zoned R1 and R2. These zoning classifications are intended to limit development to 1 or 2 residential units per acre.

The central third of the watershed, segment #2, is dominated by commercial and light industrial uses. Most of the large tracts of existing open land are zoned W1 and W2, which are defined as Park Industrial development.

The lower third of the watershed is highly developed, and is characterized by small lot subdivisions, with commercial development located along the highway corridors. The majority of the land is zoned R5, C3 and C4. Most of the urbanization in this area took place in the 1940s and 50s. Although this area is generally referred to as Glen Burnie it also includes parts of Ferndale.

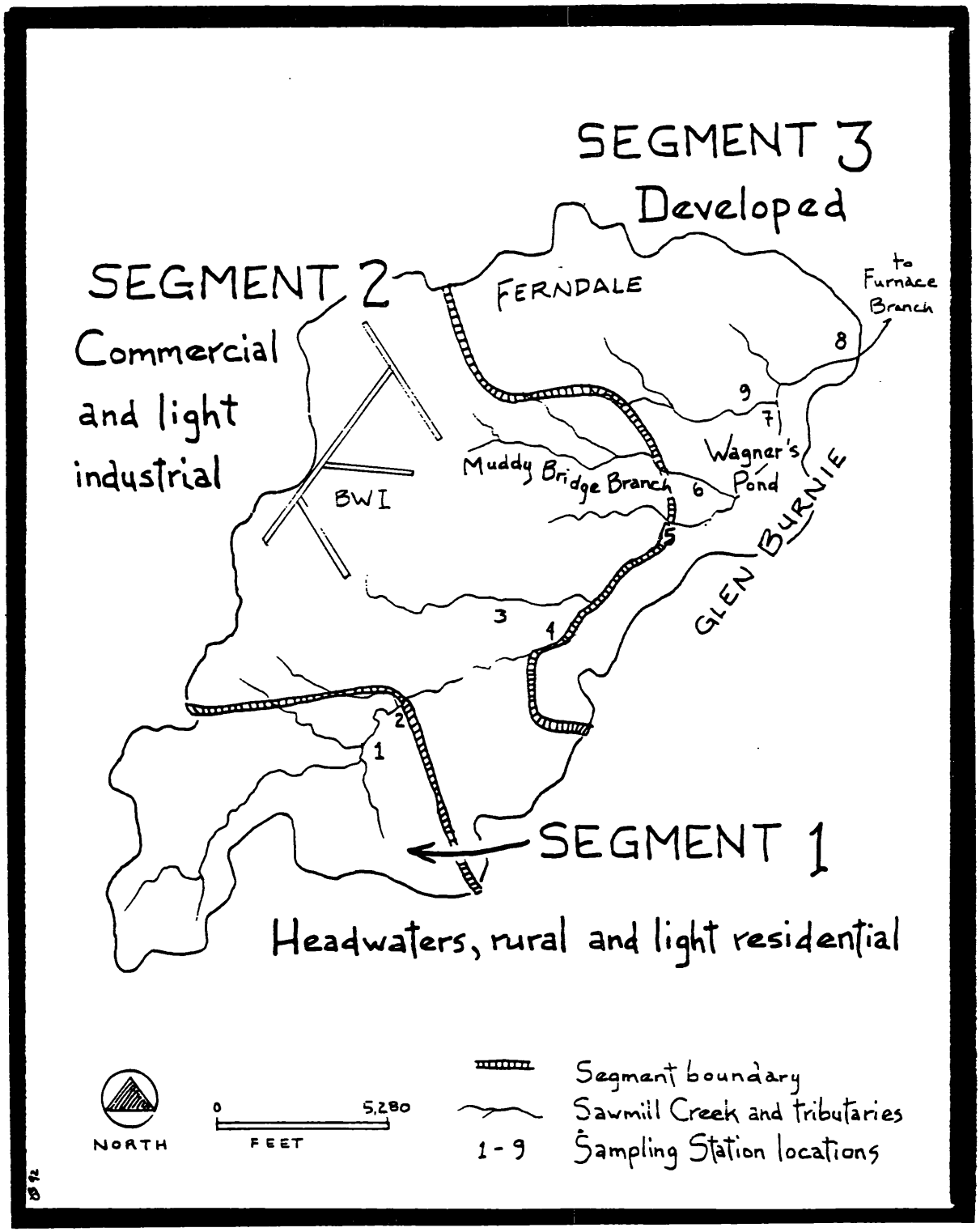



Figure 4

Major Segments of the Sawmill Creek Watershed Categorized by Predominant Land Use

3. Future Development

Although most people would consider this region urbanized, there are a significant number of land use changes still underway. In 1990 the Anne Arundel County Department of Planning and Zoning was reviewing development plans that had been submitted for 69 new projects. These projects will alter an additional 14% of the watershed (figure 5). This translates into a 32% reduction in the existing open space. Based on the most recent zoning maps, the following land use developments are expected.

In the short term, the most obvious and dramatic changes are expected to occur in segment 2, the central section of the watershed. Most of this change will occur along the Dorsey Road/Route 100 and Route 3/I 97 corridors. As a consequence of expected intense development, the Targeted Watershed Project initially focused much of the restoration planning efforts in this segment.

Land use changes in the headwaters section, segment 1, should happen more gradually. However, impacts on the watershed and the stream in this segment are harder to predict. This is because waivers and special exceptions to zoning standards are granted on a case by case basis. The construction of Route 100 and other road way improvements may accelerate the rate of development in this area.

Although not many changes in land use are expected to occur in old Glen Burnie segment 3, there are existing environmental problems that need to be addressed. These will be discussed in later sections of this report.

