

Little Patuxent River

Watershed Restoration Action Strategy



Howard County, Maryland

January 2002

Prepared by

Department of Public Works, Stormwater Management Division

In Cooperation with

Department of Planning and Zoning, Division of Environmental and Community Planning
Department of Recreation and Parks, Natural Resources Management Division
Technology and Communication Services, Geographic Information Systems

Prepared for

Maryland Department of Natural Resources, Watershed Restoration Division



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Executive Summary

The Little Patuxent River watershed is located in the eastern portion of Howard County and is approximately 51 square miles, excluding the Hammond Branch and Dorsey Run tributary watersheds. The watershed is predominantly located within the County's Planned Water and Sewer Service Area, which is also the County's Priority Funding Area. As a result, substantial urban/suburban development has occurred in the watershed over the past 30 years. The watershed contains a variety of land uses, including residential, parks, open space, institutional, commercial, industrial and agriculture.

Development in the watershed, much of which occurred prior to County adoption of stormwater management and environmental protection regulations, has eliminated and degraded habitat for both land and aquatic species. An assessment of water quality, based on impervious cover, indicates that the majority of the Little Patuxent subwatersheds are expected to have poor to fair water quality, aquatic habitat and aquatic species diversity. A stream biological assessment conducted in 2001 found that the watershed rated as poor for biological health and non-supporting for physical habitat. A forest assessment conducted in 2001 on publicly-owned land in the watershed indicates that forest health is poor, as reflected in limited forest regeneration and diversity. A Stream Corridor Assessment survey conducted in 1999/2000, identified pipe outfalls, the majority of which were stormwater outfalls, inadequate stream buffers and stream bank erosion sites as the most common potential problems in the watershed. Maryland's Unified Watershed Assessment classifies the Little Patuxent River as a Priority Category 1 watershed, indicating that the watershed does not meet clean water and other natural resource goals, and needs restoration.

This Little Patuxent Watershed Restoration Action Strategy (WRAS) includes a watershed restoration plan and implementation strategy that will serve as a workplan for protecting and restoring water quality and aquatic and terrestrial habitats, and for addressing the need for environmental outreach and education within the watershed. The WRAS defines goals and objectives for water quality, habitat and public outreach, and lists tools and actions that will help achieve these goals and objectives for the watershed. These tools and actions address land conservation, riparian buffers, better site design, erosion and sediment control, stormwater best management practices, other discharges, stream channel stabilization and restoration, habitat and wildlife management, watershed stewardship programs, and subwatershed studies. These actions are categorized into priority implementation categories to establish a workplan for the next ten years. Many of these actions will be expensive to implement and will require additional funding and staff. Possible funding sources outside the County, including Federal, State and nongovernmental grants and loans, will be pursued to assist implementation efforts.

Implementing the Little Patuxent Watershed Restoration Action Strategy will require a cooperative effort among the primary County agencies responsible for environmental activities - the Departments of Planning and Zoning, Public Works, and Recreation & Parks. The County's Environmental Steering Committee, which is comprised of representatives from these and other related agencies, such as the Howard Soil Conservation District, will provide the mechanism for coordinating and tracking these efforts. The Little Patuxent WRAS will serve as a prototype for future watershed restoration studies.

Watershed Vision

Environmental resources in the Little Patuxent watershed will be protected, used wisely, and restored to health. The actions we take toward resource management will complement State and regional initiatives. Our citizens will take part in the decisions and actions that affect them, and environmental stewardship will be encouraged throughout the watershed.

The central theme of the Howard County General Plan 2000 is that we - individual citizens, businesses, community organizations and government agencies - are stewards of the County's social, economic and environmental systems. In support of this theme, the General Plan 2000 contains the following six visions:

1. Our actions will complement State and regional initiatives in resource and growth management.
2. Our rural lands will be productive and rural character will be conserved.
3. Our development will be concentrated within a growth boundary, will be served by adequate public facilities, and will encourage economic vitality.
4. Our communities will be livable, safe and distinctive.
5. Our environmental resources will be protected, used wisely and restored to health.
6. Our citizens will take part in the decisions and actions that affect them.

The General Plan visions most applicable to the Little Patuxent Watershed Restoration Action Strategy were tailored to create this vision for the watershed.

Introduction

Purpose of Study

In 2001, Howard County entered into a two-year cooperative Watershed Restoration Action Strategy Partnership agreement with the Maryland Department of Natural Resources (DNR). The agreement allowed the County to apply for and receive State grant monies to address watershed planning and assessment needs, develop a watershed restoration action strategy (WRAS), receive technical assistance from DNR, and have the opportunity to compete for future Federal and State watershed implementation project funding.

A WRAS combines the leadership of local jurisdictions, the input of citizens and landowners, and State and Federal technical assistance and funding to prioritize and implement watershed management actions. A WRAS can also serve as a marketing and management tool for public outreach and project funding applications.

The Little Patuxent WRAS addresses the protection, conservation and restoration of stream corridors, riparian forest buffers and wetlands, for the purpose of improving water quality and habitat. This document describes the tools that were used to identify, prioritize and select sites for future management actions. The Little Patuxent WRAS complements other State-wide watershed initiatives such as the Chesapeake Bay 2000 Agreement.

Watershed Characterization and Supporting Studies

The first step in developing a Watershed Restoration Action Strategy for the Little Patuxent was to prepare a watershed characterization that compiled and analyzed existing water quality, land use and living resources data for the watershed. In April 2001, DNR and Howard County produced a Characterization of the Little Patuxent River Watershed in Howard County. While the Characterization provided good overall information on environmental conditions within the Little Patuxent watershed, information on the location of specific environmental problems was limited. To provide more specific information on the location of environmental problems and restoration opportunities, a stream corridor assessment survey, forest assessment, stream biological assessment and impervious cover assessment were conducted for the watershed. The following is a summary of the findings from the Characterization and the supporting studies.

Watershed Characterization

The Characterization focused on existing information related to land use, water quality, and living resources and their habitats within the Little Patuxent watershed.

Land Use

The Little Patuxent watershed is located in the eastern portion of Howard County and is approximately 51 square miles, excluding the Hammond Branch and Dorsey Run tributary watersheds (Map 1). The watershed is located predominantly within the County's Planned Water and Sewer Service Area, which is also the County's designated Priority Funding Area under Maryland's Smart Growth Initiative (Map 2). The watershed contains a variety of land uses, including residential, commercial, industrial, institutional, parks, open space and agriculture (Map 3).

The northern portion of the Little Patuxent watershed, generally defined as north of MD108, contains agriculture, the Alpha Ridge Landfill, the Turf Valley Golf Course and a portion of the US 40 commercial corridor. Residential development in this portion of the watershed is predominantly low density, with about two dwelling units per acre. The central portion of the watershed, which lies between MD 108 and I-95, is dominated by the Columbia New Town, which has a variety of residential densities and commercial uses. The southern portion of the watershed, which lies to the southeast of I-95, includes the US 1 corridor, which contains residential, commercial, and industrial uses. Parks and open space are located throughout the watershed and generally contain stream valley environments (Map 4). The Little Patuxent stream valley corridor is a designated County greenway.

According to the Maryland Department of Planning data, about 60 percent of the Little Patuxent watershed in Howard County, including the Hammond Branch and Dorsey Run watersheds, was in urban land use in 1997, while agriculture and forest lands covered about 15 and 25 percent, respectively. Urban lands are projected to expand to 74 percent of the watershed by 2020, while agriculture and forest lands are projected to decline. This land use shift is likely to increase the existing pressures on water quality and living resources in the watershed.

Water Quality

Maryland classifies each waterbody in the State into one of four designated use categories. The Little Patuxent River and its tributaries are classified as Use I-P, with designated uses of water contact recreation, protection of aquatic life and public water supply. Water quality criteria to support these designated uses are set by Maryland for fecal coliform (a bacteria), dissolved oxygen, temperature, pH (a measure of acidity), turbidity and toxic substances.

Maryland's Water Quality Inventory for 1993-1995 describes water quality in the Little Patuxent River as "probably fair," with high levels of bacteria, nutrients and suspended sediments. There are no long-term water quality monitoring stations in the watershed, and this assessment is based on land use and resource information. The 1996 Maryland list of water quality limited bodies describes the Little Patuxent River as impaired for nutrients, suspended sediments and cadmium from nonpoint (such as agriculture, lawns, parking lots) and natural sources. The 1998 list adds Centennial Lake as impaired for nutrients and sedimentation from nonpoint sources. A Total Maximum Daily Load (a Clean Water Act requirement) that specifies the maximum nutrient and sediment loads that

Centennial Lake can receive and still remain healthy is being developed by the Maryland Department of the Environment.

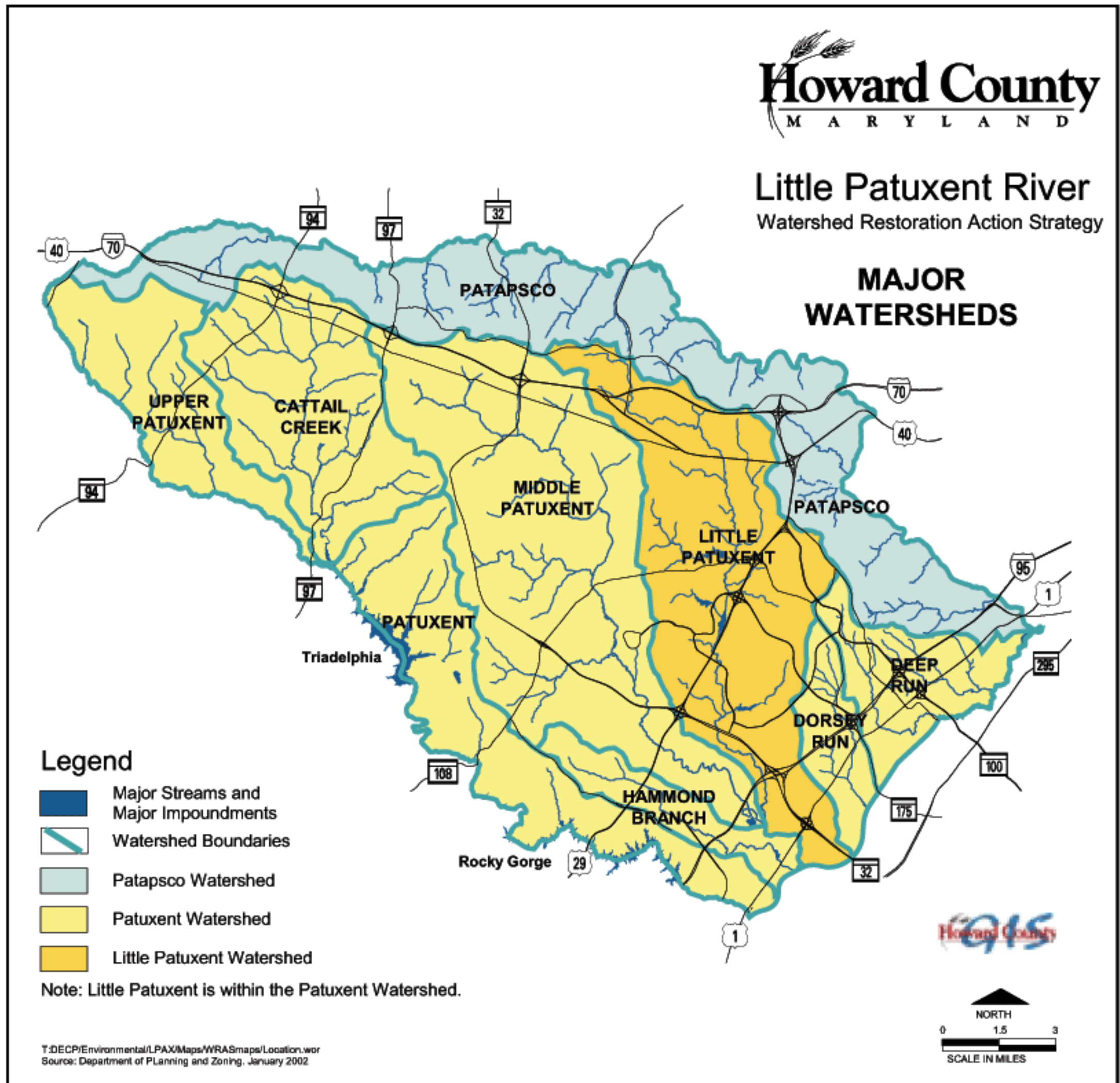
Water quality problems associated with nutrients tend to be limited to impoundments within the watershed. Suspended sediment problems appear in impoundments, where the sediments settle, and in excessive sediment bed load in local streams. Cadmium is a localized concern in a relatively limited area of the watershed east of US 1.