**Table 1**
**Land Use in Sawmill Creek Watershed By Classification, Segment and Acreage or Mileage**
**September, 1990**

| Land Use Classification | Segment 1 | Segment 2 | Segment 3 | Total Acreage |
|---|---|---|---|---|
| Residential: | | | | |
| Low-Density (11)** | 180 | 73 | 55 | 308 |
| Medium-Density (12) | 114 | 178 | 1002 | 1295 |
| High-Density (13) | 0 | 23 | 16 | 38 |
| Commercial (14) | 20 | 954 | 372 | 1346 |
| Industrial (15) | | 67 | 18 | 85 |
| Institutional (16) | | | 20 | 20 |
| Sub-Total (Developed) | 314 | 1294 | 1484 | 3092 |
| Open urban land (18) | 47 | 34 | 50 | 132 |
| Agriculture: | | | | |
| Cropland (21) | 211 | 137 | 5 | 354 |
| Pasture (22) | 1 | | 1 | 2 |
| Sub-Total (Agriculture) | 212 | 137 | 7 | 356 |
| Forest: | | | | |
| Deciduous (41) | 188 | 186 | 71 | 445 |
| Evergreen (42) | 33 | 363 | 60 | 457 |
| Mixed (43) | 224 | 447 | 24 | 695 |
| Brush (44) | | 23 | 6 | 30 |
| Sub-Total (Forest) | 445 | 1020 | 162 | 1626 |
| Wetlands (60) | | | 58 | 58 |
| Barren: | | | | |
| Bare Ground (73) | | 79 | 7 | 86 |
| TOTAL | 1019 | 2564 | 1766 | 5350 |
| Road Mileage | 10.4 | 21.5 | 48.0 | 79.9 |

*Source: Data from MD Office of Planning
**Office of Planning Land Use Code Number

Sawmill Creek Watershed (5350 acres)

September, 1990

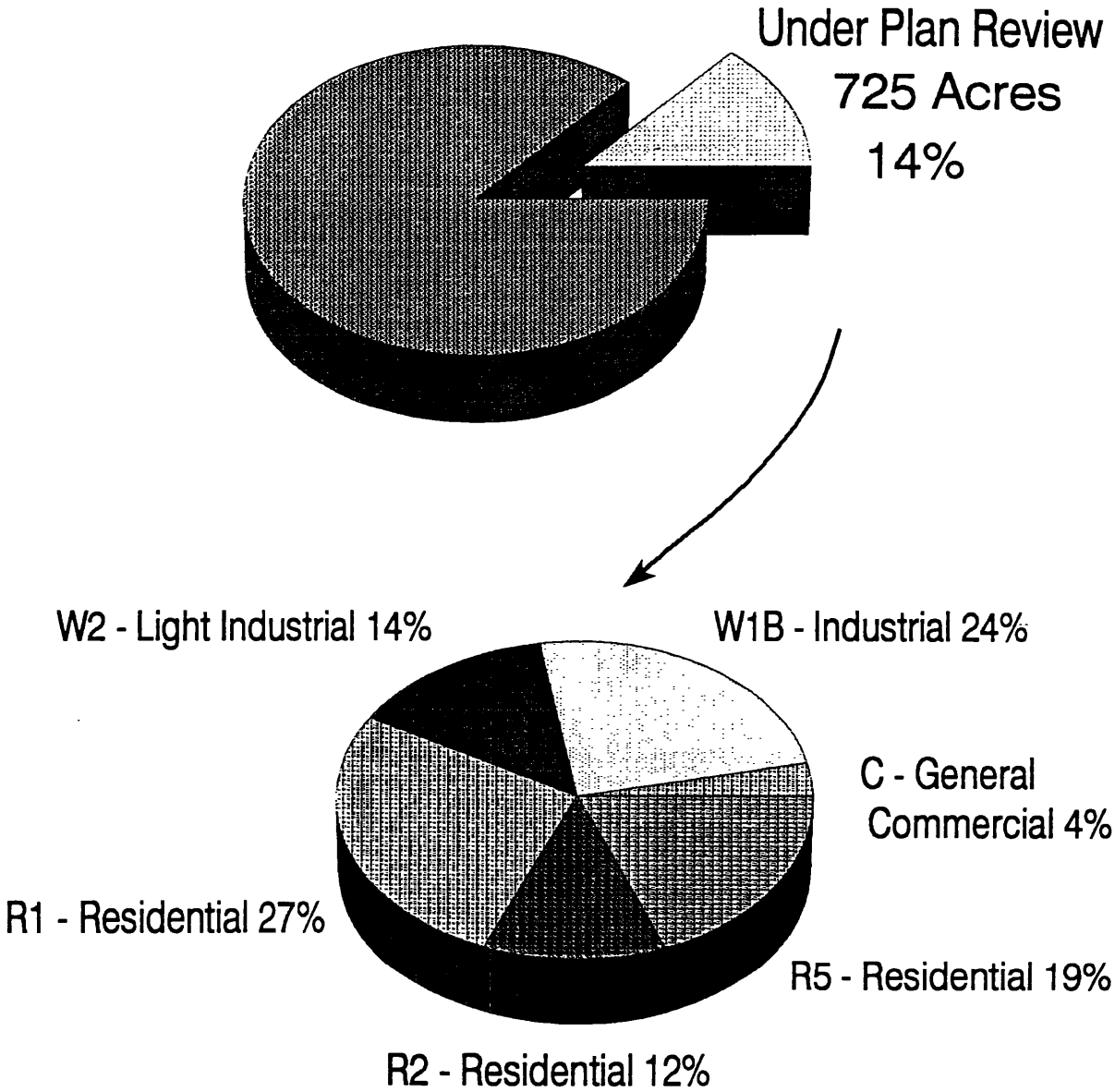



Figure 5

New Development in Plan Review Process

Source:Anne Arundel County Planning and Zoning Office

## III. EXISTING CONDITIONS: THE EFFECTS OF LAND USE ON THE STREAM'S ENVIRONMENTAL HEALTH

The following paragraphs provide an overview of the conditions currently found in the three segments of the watershed. For more details on environmental data please see the Sawmill Creek Baseline Monitoring Report (1991). Land use data summarized in Table 1 is derived from the Maryland Office of Planning analysis of 1989 high altitude photography.

### A. SEGMENT 1: Headwaters, Rural and Light Residential

Segment 1 includes the areas upstream of monitoring stations 1 and 2.

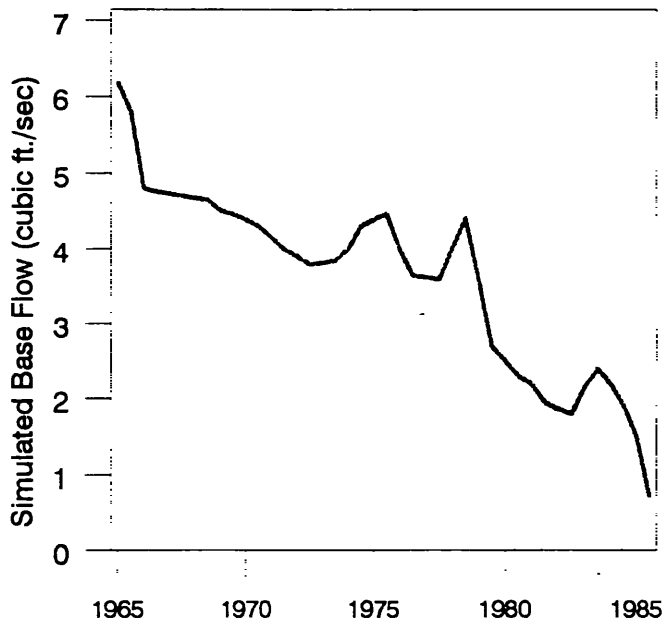
| | |
|---|---|
| Length: | mainstem 1.4 miles, tributaries 2.1 miles |
| Drainage Area: | 1018 acres (19% of the watershed) |
| Population: | 1,893 (11% of the watershed) |
| Habitat Quality: | Fair (based on reference streams) |
| Problems: | Nutrient and bacteria concentrations are elevated in some areas. Maintaining the integrity of the stream corridor and its vegetative buffer during the construction on Route 100. |