Living Resources and Habitat

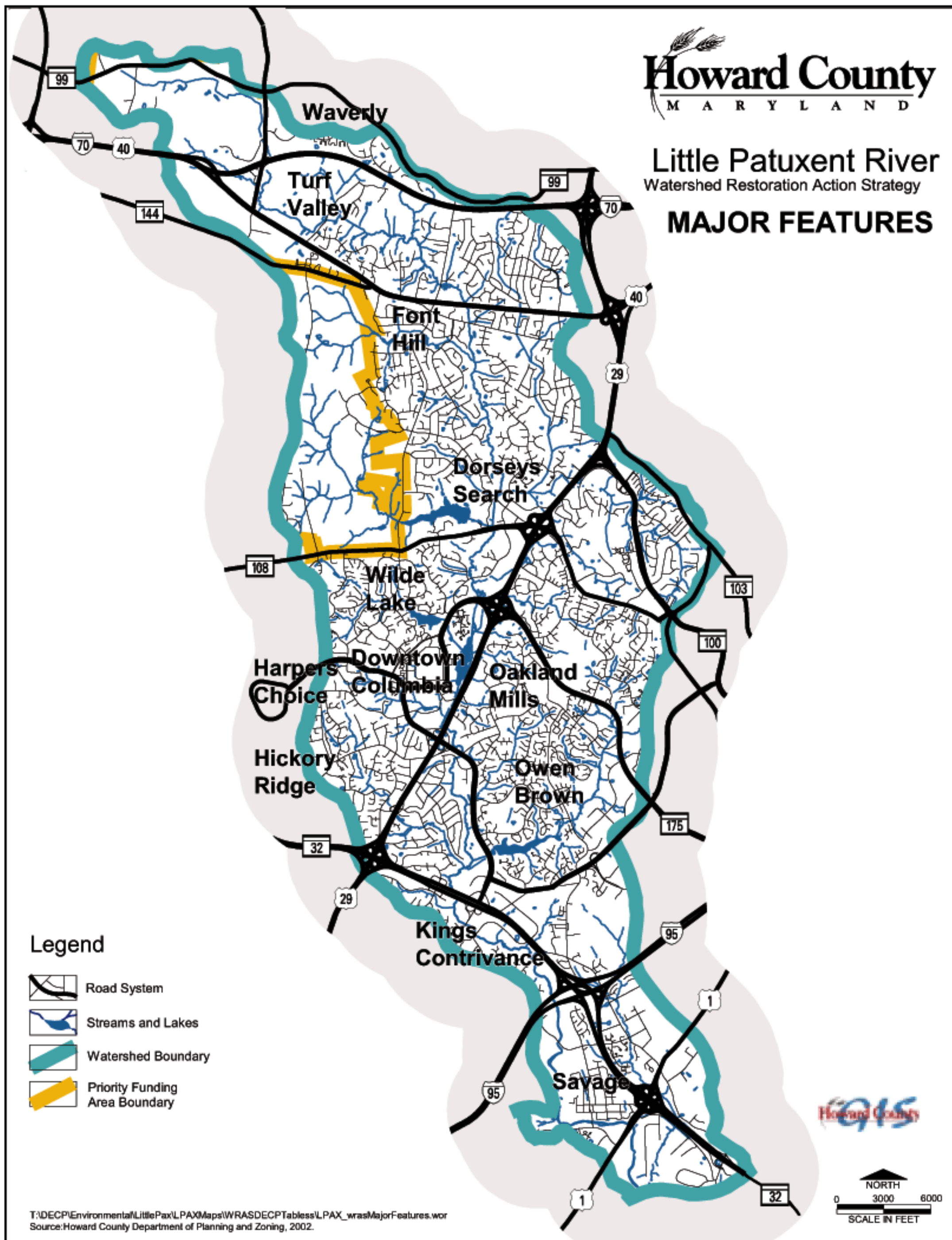
The Little Patuxent watershed lies predominantly within the Piedmont Province of Maryland. Stream valleys are extensive and contain many important natural habitats, including the streams themselves, wetlands, floodplains, forests and adjacent steep slopes. The lower portion of the watershed contains two State-designated areas that have habitat for threatened and endangered species. One of these areas contains a State-designated Wetland of Special State Concern that is afforded greater regulatory protection.

Aquatic species and habitat are under stress from a number of factors related to habitat loss and degradation, such as the historic loss of wetlands and forest, and stream channel erosion and channelization. Limited fish sampling has found that relatively few fish species are present, and those species most common or abundant tend to be those that adapt well to sandy, low gradient streams. However, the lower portion of the watershed has been designated by Maryland as having a moderately high potential to contain populations of rare fish and mussels. Because the Little Patuxent watershed does not meet clean water and other natural resource goals, it is classified as a Priority Category 1 watershed under Maryland's Unified Watershed Assessment, indicating that the watershed needs restoration.

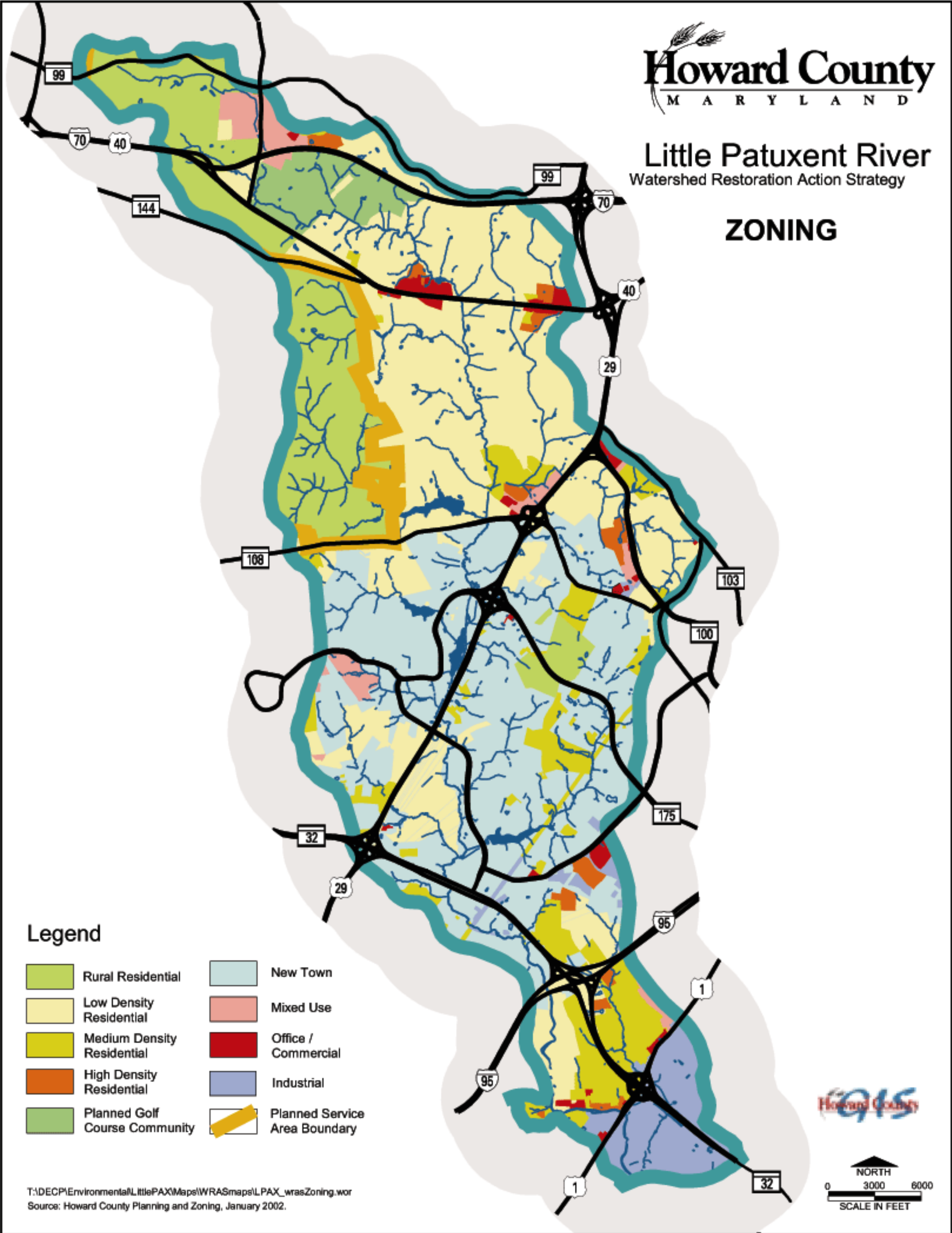
Little Patuxent River
Watershed Restoration Action Strategy



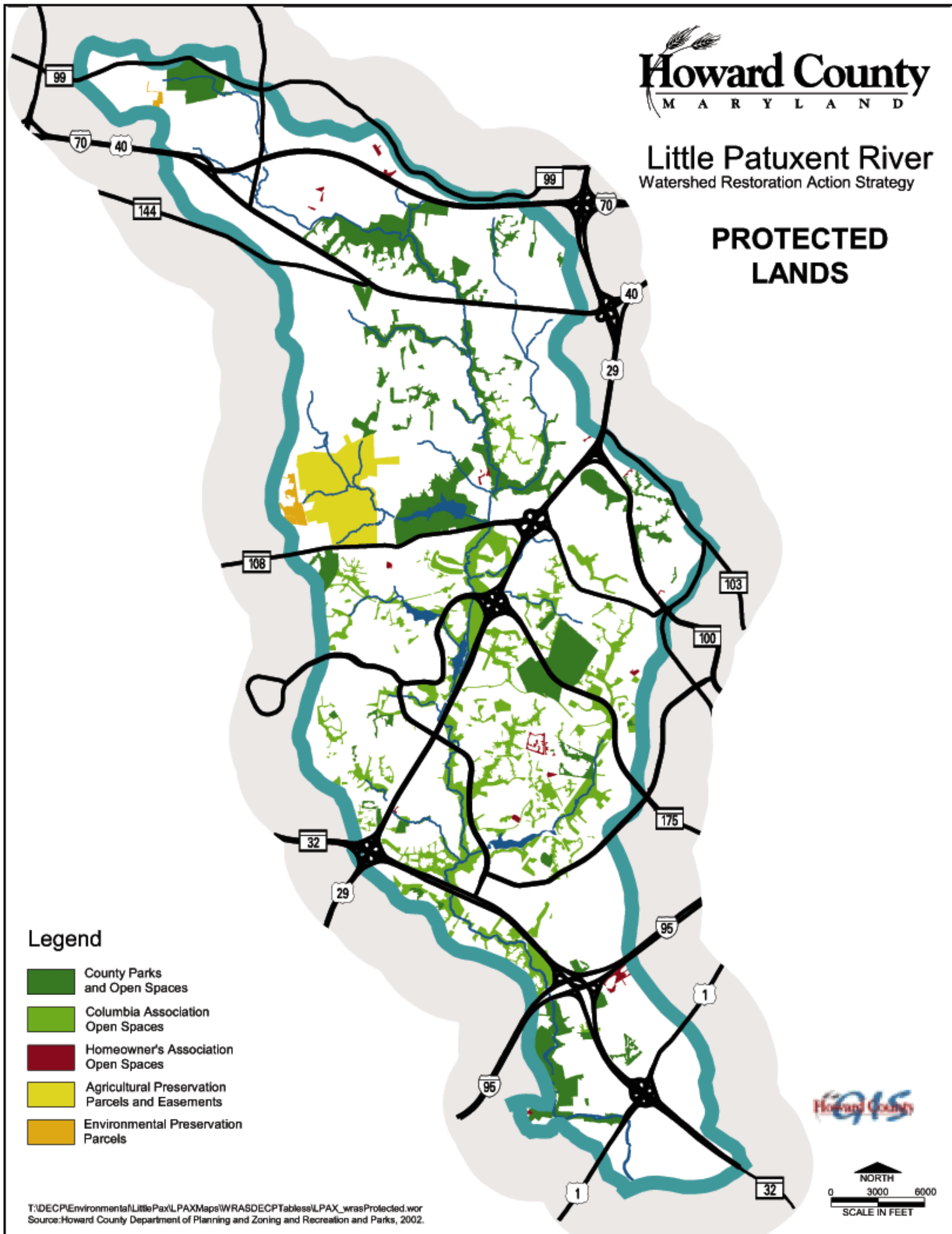
Map 1 - Major Watersheds. The Little Patuxent Watershed within Howard County, showing its relationship to the major Patuxent and Patapsco Watersheds. The Hammond Branch and Dorsey Run are part of the Little Patuxent system, but are not included in this study. Source: Howard County DPZ, January 2002.



Map 2 - Major Features. The Little Patuxent Watershed, showing all streams, lakes, roads and major communities. Source: Howard County DPZ, January 2002.



Map 3 - Zoning. Generalized Zoning within the Little Patuxent Watershed. Source: Howard County DPZ, January 2002.



Map 4 - Protected Lands. Public and privately-owned open space and park land in the Little Patuxent Watershed. Source: Howard County DPZ and DRP, January 2002.

Stream Corridor Assessment

Methods

In 1999/2000 a Stream Corridor Assessment (SCA) of the Little Patuxent stream network was performed by the Maryland Conservation Corp, who walked the streams of the Little Patuxent and identified potential problems. Although the survey was not intended to be a detailed scientific evaluation of the watershed, it provided a rapid overview of the entire stream network to determine where potential environmental problems are located and to collect some basic information about the watershed.

At each site data was collected about each problem and its location and photographs were taken to document existing conditions. To aid in prioritizing future restoration work, field crews rated all problem sites on a scale of one to five in three categories: 1) severity, 2) correctability, and 3) accessibility. The narrative rating for problem severity was given as very severe, severe, moderate, low severity or minor.

Findings

The survey identified 529 pipe outfalls, 119 sites with inadequately vegetated stream buffers, 103 bank erosion sites, 67 fish migration blockages, 46 exposed pipe sites, 45 channelized stream sections, 25 unusual condition sites, and seven trash dumping sites (Table 1). A summary of survey results and the data collected during the survey is presented in the SCA (Yetman, Rice and Pellicano, 2001). The following are the survey results by problem type.

Pipe Outfalls. Pipe outfalls include any pipes or small built channels that discharge into the stream through the stream corridor. Pipe outfalls are considered a potential environmental problem in the survey because they can carry uncontrolled runoff and pollutants such as oil, heavy metals and nutrients to a stream system. A total of 529 pipe outfalls were identified during the survey, making it the most frequently reported problem. Of the 529 outfall pipes observed, only 38 were reported to have a discharge that had some coloration or smell associated with it. The remaining discharges were recorded as clear with no odor.

Inadequate Riparian Buffers. Riparian forest buffers are the combination of native trees, shrubs, herbaceous plants, animals and insects, and soils adjacent to water. They are a unique transition from water to land. For this assessment, a riparian forest buffer was considered inadequate if it was less than 50 feet wide.

The SCA identified 119 sites where riparian forest buffers were inadequate. Approximately 36 miles of stream banks were inadequately buffered. Field teams found stretches of streams ranging in length from 75 feet to 1.3 miles with inadequate buffers. Mowed lawns were reported as the most predominant land use adjacent to sites with inadequate buffers. Also, a small amount of agricultural land and parkland contained inadequate riparian forest buffers. Most sites with inadequate riparian forest buffers received a moderate to low severity rating, indicating that the stream reaches were not long or that some trees were present at the sites.

Erosion. Erosion is a natural process of the wearing away of land surfaces by running water, wind, ice or other geological agents. Accelerated erosion primarily results from human activities and, occasionally, animals. In a stream habitat, too much erosion can destabilize stream banks and in-stream habitat, and cause sediment pollution problems downstream. Unstable eroding stream banks were reported at 103 sites during the survey. The majority of the erosion sites showed moderate to minor erosion that extended over long distances. The lengths of stream segments recorded as having unstable banks varied from six feet to two miles. Overall, the results indicated that there were approximately 9.7 miles of unstable eroding banks in the Little Patuxent watershed.

Fish Migration Barriers. Fish migration barriers are anything in the stream that significantly interferes with the free movement of fish upstream. Fish barriers can be caused by built structures such as dams or road culverts, and by natural features such as waterfalls or beaver dams.

Sixty-seven fish migration barriers were reported during the survey. The barriers were caused by a number of reasons, including: 17 road crossings, 11 debris dams, ten small dams, eight natural falls, seven ponds, five pipe crossings and five channelized stream sections. Most of the sites were given moderate to minor severity ratings. Overall, the mainstem of the Little Patuxent River was relatively barrier free.

Exposed Pipes. Exposed pipes are any pipes that are in the stream or along the stream's immediate banks that could be damaged by a high flow event. It does not include pipe outfalls, where only the open end of the pipe is exposed. In urban areas, it is very common for pipelines and other utilities to be located in the stream corridor. Damaged pipes have the potential to discharge fluids into the stream, causing water quality problems.

Exposed pipes were reported at 46 sites during the survey. Of those, 23 were places where pipelines crossing the bottom of the stream had been exposed, 13 were manhole stacks, seven sites had pipes exposed along the edge of the stream channel and three sites had pipes crossing above the stream.

Channel Alterations. Channel alterations were found in stream sections where the stream banks and channel have been significantly altered from a natural condition. This included areas where the stream may have been straightened and/or where the stream banks have been hardened using rock, gabion baskets or concrete over a significant length (usually 100 feet or more). It does not include road crossings unless a significant portion of the stream above or below the road has also been channelized. Results of this survey indicated that the stream system had been recognizably altered in 45 areas. The total length of stream affected by channelization was estimated to be about 2.7 miles. There were no major stream systems reported in the survey as being extensively channelized and most of the sites were given a moderate to minor severity rating.

Unusual Conditions. The unusual conditions were sites with anything out of the ordinary seen during the survey, specifically, sites with any unusual color or odor. Twenty-five unusual condition sites were found during the survey. Problems frequently recorded were red flock, a naturally occurring bacteria present in streams, and large amounts of algae.

Trash Dumping. Trash dump sites were places where large amounts of trash had been dumped inside the stream corridor. The field survey crew found seven sites where there was excessive trash. Only one, a construction site, was recorded as severe and was estimated to require 15 pick-up truckloads to remove the trash from the site. Four sites were recorded as having yard waste, one had residential waste and one had industrial waste. These sites were given severity ratings ranging from moderate to minor.

Table 1 - Problem Site Summary

Problem Type	Number	Length (miles)	Very Severe	Severe	Moderate	Low Severity	Minor
Pipe Outfalls	529	NA	1	2	35	245	246
Inadequate Riparian Buffers	119	17	5	15	39	49	11
Erosion Sites	103	10	2	4	33	50	14
Fish Migration Barriers	67	NA	0	4	17	21	25
Exposed Pipes	46	1	2	3	12	18	11
Channel Alterations	45	3	0	3	15	20	7
Unusual Conditions	25	NA	1	4	4	15	1
Trash Dumping	7	NA	0	1	1	3	2
Total	941	NA	11	36	156	421	317

Source: Stream Corridor Assessment, 2001.

Analysis and Recommendations

To prioritize sites for future remediation efforts, a problem site ranking system was developed using weighted criteria (this ranking system is described in more detail in Appendix A). Criteria were chosen to prioritize problem sites that posed the most severe and immediate threats to water quality, and to maximize benefits for water quality and habitat. Problem sites that met the following criteria were ranked as a higher priority for future remediation efforts:

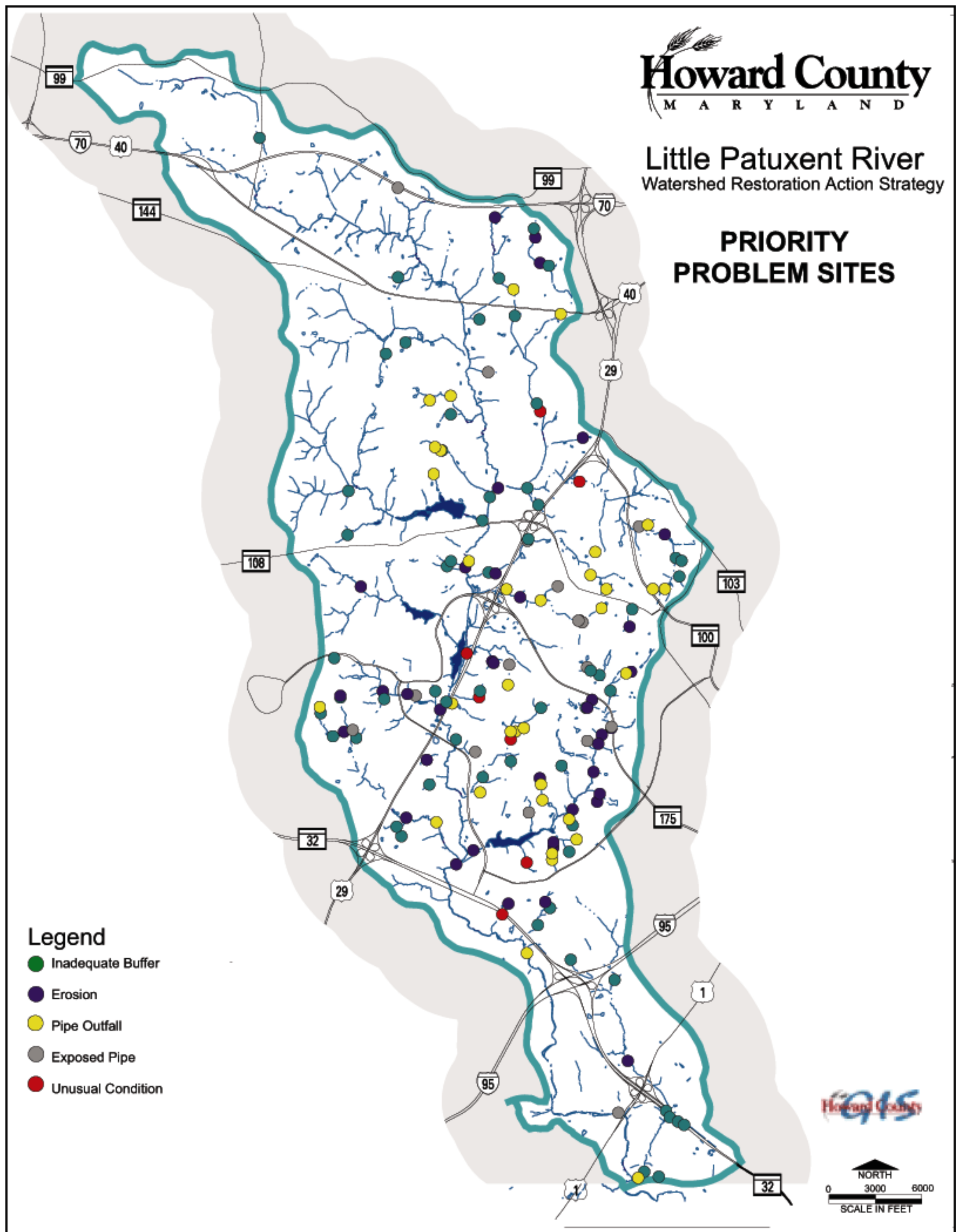
- *Problem severity ranking of moderate to very severe* - address the most severe problems first.
- *Low percentage of existing impervious cover for the surrounding subwatershed* - protect those subwatersheds with better quality from degrading further.
- *Low expected future increase in percentage of impervious cover for the surrounding subwatershed* - direct efforts to more stable subwatersheds.
- *Exposed pipe, pipe outfall, unusual condition, erosion or inadequate buffer* - address problem types that pose the most immediate threats to water quality.
- *Proximity to other erosion sites* - achieve greater benefits by addressing multiple problems.
- *Location within a headwater stream* - benefit sensitive habitat.
- *Location within a wetland* - benefit sensitive habitat.
- *Location within a greenway* - benefit sensitive habitat.
- *Location within habitat for threatened and endangered species* - benefit sensitive habitat.