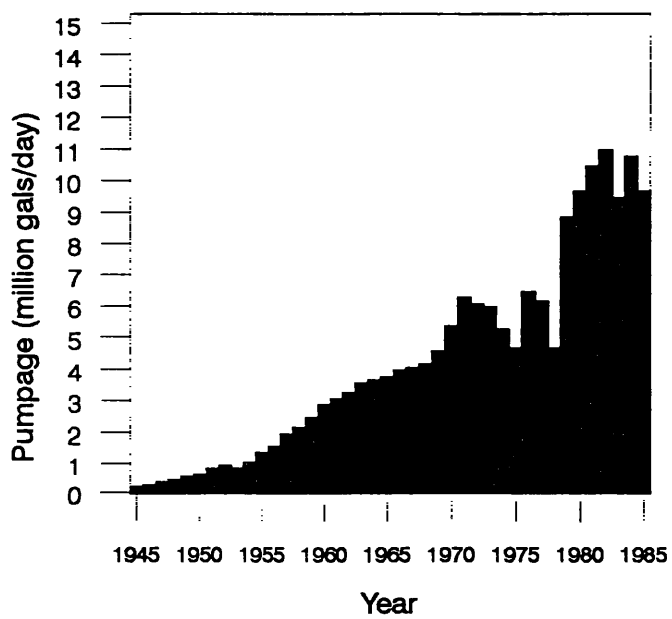
This segment is now characterized by a few subdivisions and a lot of relatively open land with truck farms and some pig farms. Most of the stream corridor and floodplain are wooded and in a relatively undisturbed condition. There are also significant areas of wooded uplands. In contrast to the degree of urbanization in the rest of the watershed, roughly 65% of this segment is agricultural or forested. The proximitry of some pig pens to the stream has resulted in elevation of nutrient concentrations and high bacteria counts at monitoring Station 1.

### B. SEGMENT 2: Commercial and Light Industrial

Segment 2 encompasses the areas upstream of monitoring stations 3,4,5 and 6. The boundaries of this segment are roughly defined by the new Route 100, I - 97 and BWI airport.

| | |
|---|---|
| Length: | mainstem 2 miles, tributaries 7.1 miles |
| Area: | 2564 acres, (48% of the watershed) |
| Population: | 4679, (27% of the watershed) |
| Habitat Quality: | Poor |

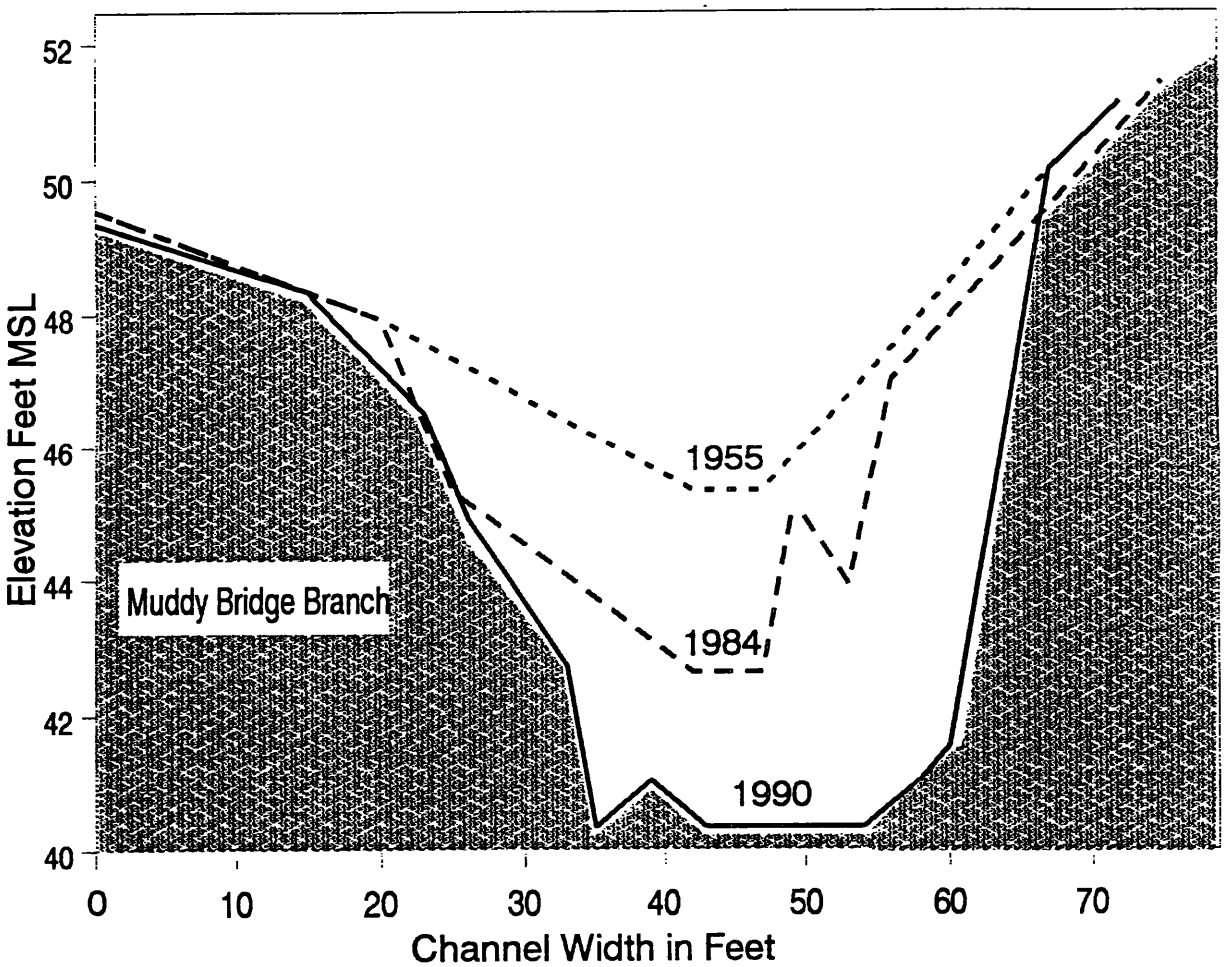



# Figure 6

## Baseflow and Ground-water Withdrawals

(Adapted from Achmad,1991)




vertical axis exaggerated

Figure 7

Change in Stream Channel Depth and Cross Section Due to Erosion From 1955 to 1990

Problems: The hydrologic cycle has been so disrupted by urbanization that the stream channel is unstable and the living resources are being eliminated. There are also indications of chemical contamination that could impact the stream biota at several sites.