The criteria were weighted to emphasize prioritizing exposed pipes, pipe outfalls and unusual conditions; problem sites with moderate to very severe ratings; and problem sites that were in proximity to other erosion sites. In addition, only those pipe outfalls with a discharge that had some coloration or smell associated with it were included in this prioritization. This effort resulted in a list of 157 priority problem sites, as shown in Table 2 and Map 5.

Table 2 - Priority Problem Sites

Problem Type	Very Severe	Severe	Moderate Severity	Total
Inadequate Buffer	5	15	39	59
Erosion	2	4	33	39
Pipe Outfall	1	2	31	34
Exposed Pipe	2	3	12	17
Unusual Condition	1	4	3	8
Total	11	28	118	157

Source: Stream Corridor Assessment, 2001.



Map 5 - Priority Problem Sites. Priority sites for future restoration efforts, based on a problem site ranking system. Source: Howard County DPW, adapted from the Stream Corridor Assessment Survey of the Little Patuxent River in Howard County, August 2001.

Forest Assessment

Introduction

Forests are valuable renewable resources that provide many benefits such as water quality protection, air quality protection, wood production, recreational opportunities for people in the area, and diverse habitat for many animals. In Howard County, nearly all of the existing forests originated in pastures and cultivated fields that were abandoned in the late 1800s and early 1900s. These forests are comprised primarily of deciduous species, including red maple, yellow poplar, ash, oak, dogwood, muscledwood and spicebush. Paved pathways and other trails exist throughout a large portion of the forests. Currently, most of the forested lands are publicly owned and citizens have access for hiking, fishing and other recreational activities.

Little specific information existed about the forests in the Little Patuxent watershed. Therefore, a forest assessment was conducted that included information about forest communities; individual trees, shrubs and herbaceous plants; and ground conditions such as soil types and slopes. The field research for this forest assessment was conducted primarily on public lands within the watershed.

Objectives for the forest assessment included:

- delineating polygons of forested and other areas with natural cover by type of cover; and
- describing and documenting conditions of forests and other natural areas.

Methods

During the summer of 2001, forested areas within the Little Patuxent watershed were inventoried. Using aerial photographs and computerized mapping programs, forested and natural cover areas were delineated and classified into deciduous, coniferous, mixed deciduous and coniferous, scrub/shrub/natural regeneration, and other natural cover (Map 6). The acreage of each class and length of forest edge were calculated.

Within the surveyed areas, 778 circular plots were installed to record the understory conditions, and 403 plots were installed to record the overstory conditions. The area and number of plots installed in each classification of land cover type is found in Table 3.

In the forests, information was collected about the following:

- area covered by plants or other features;
- physical aspects such as slope shape, steepness, and distance to water;
- presence of water, rock and debris piles;
- tree cavities, nesting and roosting sites, and fallen logs;
- roads and trails;
- damage by deer browsing;
- dominance of invasive species; and
- amount of sunlight that reached the forest floor.

Specific information collected about trees and shrubs included:

- number of plants;
- species;
- age, size, and height; and
- rate of growth and general health.

Table 3 - Land Cover Type

Land Cover Type	Area in Acres	Number of Plots
Brush or Transitional between Open and Forested		
Primarily herbaceous, non woody vegetation	300	23
Primarily shrub/brush	59	3
Mixed herbaceous and shrub/brush	36	1
Total Transitional Areas and Plots	395	27
Forest		
Deciduous forest	4,807	58
Coniferous forest	0	0
Mixed deciduous/coniferous forest	351	29
Total Forested Areas and Plots	5,158	387
Wetlands		
Emergent wetland	154	12
Scrub-shrub wetland	0	0
Forested wetland	147	12
Total Wetland Areas and Plots	301	24
Total Area and Number of Plots	5,854	438

Source: Howard County Forest Assessment, 2002.

Findings

Howard County and the Columbia Association own 1,456 acres, or 25 percent, of the forested land in the Little Patuxent watershed. Citizens or businesses own the remaining 4,398 acres, or 75 percent. Of the 5,854 acres of forests and other natural cover in the watershed, 25 percent was surveyed for the forest assessment.

Preliminary analysis has identified 67 forest communities (Map 7). A forest community is generally defined as an area of trees and shrubs, with the accompanying wildlife living in the area, that have similar needs for moisture and sunlight. Forest communities can have similar cover types, but have differences in age or density, or be areas that are not contiguous to one another. Of the forest communities identified, about 19 percent support species that indicate wetlands, 15 percent are upland forest communities, and the remainder are mid-slope or riparian communities. Nearly all forest communities were approaching 100 years old.

Tree and shrub seedlings, or regeneration, were observed on a low percentage of plots and were not well distributed across the forest communities. Understory growth can be limited by a lack of sunlight. When basal area, a measure of tree density, is less than 60 square feet per acre, this indicates that sunlight reaching the forest floor should be adequate for understory growth. Fifty-five percent of the plots had a basal area less than 60 square feet per acre.

Invasive species were found in the main crowns or dominating the understory on 65 percent of the plots. Invasive species were present in all forest communities. Damage from deer browsing was observed on nearly all plots where plants with available browse existed. The percentage of plots where severe browse damage was observed was low because little vegetation existed in the understory of most plots. Forest communities where severe damage was noted were located throughout the watershed.

Analysis and Recommendations

The forest assessment of the Little Patuxent watershed describes forest conditions in detail. The data provide base-line information that will be useful in measuring progress of watershed restoration activities. The data can be sorted and compiled in many ways to provide information to resource specialists to assist in decision-making processes.

While definitions of forest health vary tremendously, it is widely accepted that forest health reflects sustainability and diversity. For a forest to be self-sustaining, it must be capable of long-term natural regeneration. In the Little Patuxent watershed, the forest communities are maturing and adequate amounts of sunlight reach the forest floor, yet natural regeneration is limited. Seedlings that might mature into future forest trees are largely absent from the forest understory.

Diversity is also limited, with forests being largely even-aged and of similar composition. The majority of the trees within each community, as well as from one community to the next, are within a narrow age range. In general, they are maturing forests between 75 and 100 years old. The species composition also varies little. Most communities are bottomland hardwoods with yellow poplar, red maple, sycamore, pin oak, muscledwood and spicebush. Understory plants, like established shrubs and ground covers, and natural regeneration of trees, shrubs and herbaceous plants are lacking.

Three factors are likely impacting forest health in the Little Patuxent watershed: deer browsing, invasive species and human impacts. Deer browse damage was observed on most plants existing in the understory. Invasive species are prominent and dominate much of the forests in the watershed. Signs of significant impacts by people are widespread and include forest fragmentation and overuse. The effects of these three factors are interrelated. Deer browsing and heavy use by people are likely reducing the number of plants in the understory. Pressure from deer browsing and overuse by people may increase the presence and dominance of non-native invasive species. People likely increase the rate of introduction and spread of non-native invasive species. Invasive species are often able to out-compete native plants and so can damage forest health by inhibiting the survival and regeneration of desirable native species. Further, fragmentation and the lack of understory and ground-level plants likely reduce the quality of habitat for ground-dwelling birds and mammals.

Forests in the Little Patuxent watershed will not likely regenerate, or form new forests, without intervention to reduce deer browsing pressure, invasive species and impacts from people. Therefore, without intervention, sustainability is limited.

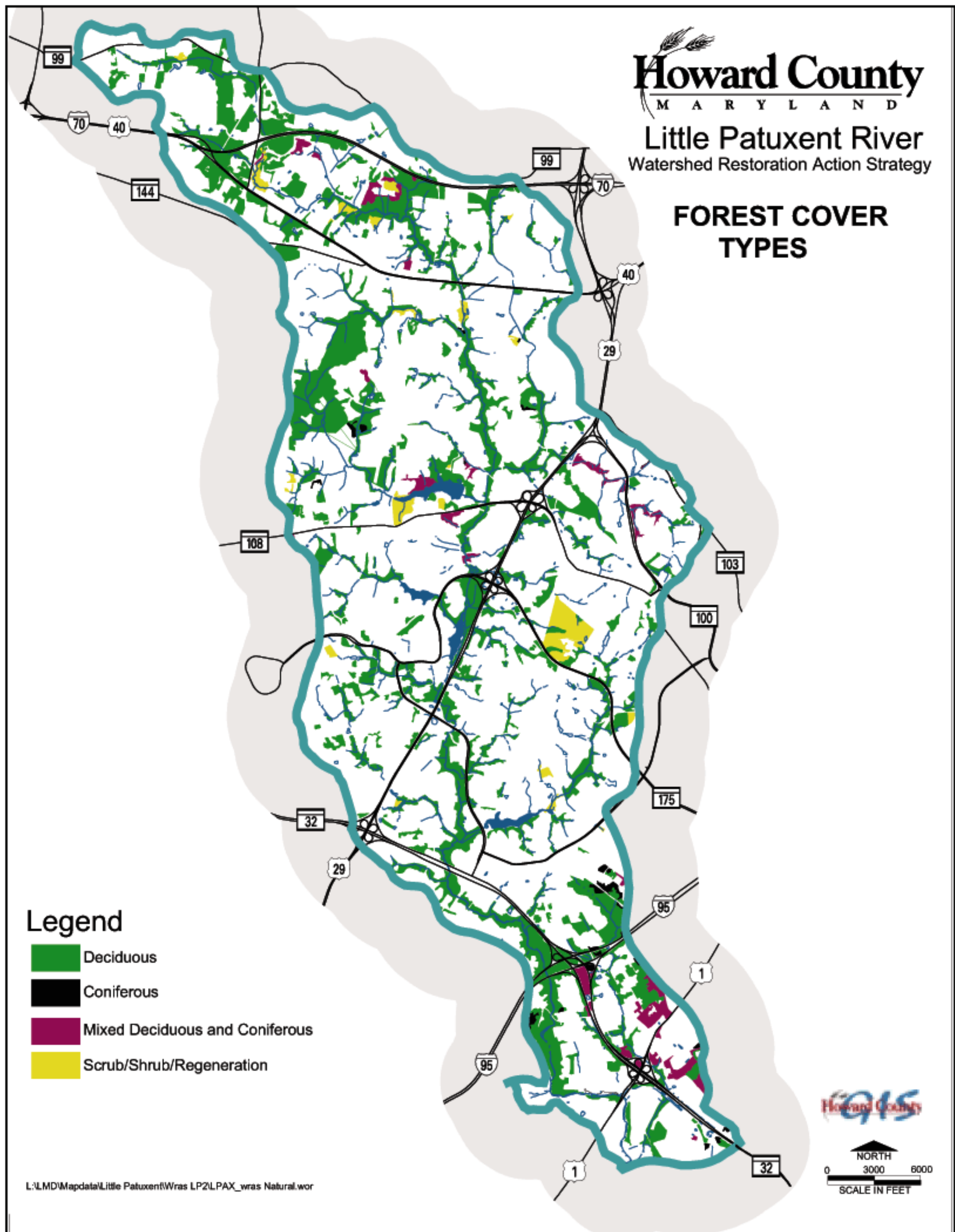
To address these issues, a wide variety of remedial measures should be continually developed, implemented and evaluated. Combining existing resources with information from the forest assessment and WRAS will provide a wide range of options for addressing these issues, including the following:

Deer Management. Howard County's Comprehensive Deer Management Plan should be supported and implemented by all County departments and agencies. County citizens should also be encouraged to support and participate in implementation of the Deer Management Plan.

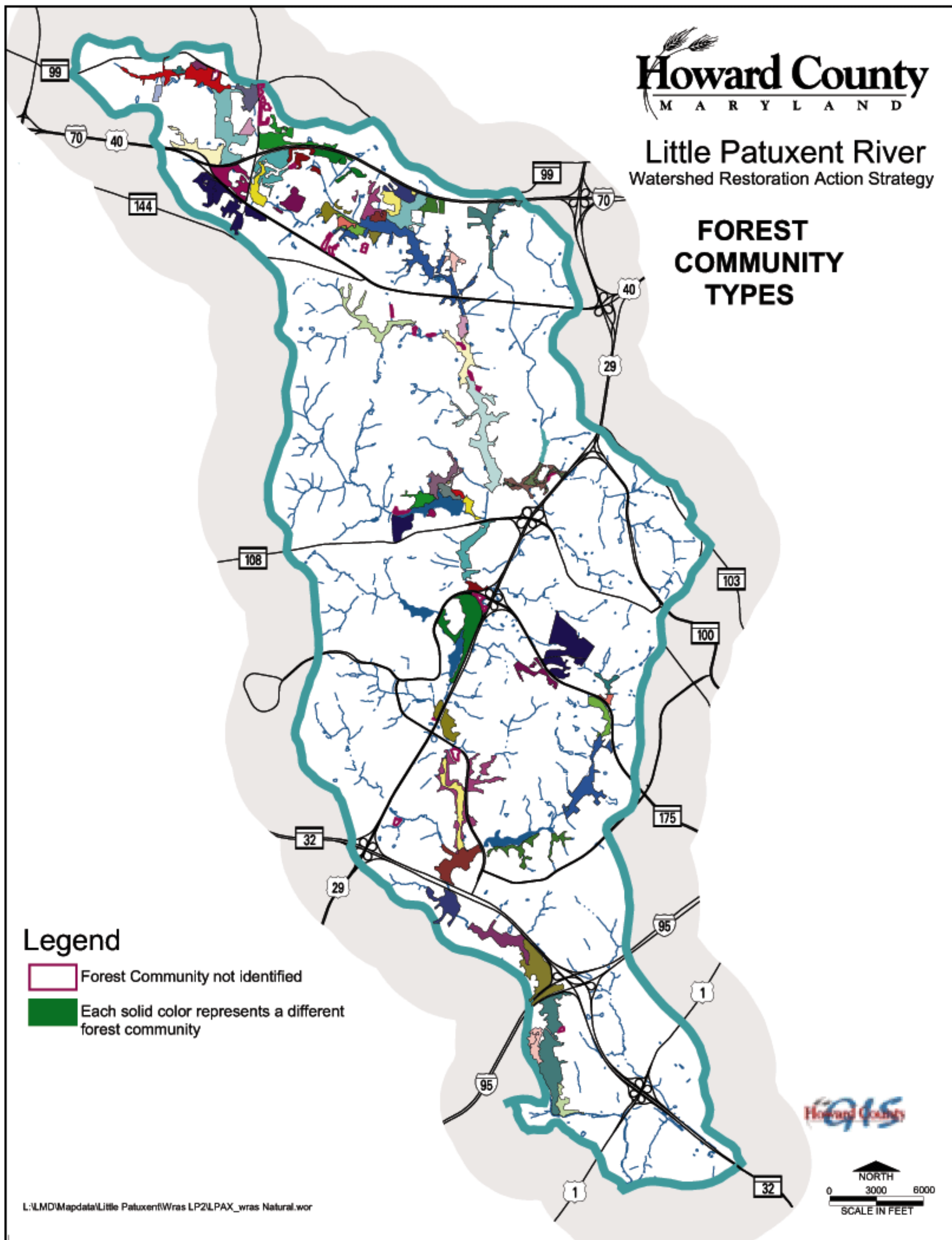
Invasive Plants. Federal, State and local guidelines exist for limiting the impacts of non-native invasive plants. Howard County should collaborate with the Maryland Cooperative Extension Service, the Maryland Native Plant Society and garden clubs to inform citizens and change behaviors.

Public Land Management. Howard County should manage park and open space lands according to best management practices that promote diversity and regeneration of native plant communities. Impacts from people could be reduced through continual enforcement of rules and regulations governing public lands. In particular, the County needs to ensure that owners of adjoining properties do not encroach on park land, clear understory vegetation or dump unwanted yard wastes.

Fragmentation. Land acquisition or the purchase of land preservation easements may be needed to ensure that key forest parcels are owned, and thus protected, by the public sector. Effective administration and enforcement of the Maryland Forest Conservation Act, environmental regulations, and the open space provisions in the County zoning and subdivision regulations may reduce additional fragmentation in the watershed.



Map 6 - Forest Cover Types. Forest cover types within the Little Patuxent Watershed. Source: Howard County Forest Assessment, February 2002.



Map 7 - Forest Community Types. Forest communities found within the Little Patuxent Watershed in the areas assessed. Howard County Forest Assessment Report, February 2002.

Stream Biological Assessment

Methods

In 2001, Howard County initiated a County-wide, long-term biomonitoring program to provide an assessment of the ecological health of the County's stream systems. As part of this program, the Maryland Department of Natural Resources (DNR) Watershed Restoration Division, in coordination with Tetra Tech, Inc. and Howard County, conducted biomonitoring in the Little Patuxent watershed.

The biomonitoring program divided the Little Patuxent watershed into three subwatersheds and nine to 11 sampling sites were randomly selected within each subwatershed (Map 8). Benthic macroinvertebrates (bottom-dwelling organisms) and fish were sampled at the randomly selected sites and information was also collected on the physical habitat, to assess the condition of individual streams and overall watershed quality. Information recorded included the abundance and type of species for both benthic and fish samples, and the length and weight of the fish. The benthic and fish surveys were conducted in accordance with DNR's Maryland Biological Stream Survey (MBSS) methods. A Benthic Index of Biotic Integrity (B-IBI) and a physical habitat rating, as developed by the MBSS, were used to determine stream health.

Benthic Index of Biotic Integrity (B-IBI). The Benthic Index of Biotic Integrity is calculated based on characteristics of the benthic macroinvertebrate community, such as the number and type of pollution-sensitive species present. This B-IBI is then compared to the B-IBI of the healthiest streams within a similar region, and is given a narrative ranking of "good," "fair," "poor" or "very poor."

Physical Habitat Rating. The physical habitat rating measures the stream's ability to support a diverse aquatic community. The rating is calculated based on a variety of parameters, such as the velocity and depth of stream flow, the presence of sediment in the stream bed, bank stability and riparian buffer width. The overall physical habitat rating is translated into a narrative rating of "comparable," "supporting," "partially supporting" or "non-supporting."

Findings of the Benthic Survey

The following presents a summary of the benthic and physical habitat survey results for each of the subwatersheds (Table 4).

Upper Little Patuxent. Eleven sites were sampled in the Upper Little Patuxent subwatershed. One site in this subwatershed rated as "very poor" for biological condition, six rated as "poor" and the remaining four sites received "fair" ratings. The mean B-IBI rating for this subwatershed is "poor." Physical habitat assessment results place seven of the sites in the "very poor" category and four sites in the "poor" category. The mean physical habitat quality rated as "very poor."

Middle Little Patuxent. Ten sites were sampled in the Middle Little Patuxent subwatershed. Six of the sites were rated as "very poor" for biological condition, three rated as "poor" and

one as “fair.” The mean B-IBI rating for this watershed is “poor.” Physical habitat assessment results indicate that eight of the sites are “very poor” and two received “poor” ratings. The mean physical habitat quality rated as “very poor.”

Lower Little Patuxent. Nine sites were sampled in the Lower Little Patuxent subwatershed. Four of the nine sites rated “very poor” for biological condition, four rated “poor” and one scored “fair.” The overall narrative B-IBI rating for this subwatershed is “poor.” Five of the nine sites sampled were rated as “poor” for physical habitat and the other four were “very poor.” The mean physical habitat quality in this subwatershed was rated as “very poor.”

Table 4 - Summary of Results for the Benthic Survey

Subwatershed	Physical Habitat	Benthic Survey
Upper Little Patuxent	Non-supporting	Poor
Middle Little Patuxent	Non-supporting	Poor
Lower Little Patuxent	Non-supporting	Poor

Source: Biological Assessment of the Little Patuxent River, Cattail Creek, and Brighton Dam Watersheds, Howard County, Maryland, 2001.

Findings of the Fish Survey

The following presents a summary of the fish survey results for each of the subwatersheds (Table 5).

Upper Little Patuxent. A combined total of 5,064 fish were collected at 11 stream sites in the Upper Little Patuxent. The number of fish species collected at each site ranged from three to 18, and averaged ten species per site. The most abundant species found in the sampled streams was the blacknose dace, a pollution tolerant fish.

Middle Little Patuxent. A combined total of 3,812 fish were collected at ten sites in the Middle Little Patuxent subwatershed. All the stream sites, except for one, in this subwatershed contained fish. The number of fish species ranged from zero to 18, and averaged seven fish species per site. The most abundant species found in the sampled streams was the blacknose dace, a pollution tolerant fish.

Lower Little Patuxent. A combined total of 3,108 fish were collected at eight sites in the Lower Little Patuxent subwatershed. The number of species found at the sites ranged from one to 24, and averaged 11 fish species per site. The blacknose dace and tessellated darters, both pollution tolerant fish, were the most abundant species found in the streams in this subwatershed.