Urban stormwater runoff, water withdrawals and construction of instream structures have created problems with: reduced baseflow (figure 6), flooding, stream channel erosion (figure 7), sedimentation, and turbidity. The cumulative impacts of these factors cause losses of instream and riparian habitat and severely degrade the water quality during storm events. Most of these environmental problems were caused by older development practices that did not consider the intricate relationship between land use, the natural hydrologic cycle (figure 8) and living resources within a stream system.

The largest concentration of municipal water supply wells is located in this segment. Portions of some tributaries that formerly were perennial streams now are dry almost every summer.

The headwaters and most of the length of Muddy Bridge Branch is within this segment. This tributary has been exposed to almost every type of impact that an urbanized stream can experience. This subwatershed contains a large amount of government property and a large number of current or impending construction projects within its boundaries.

Currently there are a variety of opportunities for the government agencies to coordinate their regulatory and management actions in order to maximize stream restoration activities on this tributary. For these reasons, the Muddy Bridge Branch subwatershed is the focus of the first comprehensive restoration efforts described in later parts of this plan.

There is a large marsh system on the mainstem of the creek above station 5. Although this wetland is somewhat isolated from public view it provides significant water quality benefits and wildlife habitat in this segment. Approximately 40% of segment 2 is still forested.

**C. SEGMENT 3 - Developed, Residential, High Density**

Segment 3 encompasses the areas upstream of monitoring stations 7,8 and 9.

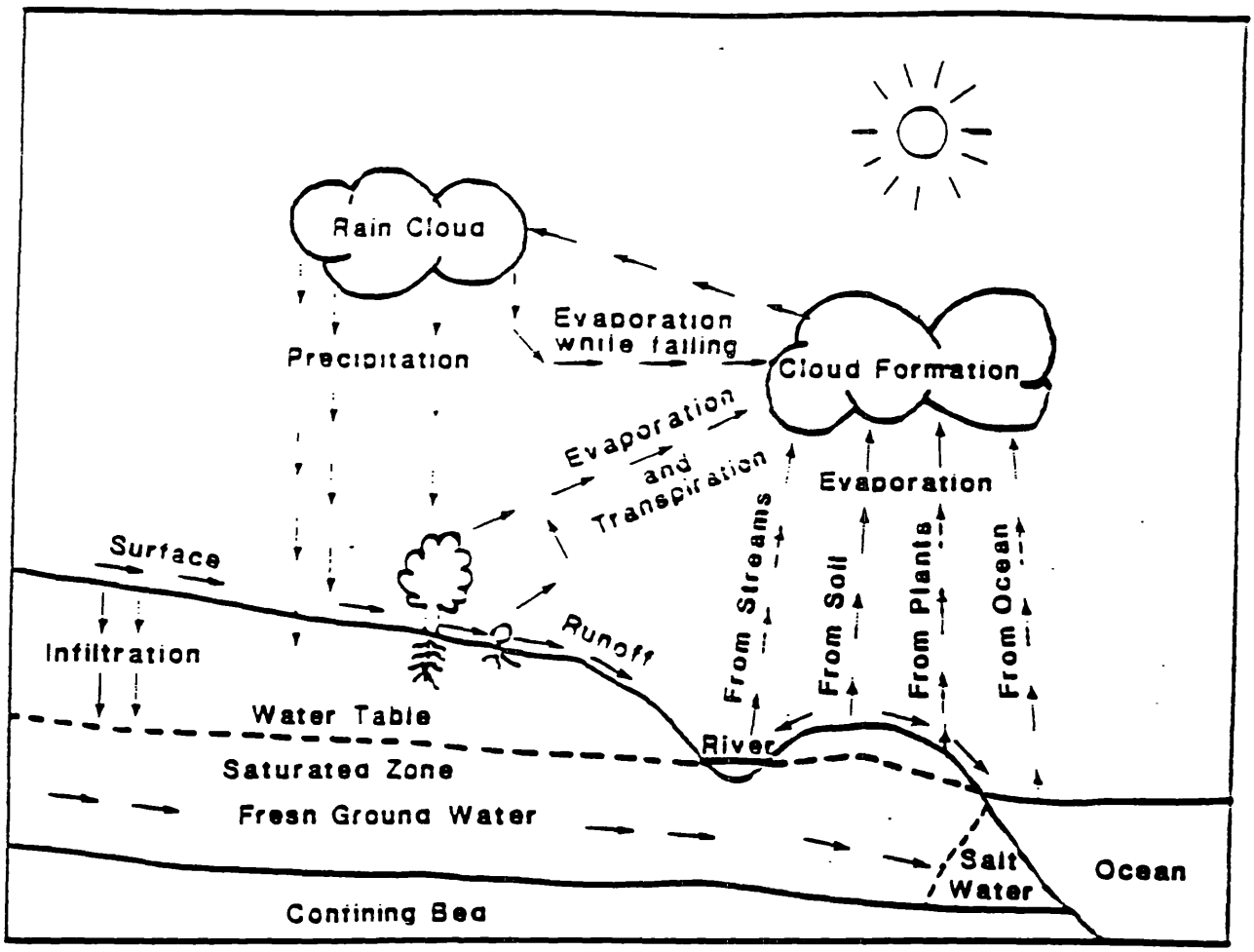
Length: mainstem 1.6 miles, tributaries 3.3 miles

Drainage Area: 1766 acres, (32% of the watershed)

Population: 10,569, (62% of the watershed)

Habitat Quality: Fair in the mainstem, poor in the tributaries

Problems: Instream impacts are the same as segment 2, however the problem sources are more diverse.




After Johnson, 1975.

Figure 8

The Hydrologic Cycle

This segment is characterized by high density, small lot subdivisions and commercial strips along the major roadways. These were built before the current environmental regulations were in place. There is little remaining open land; less than 10% of the segment is forested.

The headwaters of these sub-watersheds have been paved over and the upper parts of the tributaries have been converted into storm drains under the streets. The stream channels are being severely impacted by uncontrolled stormwater runoff from the storm drains in the upper reaches. There is some riparian vegetation remaining in the ravines that were too steep to be developed. There are indications that the surviving aquatic community is being stressed by chemical contaminants.

The most significant natural feature of this segment is Wagner's Pond, with its 40 acres of contiguous marshes and forested wetlands. This is the site of the original sawmill dam.

## IV. COMMUNICATIONS AND PUBLIC INVOLVEMENT

From the outset of the Targeted Watershed Project, the active involvement of citizens has been basic to the success of the effort. This section provides a summary of communications efforts to raise public awareness and enlist citizen involvement.

### A. Efforts to Date

To date, public communications have focused on six areas:

1. Informing the local public about the targeted watershed project through press coverage and a brochure.

2. Enlisting citizen water-quality monitors. A team of monitors, originally under the direction of the Alliance for the Chesapeake Bay, has been monitoring nine sites along the creek since the fall of 1989.

3. Identifying opportunities for, and facilitating, restoration projects. With the cooperation of Anne Arundel County, watershed, park, and stream cleanups have been undertaken at public parks in the spring and fall of 1990 and 1991. (In addition, storm drains throughout the watershed were painted with "Don't Dump, Chesapeake Bay Drainage" as part of an individual Eagle Scout project).

4. Outreach to special local groups (e.g., Glen Burnie Improvement Association, Sawmill Creek Watershed Association, Pascal Senior Center), informing them of special projects--e.g., citizen monitoring needs and enlisting their support.

5. Directly assisting citizens experiencing problems in the watershed (e.g., Meadowbrook Road area erosion problems).

6. Public recognition of citizen efforts. In June 1991, the Sawmill Citizen monitors were presented with Governor's Citation awards for their monitoring work.

### B. Current Focus: Adopt-a-Stream

In July 1991, Maryland Save Our Streams received a $20,000 grant from the Chesapeake Bay Trust (CBT), for a one-year project to launch a public education campaign in the watershed. The CBT sum was to be supplemented by $10,000 in SOS funds, for a total of $30,000. Save Our Stream's "Adopt-a-Stream" campaign, sponsored by the Department of Natural Resources, provides the project framework, and involves the following activities:

1. Slide show and educational materials:

- Workshop series brochure. Includes a brief overview of the history and current problems of the watershed, and outlines the citizen workshop series planned by SOS to educate and involve citizens of the watershed through presentation of specific adoption activities.
- "Numbers to Know" door hanger. Local and state environmental telephone numbers to report problems or acquire information.
- "Six Simple Steps to Restoring Your Neighborhood Stream." This flyer raises awareness of homeowner impacts on local streams by listing six household best management practices.

2. Community outreach: Workshop series on Adopt-a-Stream acitivies. Workshops will focus on stormwater management, sediment control, water-quality monitoring, watershed surveys. Ongoing, from November, 1991 through Spring, 1992.

**C. Future Plans**

In addition to continuing all ongoing efforts and moving forward with the stream adoption campaign, communication plans include:

1. Public information signs for park areas.

2. Ongoing efforts to highlight project milestones and successes in local press outlets.

3. Investigating the possibility of having SHA road signs identifying Sawmill Creek on all major arteries crossing the Creek (e.g., I-97, Business 3, Route 2).

4. Identify appropriate projects for citizen involvement in specific restoration efforts recommended by the technical teams. These projects could include litter, trash and pet waste control and the revegetation of open lands.

## V. CONCLUSIONS

This document provides an overview of the problems and a general strategy for restoration efforts. The most obvious problems will be addressed first but the specific restoration tactics will be developed later as separate work plans. This means that the targeting team will be transformed into a number of working groups with overlapping memberships. These groups will be responsible for specific restoration plans. Inter-disciplinary communications should be maintained by this approach.

Examples of existing work groups include: Stormwater Management, Instream Flow and Water Supply, and Public Participation (see membership lists in the Appendix). Additional work groups will focus on toxics and future development.

The following paragraphs describe the major conclusions about the present environmental conditions in the Sawmill Creek Watershed:

1. Environmental impacts to living resources result from the cumulative effects of many human activities over time in the watershed. Although it is difficult to isolate the magnitude of each cause and effect relationship between human activity and environmental impact, some important relationships have been identified. Prioritization in the restoration strategy relies on our understanding (whether general or specific) of these cause and effect relationships.

2. Identification and prioritization of restoration projects is an ongoing task. Initial restoration plans will be based on the current data base and understanding of the processes at work in the watershed. As our experience with restoration projects grows, this knowledge will be used to target subsequent project efforts.

3. Each sub-watershed segment is unique. Approaching the watershed as a whole system provides a logical way to try to protect and restore water quality and habitat for living resources. Partitioning the watershed into three major segments based on geography and land use makes the work more manageable. It is essential that the specific restoration projects be planned and built within the perspective of managing the whole watershed.

4. Segment 2 has received the most detailed attention because it has the most obvious environmental problems and it will continue to be the location of the most development and change. It also presents the greatest opportunities for protection and restoration efforts. Restoration techniques that are successful in any segment will be adapted for use in the other segments.

5. Many urban watershed restoration projects place the majority of project resources into actions to abate and control stormwater runoff. This is a logical approach, since it is possible to correct a number of problems at the same time. We have found this to be a

good starting point for the restoration efforts in Segments 2 and 3, while keeping in mind the overall goals of water quality and habitat improvement.

It should be pointed out that large stormwater management structures are only part of the restoration picture. A mix of innovative stormwater control techniques and habitat improvements must also be considered here. It is too easy to think that a problem is solved just by spending a lot of time and money on concrete and steel.

6. In Sawmill Creek, sediment transport is the main functional link between the hydrologic regime (water quality) and the physical structure of the stream channel (physical habitat). Erosion and sedimentation patterns are also controlled by the presence of structures (culverts, channels, etc.) in the stream. In order to effectively alter any one of these factors, all must be considered in concert.

7. Habitat conditions and living resources were among the first indicators assessed in order to establish the stream's health and vitality. Living resources numbers are depressed and their habitat is less diverse than would be found in a less impacted stream. The goal of the project is to increase both the numbers and diversity of species of fish and benthic organisms by improving the habitat and water quality. The success of restoration efforts for Sawmill Creek will be measured by the results of periodic comparisons of the habitat and the aquatic biota as the restoration projects are implemented.