Table 5 - Summary of Results for the Fish Survey

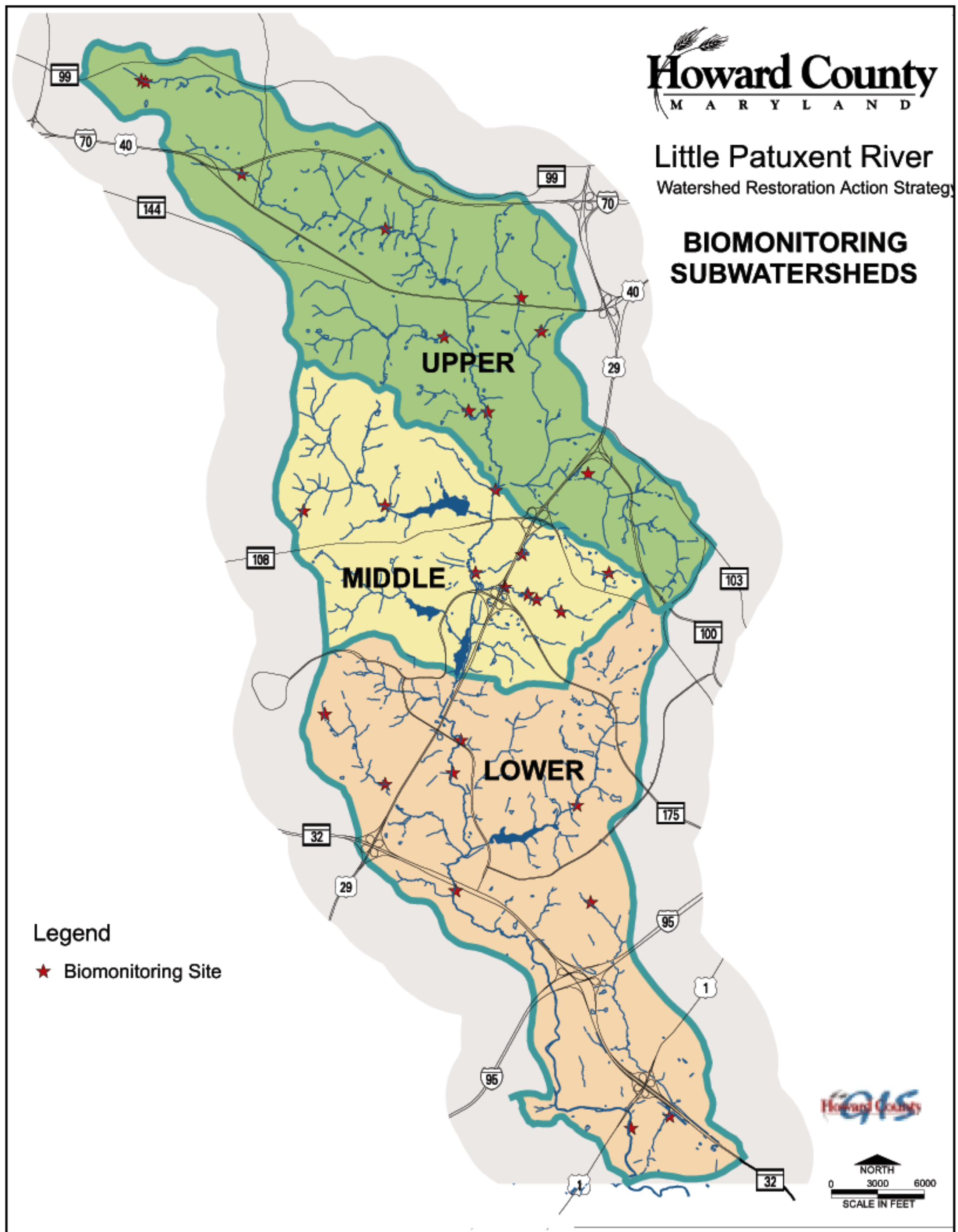
Subwatershed	Total Number of Fish Collected	Number of Sites Sampled	Average Number of Species Found at Each Site
Upper Little Patuxent	5,064	11	10
Middle Little Patuxent	3,812	10	7
Lower Little Patuxent	3,108	8	11

Source: Biological Assessment of the Little Patuxent River, Cattail Creek, and Brighton Dam Watersheds, Howard County, Maryland, 2001.

Analysis and Recommendations

The benthic and fish assessments provide general health and baseline information on the condition of the Little Patuxent watershed. The benthic survey found that the watershed has poor biological health and non-supporting physical habitat. The fish survey found that the most abundant species were pollution tolerant fish.

These assessments also provide a baseline to measure the effectiveness of watershed protection and rehabilitation strategies. The County biomonitoring program will conduct assessments of the watershed on a five-year cycle. As actions are implemented to improve water quality and physical habitat, future ratings for the watershed should improve.



Map 8 - Biomonitoring Subwatersheds. Benthic and fish surveys were conducted at each site within the three subwatersheds of the Little Patuxent Watershed. Source: Howard County DPW and Tetra Tech, Inc., adapted from the Biological Assessment of the Little Patuxent River, October 2001.

Impervious Cover Assessment

Methods

Under the Federal Clean Water Act, Howard County has a National Pollutant Discharge Elimination System (NPDES) permit for discharges from the County stormwater management system. The NPDES permit has significant requirements for producing measurable improvements to water quality in the County.

The NPDES program divided the County into subwatersheds, of two to ten square miles, to assess water quality and aquatic habitat conditions. This assessment uses impervious area coverage (caused by built structures such as parking lots, roads and buildings) as an indicator of expected water quality and aquatic habitat conditions. This information was used by the NPDES program to develop a list of priority subwatersheds for future restoration efforts. Table 6 shows how subwatersheds are categorized, based on impervious cover, along with expected stream conditions.

Table 6 - Subwatershed Categories and Expected Stream Conditions

Subwatershed Category	Percent Impervious Cover	Water Quality, Aquatic Habitat and Aquatic Species Diversity
Sensitive	less than or equal to 10	good to excellent
Impacted	greater than 10 and less than or equal to 25	fair to good
Non-supporting	greater than 25	poor to fair

Source: Stormwater Management Division, Howard County, Maryland.

These categories show that as impervious cover increases with increasing development, stream health is expected to decline as forests are cleared, groundwater recharge is reduced, and polluted runoff increases in volume and frequency. Subwatersheds in the sensitive category have a limited amount of development and are expected to have the healthiest streams, impacted subwatersheds are expected to have streams showing clear signs of degradation, and non-supporting subwatersheds are expected to have streams with significant degradation. The more degraded a stream system, the more difficult and costly restoration efforts become.

Findings

The Little Patuxent watershed contains 14 NPDES subwatersheds. Impervious cover and subwatershed category information for these subwatersheds is presented in Table 7 and Map 9.

The majority of the subwatersheds are currently in the non-supporting category and not are expected to undergo significant future increases in impervious surface. Based on expected future development, the only subwatershed currently in the sensitive category (Centennial Lake) will change to the impacted category, and one of the three subwatersheds currently in the impacted category (Guilford Branch) will change to non-supporting. In addition, one subwatershed (Little Patuxent Headwaters) is expected to undergo a substantial (11.4 percent) future increase in impervious cover, although this will not cause a change in category.

Table 7 - Subwatershed Impervious Cover and Category

Number *	Subwatershed Name	Existing Percent Impervious	Existing Category	Future Percent Impervious	Future Category	Change in Percent Impervious
1	Little Patuxent Headwaters	11.2	Impacted	22.6	Impacted	11.4
2	Font Hill Branch	19.0	Impacted	21.5	Impacted	2.5
3	Plumtree Branch	28.5	Non-supporting	29.2	Non-supporting	0.7
4	Little Patuxent below Font Hill	25.4	Non-supporting	25.1	Non-supporting	0
5	Centennial Lake	8.9	Sensitive	10.1	Impacted	1.2
6	Red Hill Branch	26.5	Non-supporting	28.8	Non-supporting	2.3
7	Wilde Lake	31.9	Non-supporting	31.8	Non-supporting	0
8	Lake Kittamaquondi	31.9	Non-supporting	31.5	Non-supporting	0
9	Beaver Run	29.8	Non-supporting	30.1	Non-supporting	0.3
10	Little Patuxent below Lake Kittamaquondi	30.7	Non-supporting	32.1	Non-supporting	1.4
11	Lake Elkhorn	32.6	Non-supporting	33.2	Non-supporting	0.6
12	Little Patuxent below Lake Elkhorn	32.5	Non-supporting	32.8	Non-supporting	0.3
13	Guilford Branch	24.8	Impacted	29.6	Non-supporting	4.8
14	Junction Industrial Park Tributary	36.6	Non-supporting	36.7	Non-supporting	0.1

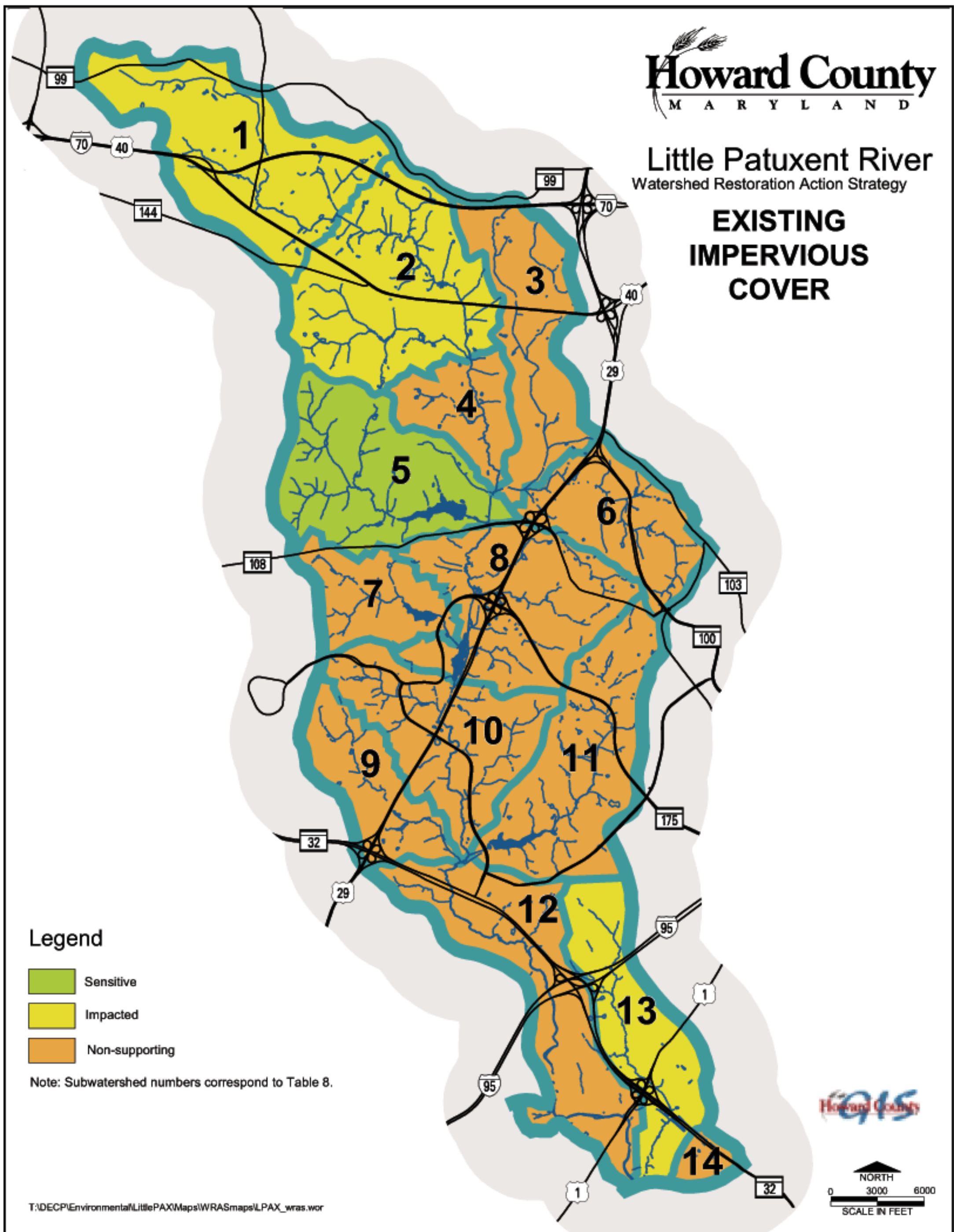
* Subwatersheds are numbered from north to south.

Source: Stormwater Management Division, Howard County, Maryland.

Analysis and Recommendations

To prioritize subwatersheds for future restoration efforts, a ranking system was developed using weighted criteria. Criteria were chosen to prioritize stable subwatersheds with moderate amounts of impervious cover, where restoration efforts could show measurable improvements. Criteria also were chosen to prioritize subwatersheds with higher amounts of publicly owned or homeowners association owned land, to provide more opportunities for restoration projects, and to complement existing and future planning efforts. Planning efforts affecting the Little Patuxent watershed are the Route 1 Corridor Revitalization Study, a future Route 40 corridor study, the Little Patuxent WRAS, urban lake restoration efforts and the Little Patuxent greenway land acquisition priority area.

The criteria were weighted to emphasize prioritizing impacted subwatersheds with an expected low future increase in impervious cover. High ranking subwatersheds are being further reviewed and sorted based on staff knowledge and field assessments of subwatershed conditions. It is probable that a subwatershed in the Little Patuxent watershed will be chosen as the number one and/or two priority for future restoration efforts. Under the conditions of the NPDES permit, the County is required to develop a restoration plan and begin implementation efforts for the first priority subwatershed, and to develop a restoration plan for the second priority subwatershed by June 2005.



Map 9 - Existing Impervious Cover. Existing impervious cover categories for the 14 subwatersheds of the Little Patuxent Watershed, as defined for the County’s National Pollutant Discharge Elimination System program. Source: Howard County and Tetra Tech, Inc., January 2002.

Watershed Restoration Plan and Implementation Strategy

Summary of Characterization and Supporting Studies Findings

As noted previously, the Little Patuxent watershed is located predominantly within the County's Planned Water and Sewer Service Area, which is also the County's designated Priority Funding Area, under Maryland's Smart Growth Initiative. As a result, substantial urban/suburban development has occurred in the watershed over the past 30 years. In fact, the Little Patuxent watershed contains eight of the ten subwatersheds within the County that have the highest levels of impervious cover.

This development, much of which occurred prior to County adoption of stormwater management and environmental protection regulations, has eliminated and degraded habitat for both land and aquatic species, as wetlands were filled, forests were cleared, and streams received polluted runoff at an increased volume and frequency. The impervious cover assessment indicates that the majority of the Little Patuxent subwatersheds are in the non-supporting category and are expected to have poor to fair water quality, aquatic habitat and aquatic species diversity. This assessment is supported by the results of the stream biological assessment, which ranked all three larger subwatersheds as poor for biological health and non-supporting for physical habitat.

Despite the increasing urbanization of the watershed, significant portions of the stream valley corridors are in public or homeowners association ownership. This ownership often affords greater protection for sensitive resources and provides potential opportunities for restoration efforts. The majority of the forests in the watershed are located along stream valley corridors. However, the forest assessment indicates that the forest health is poor, as reflected in the limited forest regeneration and diversity, which reduces the habitat value of the forest. This decline in forest health is attributable to pressure from excessive deer browsing, invasive species, forest fragmentation and overuse by humans.

The stream corridor assessment survey found potential problem sites throughout the watershed, but the majority were within the more developed portions of the watershed. The most common potential problem types were pipe outfalls, the majority of which were stormwater outfalls, inadequate stream buffers and stream bank erosion sites. However, the majority of the sites (78 percent) had a low to minor severity rating. Additionally, stream channel alterations were a minor problem in the watershed, with less than five percent of the stream miles having some type of channel alteration. This indicates that a natural channel still remains in the majority of the watershed.

Fortunately, the impervious cover assessment also indicates that the majority of Little Patuxent subwatersheds are not expected to see significant future increases in impervious cover. The most notable exception to this future stability is the headwaters of the mainstem Little Patuxent River, which is predicted to see an 11.4 percent increase in impervious cover. MDP projections show that urban development will continue to increase in the watershed. However, the majority of this projected increase will occur in the Hammond Branch watershed. This means that restoration efforts have a better chance of success because expected benefits will not be undermined by future

development. This predicted future growth in the headwaters may mean that restoration efforts should be directed away from the mainstem Little Patuxent towards the tributaries.

Watershed Restoration Goals and Objectives

The Characterization and supporting studies provide evidence that the Little Patuxent watershed has been substantially impacted by development. However, these studies also indicate that restoration efforts are feasible and can result in measurable improvements to water quality and habitat. To achieve the vision for the Little Patuxent watershed, the following goals and objectives have been established for water quality, habitat and public outreach:

Water Quality

Goal: Achieve and maintain the water quality necessary to support the aquatic living resources of the Little Patuxent River watershed and to protect human health.

Objectives:

- Improve biological and physical habitat ratings.
- Meet State water quality standards.
- Reduce sediment and nutrient loads.

Habitat

Goal: Protect, enhance and restore those habitats and natural areas that are vital to the survival and diversity of the living resources of the Little Patuxent River watershed.

Objectives:

- Retain, enhance, and restore forests, wetlands, meadows and other areas of natural cover.
- Increase the habitat value of lakes and ponds.
- Enhance and restore instream physical habitat, including streambeds and streambanks.
- Manage wildlife to support healthy and diverse populations of native species.

Public Outreach

Goal: Promote environmental stewardship and assist individuals, community-based organizations, businesses, schools and others to undertake watershed restoration initiatives.

Objectives:

- Increase awareness and personal involvement.
- Encourage participation in land preservation programs.
- Promote land management practices that conserve resources, reduce pollution and enhance habitat.
- Support the establishment of watershed protection organizations and partnerships.

Watershed Protection and Restoration Tools, Actions and Constraints

To achieve the goals and objectives for the Little Patuxent watershed, the following watershed protection and restoration tools and related actions are needed:

Land Conservation. Protect sensitive land and water resources and habitats.

- Purchase key greenway and upland parcels using State and County open space funds.
- Acquire easements through the Agricultural Land Preservation Program, Howard County Conservancy, Forest Conservation Program and other appropriate easement programs.

- Continue research and refinement of regulations for the protection of open space, sensitive resources and forest conservation.
- Promote forest conservation banking for forest retention and reforestation.
- Improve land management practices and enforcement on protected lands.

Riparian Buffers. Establish, protect and enhance forested buffers for streams, wetlands and lakes.

- Prioritize locations where buffers are absent, as identified in the forest assessment and stream corridor assessment survey, and develop a planting strategy defining number of acres or linear feet per year to be planted.
- Continue planting buffers on County green space.
- Promote the Conservation Reserve Enhance Program and other habitat improvement programs to the rural and agricultural community.
- Develop and implement a strategy for control of invasive plants.
- Encourage private property owners to plant forested buffers, and to reduce mowing and use best management practices in existing buffers.
- Identify and develop funding sources for private buffer plantings.

Better Site Design. Minimize impervious surfaces and maximize open space through techniques such as cluster development.

- Develop an environmental regulations handbook for developers and citizens that explains the rationale for County environmental regulations, provides examples of effective design solutions and presents the benefits of going beyond minimum requirements.
- Prepare case studies documenting successful projects that reduce impervious cover and increase open space.
- Continue research and refinement of regulations that promote better site design.

Erosion and Sediment Control. Reduce sediment loss during construction and ensure sensitive areas are protected.

- Maintain State certification of the County sediment and erosion control program.
- Monitor the effectiveness of the sediment and erosion control program enforcement.
- Identify occurrences of land erosion outside of the construction process that contribute to stream erosion and sedimentation, and develop a strategy to encourage stabilization and repair. Examples of such occurrences include all-terrain vehicle trails, areas lacking vegetation, and unpaved roads and trails.
- Encourage the development and implementation of soil conservation and water quality plans for agricultural lands.

Stormwater Best Management Practices. Install practices to maintain groundwater recharge, reduce pollutant loads, protect stream channels and reduce flooding.

- Retrofit publicly maintained facilities identified as priorities in the County retrofit survey.
- Identify privately maintained facilities that are retrofit candidates and secure funding for retrofits of these facilities.
- Retrofit existing facilities and develop new facilities on County owned sites.

- Monitor the effectiveness of the new stormwater management regulations and facilities, and develop demonstration sites or case studies documenting successful projects, to educate developers and engineers.
- Encourage communities, agencies and nongovernmental organizations to convert existing dry ponds to stormwater wetlands or otherwise increase the habitat value of existing facilities.

Other Discharges. Manage septic systems, sanitary sewers and industrial discharges.

- Monitor pipe outfalls through the County illicit discharge program.
- Address priority pipe outfalls, exposed pipes and unusual conditions identified in the stream corridor assessment survey.
- Ensure that problem septic areas are addressed through the Health Department.

Stream Channel Stabilization and Restoration. Improve aquatic habitat and reduce sediment loads to the stream.

- Address priority erosion sites identified in the stream corridor assessment survey using bioengineering techniques where feasible.
- Develop long-term strategies to address channelized stream sections and the removal of fish passage blockages identified in the stream corridor assessment survey.

Habitat and Wildlife Management. Establish, protect and enhance valuable habitat, and manage wildlife to support healthy and diverse populations of native species.

- Protect and create areas of forest interior habitat, threatened and endangered species habitat, and other areas of diverse sensitive habitat.
- Develop a forest management plan to ensure forest diversity and resilience.
- Plant forests in targeted areas to link, connect and extend forests.
- Promote native plant landscaping and encourage non-turf alternatives.
- Enhance existing wetlands and create new wetlands where feasible.
- Support continued implementation and evaluation of the County deer management program.
- Endorse development of urban wildlife management studies.

Watershed Stewardship Programs. Increase public understanding and promote better private land management.

- Develop a generic public outreach strategy that can be tailored to promote specific messages for each identified target audience.

Subwatershed Studies. Develop more detailed restoration plans for priority subwatersheds.

- Develop and implement subwatershed restoration plans through the County's National Pollution Discharge Elimination System stormwater discharge permit program.

Constraints on the implementation of these tools and actions can include the following:

- *Funding* - Many of the actions listed previously are expensive to implement and County funding and staff are limited. Implementing actions that require new programs or new efforts under existing programs will require additional funding and staff. Possible funding sources include Federal, State and nongovernmental grants and loans.

- *Landowner cooperation* - Lack of landowner cooperation for a proposed project on private property can slow a project, adding to the project cost, or even stop project implementation.
- *Site access* - Some restoration sites may be relatively inaccessible. If restoration requires access by heavy equipment, and such access cause more harm than good, the project will not be pursued.

Public Outreach

Increasing public understanding about environmental resources and promoting better private land management is important to the success of the Little Patuxent watershed restoration effort, because the majority of land in the watershed is privately owned. During development of the WRAS, a public outreach campaign was conducted to inform watershed residents about the WRAS and to encourage participation in the planning process. Based on existing land use within the watershed, this campaign targeted four audiences - the agricultural community, the residential community, the Columbia Association and the business community.

The public outreach campaign for the WRAS also formed the basis for a generic public outreach strategy that was developed to help implement the WRAS. This generic strategy can be tailored for a specific target audience and message, such as promoting the planting of riparian buffers on residential properties. A description of the public outreach campaign for developing the WRAS and the generic public outreach strategy can be found in Appendix B.

Next Steps and Implementation Priorities

Table 8 presents priorities for implementing the restoration actions listed previously. Actions have been grouped into one of five implementation priority categories:

- *Ongoing actions* - Existing County programs address these actions.
- *Enhanced ongoing actions* - Existing County programs will have enhancements added that specifically address these actions.
- *Next steps* - New programs or new actions under existing programs will be implemented within the next five years, with implementation beginning within the next two years.
- *Short-term actions* - New programs or new actions under existing programs will be implemented within the next five years.
- *Long-term actions* - New programs or new actions under existing programs will be implemented within the next six to ten years.

Summary

Implementing the Little Patuxent Watershed Restoration Action Strategy will require a cooperative effort among the primary County agencies responsible for environmental activities - the Departments of Planning and Zoning, Public Works, and Recreation & Parks. The County's Environmental Steering Committee, which is comprised of representatives from these and other related agencies, such as the Howard Soil Conservation District, will provide the mechanism for coordinating and tracking these efforts.

The Howard County General Plan 2000 lists key implementation priorities that are to be undertaken in the first five years after plan adoption. A key implementation priority is to prepare watershed management plans for priority watersheds to guide protection and restoration programs. The Little Patuxent WRAS addresses this priority and will also serve as a prototype for future watershed restoration studies.