8. The information sharing by the Targeted Watershed Project Team Members has identified and started to correct some of the gaps in the environmental management of this watershed.* The resource protection agencies can provide guidance for a holistic approach to restoration efforts. The agencies with operational responsibilities can expect advice and support for work that is consistent with the goals of restoring and protecting the living resources of the whole watershed.

*Examples of the environmental improvements that are attributable to targeting team communications. (This work has preceded any formal restoration projects):

- Water supply managers were unaware of the impacts of significant groundwater pumpage and the resulting reduced baseflow impacts on the stream biota. They have now agreed to consult with living resource agencies on a strategy to restore baseflow.

- Provisions for fish passage and stream channel stabilization are now being incorporated into five current highway widening designs.

- Stormwater management and wetlands creation designs are being added to a road widening project. MAA and SHA will share mitigation credits and cost reduction benefits.

- Waterway construction projects are now incorporating better designs for low-flow conditions which are critical for stream biota. Traditionally the review of construction projects has focused on reducing flooding risks to human property.

- Fish and invertebrate surveys and field bioassays have identified several sources of chemical contamination that are probably reducing the diversity of the instream biota.

- Laboratory research has determined that the environmental impact of two industrial chemicals used in the watershed has been significantly underestimated by the federal regulatory agencies.

- NPDES discharge permits for several businesses have been revised and upgraded in order to reduce point source discharges.

- County planners now consult with team biologists when reviewing the environmental impacts of zoning waiver requests.

## VI. RECOMMENDATIONS FOR OVERALL RESTORATION STRATEGY

During the first year of the project there were a number of meetings of the entire targeting team. One of the main purposes of those meetings was to share information on environmental problems in the watershed. Another purpose was to clarify areas of responsibility and to identify gaps in our environmental management structure. During the second year of the project, the meetings have been smaller with the emphasis on resolution of specific issues that involve only some of the specialists on the team. **This section provides a strategic overview of the restoration plans for each of the sub-watershed segments. Detailed restoration actions will be presented in the site-specific plans developed by the targeting team work groups.**

Environmental problems in the watershed generally fall into one of three categories: water quantity; water quality; or habitat degradation (instream or riparian). The restoration strategy will have a different emphasis in each one of the three segments. The focus in each segment will depend on the special conditions in that area. While many issues are being addressed simultaneously, a natural prioritization of efforts has developed. There is a consensus that water quantity, including both high and low flow issues, must be stabilized before water quality and habitat problems can be more completely resolved. Most of the water quantity issues are presented in the discussion on segment 2, but that discussion of the quantity problems is relevant to the whole Sawmill Creek watershed.

The Targeted Watershed Project has fostered considerable informal communication among the team members. The "networking" of the team members will be an important part of future implementation projects.

### A. SEGMENT 1: Headwaters, Rural and Light Residential

In terms of environmental protection, the intensity of development impacts is reduced somewhat by low-density R1 & R2 zoning and by the increased environmental protection afforded by the current regulations. The most serious issues to be addressed are:

1. Maintain adequate stream buffers that extend all the way to the headwaters of each tributary.

2. Maintain existing low density rural character by minimizing changes to the zoning rules that currently protect the environment.

3. Adhere to the stormwater management goals of protecting water quality as well as controlling water quantity in new development projects. This would not preclude innovative stormwater management techniques.

4. Identify and develop agricultural soil conservation and water quality plans for nutrient management and water quality protection through the use of Maryland Agriculture Cost-Share Program (MACS) that provides grants to farmers. Vigorously promote BMP implementation, and implement stream habitat rehabilitation where appropriate.

5. Minimize the construction impacts of Route 100 by strict adherence to new sediment control guidelines.

Most of these issues are primarily the responsibility of various agencies within **Anne Arundel County Government**, but **MDA, MDE, SCS, MDOT** and **DNR** can provide support for these actions.

**Lead agencies: Anne Arundel County, SCD, CES, MDA**

**B. SEGMENT 2: Middle Reach, Commercial and Light Industrial**

While there are a variety of organizations responsible for stream protection, restoration, and enhancement in this segment of the Sawmill Creek watershed, the State of Maryland should take the lead, because it is one of the largest landowners and developers in this segment of the watershed.

The consensus of the Targeted Watershed Project is that the first priority must be the restoration of a more natural hydrologic cycle. As part of this restoration process, both water quality and quantity issues must be addressed. Quality and quantity issues can not be completely separated, but are listed individually below in order to clarify the topics to be covered.

1. Water Quantity - episodic high flow problems

As a first step, a regional Stormwater Management Plan should be completed and implemented for the Muddy Bridge Branch tributary. The Maryland Aviation Administration has already contributed to the team's efforts by allocating funds to their consulting engineers to prepare a report that summarizes the current conditions and problems on Muddy Bridge Branch (Greiner, Inc. 1991). The Greiner report helps clarify the range of stormwater management issues that need to be addressed in the regional restoration plan.

The Sediment and Stormwater Administration (MDE) is currently drafting the criteria for a regional stormwater management (SWM) plan for the Muddy Bridge Branch. This will be an innovative initiative that will incorporate water quality and habitat restoration, as well as flood protection for the entire sub-watershed. As the plan for this tributary is refined, it can be used as a guide for resolving stormwater management problems on a whole watershed basis. The major design criterion will be to coordinate and control all SWM facilities so that discharges will not cause excessive stream channel erosion.

**Lead agencies: MDE, MDOT, DNR, Anne Arundel County**

2. Water Quantity - stream baseflow problems

Research by DNR and Anne Arundel County has determined that stream baseflow has been significantly reduced by extensive ground water pumpage in this watershed (Achmad, 1991). Baseflow must be restored in order to protect the living resources and to reduce the magnitude of change between baseflow and stormflow, which has implications for stream geomorphology. This work will require the implementation of a coordinated management plan that involves actions by both the state and county.

In order to restore baseflow a water budget for present and projected conditions will have to be developed and implemented. This budget would be a management tool that provides water users with a way to assess the relative importance of all the elements that affect water quantity. It should include the following elements:

a. minimum stream flow requirements for living resources
b. water demand, including withdrawal rates from the different aquifers
c. net water losses through sewer system export
d. changes in infiltration and recharge rates, with an emphasis on the effects of increases in impervious surfaces and stormwater management
e. regional water supply network
f. water conservation and other alternatives
g. provisions for a shared data base for continuing management of water supply issues

Some of the work on baseflow restoration is already in progress. A range of instream flow values for living resources has been developed by a work group of the Targeted Watershed Project, and MGS has refined some of the techniques that it uses to forecast the effects of water withdrawals on stream flow. A well head protection program is also in the planning stages and this could provide useful information for the water management plan.

**Lead agencies: DNR (WRA, MGS, TID), Anne Arundel County, MDE, FWS**

3. Water Quality Issues

Problems that are being addressed include:

a. sediments
b. nutrients
c. toxic contaminants

Sediment loading in this system is primarily due to stream bed and channel erosion, caused by excessive stormwater runoff. Most of this problem must be addressed by reducing the frequency and duration of flows that exceed the erosive velocity of the stream channel. This reduction in peak flows is the primary criterion of the stormwater

management plan discussed in #1 above. Monitoring and enforcement of erosion control practices at construction sites is also an important requirement for sediment reduction.

Nutrients in this watershed come from a variety of nonpoint sources. A nutrient reduction strategy is dependent on a quantitative description of the sources. The Monitoring Team's reports will provide more details on the areas of most significant nutrient contribution.

Several sources of chemicals that are potentially damaging to the stream biota are being investigated by the Targeted Watershed Project. A work group will have to quantify sources of problems, instream effects and export rates of pollutants. In contrast to the plan development approach of the previous items, this will primarily be an investigative process driven by field observations. An important part of the monitoring program is the ability to do bioassays in the field. The DNR has a mobile laboratory that can help isolate the sources of some water quality problems. Better coordination between monitoring and regulatory agencies is already being developed.

**Lead agencies: DNR, MDE, Anne Arundel County**

4. Habitat for Living Resources

Habitat for living resources depends first of all on a stable, more natural stream hydrology. After stream hydrology is addressed, a basin-wide plan for habitat restoration can be refined. Potential restoration mechanisms include: bank stabilization; riparian buffer management; reforestation; fish passage; instream habitat structures; and wetlands replacement. This habitat restoration would involve work at both new construction and mitigation sites. Some of these techniques are already being incorporated into existing individual development plans. A good example of current work is the stabilizing of culvert outfalls and providing for fish passage at several of the 15 highway stream crossings that are currently being designed or constructed.

Although some specific habitat problems are already being addressed there are several steps that can be taken to identify and prioritize habitat restoration projects:

- Citizen monitors report erosion and water quality problems that they observe.
- Save Our Streams could schedule training sessions for stream inventories that will cover the watershed.
- Water quality sampling by DNR (both routine and storm events) provides information on problems.

The EPA rapid bioassessment method has been used by the monitoring team several times to quantify and compare habitat conditions in different parts of the watershed, and at reference sites on relatively undisturbed streams. This methodology is particularly useful because it is a consistent way to rate the relative magnitude of a habitat problem and it can provide insight as to what kind of restoration work is needed.

**Lead agencies: DNR, MDOT, FWS, Anne Arundel County**

## C. SEGMENT 3 - Developed, Residential, High Density

Many of the plans developed for segment 2 would be appropriate for segment 3, particularly those relating to stormwater management. However, the availability of land and funding sources is more limited in segment 3. In order to make the best use of existing resources the following strategy is suggested.

1. Divide segment 3 into short stream reaches (such as sections between road crossings) and inventory problems.
2. Quantify magnitude of problems on each stream reach.
3. Identify all possible restoration alternatives.
4. Prioritize alternatives based on expected stream improvements.

Based on existing knowledge of segment 3, the tributary behind the Glen Burnie Industrial Park (Station 9) would be the first target for stormwater management retro-fits and more detailed toxic testing.

Since the largest percentage of residents live in this portion of the watershed, this would be a prime area for public education and participation projects. The existing parks and woods and wetlands around Wagner's Pond offer many opportunities for public involvement. Anne Arundel County already owns or controls more than 40 acres around the pond. A boardwalk and interpretive trail along the pond could be developed. The county is also acquiring easements on many of the floodplains in the watershed.

The Anne Arundel County Department of Parks and Recreation has been working with MDOT on trails that will connect existing recreation facilities in and outside of the watershed. A master plan that highlights the stream system would enhance public awareness of the aquatic ecology and the linkage to the Bay. This watershed appears to be an ideal location for a Greenways project.

**Lead Agencies: Anne Arundel County, MDE, DNR, CBT, SOS**

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## OVERVIEW OF THE TARGETED WATERSHED PROJECT TASKS

**Task 1. Develop Plan: Completed**

Develop working plans for the overall project and for the separate watersheds. The strategy of using multi-agency, multi-disciplinary teams to conduct the project work was agreed upon, and initial recruitment and criteria development for choosing watersheds was begun.

**Task 2. Recruit and Build Teams: Completed.**

Identify, contact and obtain commitments from appropriate professionals to form the project teams. In each watershed there are monitoring and restoration teams. Some individuals work on both monitoring and restoration, and some individuals work on all four watersheds. Each watershed restoration team has a Project Leader and a person who has the lead responsibility for communications tasks.

**Task 3. Select Watersheds: Completed.**

Criteria for evaluating candidate watersheds were developed and applied. Figure 2, on page 2, presents a map of Maryland showing the general location of the four targeted watersheds. The following list gives the county and predominant land uses of the four selected watersheds. A discussion of the principal reasons these watersheds were chosen is included at the beginning of the discussion of each watershed.

Sawmill Creek - Anne Arundel County. Land uses: Mixed: urban, residential, commercial, light industrial, and transportation.
Bird River - Baltimore County Land uses: Mixed: urban, residential, commercial, surface mining, light industrial, and transportation.
German Branch - Queen Anne's County Land uses: agricultural.
Piney/Alloway Creek - Carroll County Land uses: agricultural.

**Task 4. Conduct Baseline Monitoring: Ongoing.**

Monitoring has grown in importance, intensity and complexity as the project progresses. The purpose of the baseline monitoring work is to determine present conditions in the watersheds, identify environmental problems, and provide the basis for evaluating the effects of restoration and management actions.

Citizen volunteers have supplemented the monitoring work of the agencies in each of the four watersheds. Citizen involvement is being funded by DNR and coordinated by the Alliance for the Chesapeake Bay in three of the watersheds. In the Bird River watershed, Save Our Streams and Baltimore County have an ongoing citizen monitoring project that will be the framework of the citizen work there.

**Task 5. Restoration: Being Planned and Implemented.**

The purpose of the restoration work is to improve the water quality and habitat conditions for living resources in these four watersheds. Factors that have degraded the environment have been and will continue to be systematically identified. Existing programs that are designed to address these problems have been identified. Watershed restoration requires a multi-agency and multi-disciplinary approach to analyzing, planning and carrying out environmental management and restoration.