Table 8 - Implementation Priorities

Implementation Priority	Action	Responsible Agencies
Ongoing	Purchase key greenway and upland parcels.	DRP
	Acquire conservation easements.	DPZ
	Continue refinement of environmental regulations.	DPZ & DRP
	Continue planting buffers on County green space.	DRP
	Promote habitat improvement programs in the rural/agricultural community.	HSCD
	Continue refinement of better site design regulations.	DPZ
	Maintain State certification of the County sediment and erosion control program.	DPW
	Identify occurrences of land erosion and develop a strategy to encourage stabilization and repair.	DPW & DRP
	Encourage the development and implementation of soil conservation and water quality plans.	HSCD
	Retrofit priority, publicly maintained stormwater management facilities.	DPW
	Monitor pipe outfalls through the County illicit discharge program.	DPW
	Ensure that problem septic areas are addressed.	HD
	Continue implementation of the County deer management program.	DRP
Enhanced Ongoing	Promote forest conservation banking for forest retention and reforestation.	DPZ
	Improve land management practices and enforcement on protected lands.	DRP
	Monitor the effectiveness of the sediment and erosion control program enforcement.	DPW
	Plant forests in targeted areas to link, connect and extend forests.	DPW & DRP
	Endorse development of urban wildlife management studies.	DRP
Next Steps	Prioritize locations where riparian buffers are absent and develop a planting strategy.	DPW & DRP
	Implement a strategy for control of invasive plants.	DRP
	Encourage private property owners to plant forested riparian buffers and to use best management practices in existing buffers.	DPW & DRP
	Identify and develop funding sources for private riparian buffer plantings.	DPW
	Address priority pipe outfalls, exposed pipes and unusual conditions.	DPW
	Promote native plant landscaping and encourage non-turf alternatives.	DPZ, DPW & DRP
	Develop a generic public outreach strategy that can be tailored to target audiences.	DPZ, DPW & DRP
	Develop and implement subwatershed restoration plans.	DPZ & DPW

Table 8 - Implementation Priorities (continued)

Implementation Priority	Action	Responsible Agencies
Short-Term	Develop an environmental regulations handbook.	DPZ
	Prepare case studies documenting successful projects that reduce impervious cover and increase open space.	DPZ & DPW
	Retrofit existing stormwater management facilities and develop new facilities on County owned sites.	DPW
	Monitor the effectiveness of the new stormwater management regulations and develop demonstration sites or case studies for successful projects.	DPZ & DPW
	Encourage the conversion of dry ponds to stormwater wetlands or otherwise increase the habitat value of existing facilities.	DPW
	Address priority stream channel erosion sites.	DPW
	Develop a forest management plan to ensure forest diversity and resilience.	DRP
Long-Term	Identify privately maintained stormwater management facilities that are retrofit candidates and secure funding for these retrofits.	DPW
	Develop strategies to address channelized stream sections and the removal of fish passage blockages.	DPW
	Protect and create areas of diverse sensitive habitat.	DPZ & DRP
	Enhance existing wetlands and create new wetlands where feasible.	DPW

Source: Howard County WRAS Group

DPZ - Department of Planning and Zoning
 DPW - Department of Public Works
 DRP - Department of Recreation and Parks
 HD - Health Department
 HSCD - Howard Soil Conservation District

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Appendix A

Prioritization of Problem Sites

In 1999-2000, Howard County conducted a Stream Corridor Assessment (SCA) in the Little Patuxent watershed. The SCA was used as a primary identifier of problems within the watershed for development of the Little Patuxent Watershed Restoration Action Strategy. The SCA identified the following potential problems: pipe outfalls, tree blockages, erosion sites, inadequate buffers, fish migration barriers, channel alterations, exposed pipes, unusual conditions and trash dumping. Identified potential problems were given a narrative problem severity rating of very severe, severe, moderate, low or minor.

To prioritize problem sites for future remediation efforts, a problem site ranking system was developed using weighted criteria. Criteria were chosen to prioritize problem sites that posed the most severe and immediate threats to water quality, and to maximize benefits for water quality and habitat. Criteria were assigned a ranking of one to five, with five being the highest priority and one being the lowest. The following is a description of the criteria and their associated ranking used in this system:

- *Severity*. The severity ranking is a subjective ranking on how bad a specific site is relative to other problems in the same problem category. A site that received a very severity ranking has problems that appear to have a direct impact on the stream's aquatic resources and indicates that the problem is among the worst that the field crew would have seen or expects to see in Maryland. Problem site severity was given a ranking of one to five, with very severe sites ranking as five.
- *Percent of existing impervious cover*. The percent of existing impervious cover refers to the area of impervious cover within the subwatershed for each problem site, using the results of the impervious cover assessment. The ranking for this criteria places a priority on addressing problems in healthier watersheds, to protect them from further degradation. The ranking for this criteria is presented in the following table.

Percent of Existing Impervious Cover

Percent Impervious Cover	Subwatershed Category	Ranking
Less than or equal to 10	sensitive	5
Greater than 10 but less than or equal to 20	moderate impacted	4
Greater than 20 but less than or equal to 25	high impacted	3
Greater than 25 but less than or equal to 30	low non-supporting	2
Greater than 30 but less than or equal to 40	high non-supporting	1

Source: Stormwater Management Division, Howard County, 2001

- Change in percent of impervious cover.* Change in percent of impervious cover measures the increase in impervious cover caused by future development for the subwatershed surrounding the problem site. The ranking for this criteria places a priority on addressing problems in subwatersheds that are projected to have a small increase in impervious cover, to direct efforts to more stable subwatersheds. Remediation efforts in more stable subwatersheds have less likelihood of having problems caused by future development. The ranking for this criteria is presented in the following table.

Change in Percent of Existing Impervious Cover

Percent Change in Impervious Cover	Ranking	Number of Subwatersheds in this Category
Less than or equal to 0.5	5	6
Greater than 0.5 but less than or equal to 1.0	4	2
Greater than 1.0 but less than or equal to 2.0	3	2
Greater than 2.0 but less than or equal to 5.0	2	3
Greater than 5.0	1	1

Source: Stormwater Management Division, Howard County, 2001

- Problem type.* The ranking for this criteria places a priority on addressing problem types that have the greatest impacts to water and habitat quality. Exposed pipes, pipe outfalls and unusual conditions were given a ranking of five, because problems in these categories have the potential to pose an immediate threat to water quality. Erosion was given a ranking of four, because restoring stable stream banks provides substantial benefits to water and habitat quality. In addition, stabilization of an erosion site is an important first step before conducting a buffer planting. Inadequate stream buffer was given a ranking of three because buffers provide significant benefits to water and habitat quality. Fish blockage and channel alteration were assigned a ranking of two because they provide less significant benefits for water and habitat quality. Trash was given a ranking of one because it would provide the least benefits.

- *Proximity to erosion sites.* The ranking for this criteria places a priority on problem sites that are located within 100 feet of an erosion problem site, to maximize benefits from restoration efforts. Problem sites near erosion sites were given a ranking of five and problem sites that were not near erosion sites were given a ranking of one.
- *Location on a headwater stream.* The ranking for this criteria places a priority on problem sites on headwater streams, to maximize protection for these sensitive areas. Problem sites that were located on a first order stream were given a ranking of five, and problems sites that were not located on a first order stream were given a ranking of one.
- *Location in a wetland.* The ranking for this criteria places a priority on problem sites in wetlands, to maximize protection for these sensitive areas. The National Wetlands Inventory was used to determine wetland locations. Problem sites located in wetlands received a ranking of five, while problem sites that were not located in wetlands received a ranking of one.
- *Location in a greenway.* The ranking for this criteria places a priority on problem sites in County designated greenways, to maximize protection for these sensitive areas. Problem sites located within a greenway were given a ranking of five, and problems sites not located in a greenway were given a ranking of one.
- *Location in or near sensitive species areas.* The ranking for this criteria places a priority on problem sites in or near a sensitive species area, to maximize protection for these sensitive habitats. The Maryland Department of Natural Resources Sensitive Species Habitat Protection Area information was used to determine these area locations. Problem sites that were located within a sensitive species area were given a ranking of five, while sites that were not located in an area received a ranking of one.

The priority problem site ranking system assigned a weighting to each criteria. Problem severity, problem type and proximity to erosion were given primary emphasis; location in a wetland, on a headwater stream, and in or near a sensitive species area were given secondary emphasis; and percent impervious cover, change in percent impervious cover and location in a greenway were given the least emphasis. The criteria were further weighted to emphasize exposed pipe, pipe outfall and unusual trash condition problem sites. The system did not include problem sites with a low or minor severity ranking, or fish blockage, channel alteration and trash problem sites. In addition, the system only included pipe outfall problem sites that had a discharge with an odor or color. This ranking generated a list of 157 priority problem sites.

Appendix B

Public Outreach Campaign

This public outreach campaign is intended to inform watershed residents about the development of the Little Patuxent watershed restoration plan and implementation strategy, and to encourage participation in this planning process. The public outreach campaign begins a process that will continue throughout implementation of the Little Patuxent Watershed Restoration Action Strategy (WRAS).

There are four target audiences identified within the watershed, including the agricultural community, the residential community, the Columbia Association, and the business community. Each community has different circumstances, needs and opportunities.

The following table presents products and activities that the Little Patuxent WRAS team will be working on during the planning phase and may continue during the implementation phase.

Little Patuxent WRAS Public Outreach Campaign

Products	Time	Target Audience	Participants	Status
Produce WRAS display to use at public events such as the Earth Day event at the Howard County Conservancy.	April 2001	All groups: Agricultural, Residential, Columbia Association and Business	DPZ	Completed 4/22/01
Develop Little Patuxent WRAS PowerPoint presentation on study purpose and process.	April - May 2001	All groups	DPZ, DPW and DRP	Completed 7/10/01
Work with Public Information Office to have press release on WRAS, and subsequent updates.	April - November 2001	All groups	DPZ	Initial Press Release 4/16/01
Develop an informational brochure on the WRAS to place in County buildings, libraries and schools.	May 2001	All groups	DRP	Completed 12/30/01

Source: Howard County, 2001

DPZ - Department of Planning and Zoning
 DPW - Department of Public Works
 DRP - Department of Recreation and Parks
 HD - Health Department
 HSCD - Howard Soil Conservation District

Little Patuxent WRAS Public Outreach Campaign (continued)

Presentations & Outreach	Time	Target Audience	Participants	Status
Create a questionnaire for the public to provide feedback on their vision for the watershed. Place the questionnaire on the County web site.	May 2001	All groups	DPZ, DPW and DRP	Completed 7/01
Interview with GTV on the forest assessment, with a potential follow up interview.	March and October 2001	Residential	DPW and DRP	Completed 3/27/01
Exhibit WRAS display at Earth Day event at Howard County Conservancy.	April 2001	Residential and Agricultural	DPZ	Completed 4/22/01
Work with residents from Grey Rock and other communities (as requested) to plant riparian buffers.	April and October 2001	Residential	DRP	Grey Rock buffer planting 10/01
Promote Conservation Reserve Enhancement Program and other riparian buffer planting programs.	April - November 2001	Agricultural	HSCD and DPZ	Ongoing
Develop Public Service Announcements on WRAS and forest assessment for Comcast.	May - October 2001	Residential	DPW and DRP	Future activity
Meet with Columbia Association and Village Boards (VB) to discuss WRAS and to partner with them for public outreach on WRAS.	May - November 2001	Columbia Association and Residential	DPZ, DPW and DRP	Kings Contrivance VB meeting 11/7/01
Present periodic updates of the WRAS to the Agricultural Community, Environmental Advocacy Committee (EAC), Community Advocacy Committee, Columbia Revitalization Committee and Patuxent River Commission (PRC).	May - November 2001	All groups	HSCD, DPZ and DRP	PRC updated 10/12/00 and 10/10/01; EAC updated 1/24/01
Update the County web site with information about the WRAS. Research the possibility of creating site with the Little Patuxent Watershed as domain name.	May - November 2001	All groups	DPZ, DPW and DRP	Updated 7/01
Attend community, environmental and businesses group meetings (as requested) to educate and inform about WRAS (use PowerPoint presentation).	May - October 2001	Residential and Business	DPZ, DPW and DRP	Future activity

Source: Howard County, 2001

DPZ - Department of Planning and Zoning
 DPW - Department of Public Works
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For information or alternative formats contact:

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