Implementing restoration actions is not a static, linear or "one time only" process. Findings from the monitoring and from on-site evaluations of watershed conditions guide the watershed restoration work.

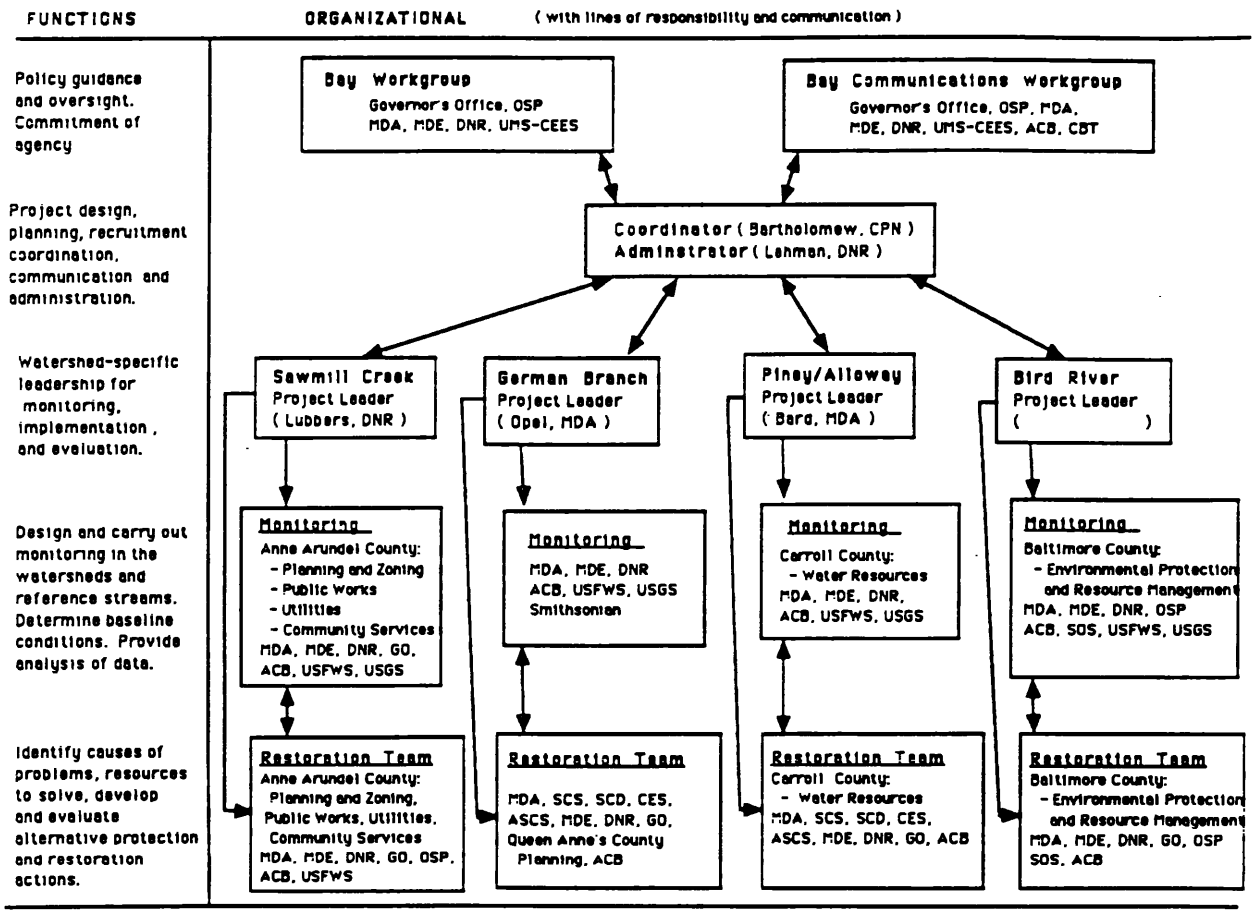
**Task 6. Communication: Ongoing.**

The communications tasks serve two functions, one internal and one external. First, frequent interagency communications in the form of formal and informal meetings and correspondence are part of the routine operations of the monitoring and restoration teams. Secondly, communications with the public will help develop stewardship and awareness of their individual watersheds by providing background information about watersheds, the goals of this project, periodic updates on the project's progress and to describe opportunities for environmental protection and stewardship activities.

**Tasks 7. Review and Evaluate: Complete for 1990.**

A record of the first year of the overall activities for the targeted watershed project is summarized in an overview report. A separate report is being prepared on the findings from the monitoring work. Evaluation and review will continue to be important to maintain continuity within the project and to provide comparative information.

# Project Organization Chart

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May, 1992

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**APPENDIX FIVE**

## ACRONYMS

ACB - Alliance for the Chesapeake Bay
ASCS - Agricultural Stabilization and Conservation Service
BMP - Best Management Practice
CBRM - Chesapeake Bay Research and Monitoring
CBT - Chesapeake Bay Trust
CES - Cooperative Extension Service
CEES - Center for Environmental and Estuarine Studies
CPN - Center for Policy Negotiation
DEPRM - Department of Environmental and Resource Management, Baltimore County
DNR - Department of Natural Resources
EPA - United States Environmental Protection Agency
FP&W - Forest Parks and Wildlife Administration
GO - Governor's Office
MACS - Maryland Agricultural Cost Share Program
MDA - Maryland Department of Agriculture
MDE - Maryland Department of Environment
MES - Maryland Environmental Service
MAA - Maryland Aviation Administration
MBB - Muddy Bridge Branch
NMFS - National Marine Fisheries Service
ORC - Office of Resource Conservation
OSP - Office of State Planning
PEMO - Public Education and Media Office
PPER - Power Plant and Environmental Review
SCD - Soil Conservation District
SC&E - Small Creeks and Estuaries Program
SCS - Soil Conservation Service
SHA - State Highway Administration
SOS - Save Our Streams
SSA - Sediment and Stormwater Administration
SWM - Stormwater Management
UMS-CEES - University of Maryland System - Center for Environmental and Estuarine Studies
USFWS - United States Fish and Wildlife Service
USGS - United States Geological Survey
WRA - Water Resources Administration
WMA - Water Management Administration

The Targeted Watershed Project is a multi-disciplinary project to demonstrate stream restoration and watershed protection methods in selected small watersheds in Maryland. The Maryland Governor's Office, Department of Natural Resources, Maryland Department of the Environment, Maryland Department of Agriculture, Maryland Office of Planning, County Governments, Federal agencies, citizens and businesses are cooperating partners in the project.

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