Stream Corridor Assessment Survey for the Miles River Watershed, Talbot County, Maryland

Prepared by:

Department of the Environment
1800 Washington Boulevard, Suite 540
Baltimore MD 21230-1718

April 2006

This project was funded in part by a Section 319 Clean Water Act Grant from the U.S. EPA. Although this project was funded by U.S. EPA, the contents of this report do not necessarily reflect the opinion or position of the EPA.

Table of Contents

List Of Figures

List of Tables

EXECUTIVE SUMMARY

In 1998, the Maryland Clean Water Action Plan identified the Miles River watershed as one of the State's water bodies that did not meet water quality requirements. In response to this finding, the Maryland Department of Environment (MDE) and Talbot County formed a partnership to develop a Watershed Restoration Action Strategy (WRAS) for the Miles River watershed. The following Stream Corridor Assessment (SCA) survey is part of the WRAS development process.

The SCA survey provides descriptive and positional data for potential environmental problems along a watershed's non-tidal stream network. Developed by DNR's Watershed Services, the survey is a watershed management tool to identify environmental problems and help prioritize restoration opportunities on a watershed basis. As part of the survey, specially trained personnel walk a watershed's streams and record data and the location for several environmental problems that can be easily observed within the stream corridor. Each potential problem site is ranked on a scale of one to five for its severity, correctability, and access for restoration work.

SCA survey fieldwork for the Miles River began in June 2005 and was completed by November 2005. There are approximately 68 miles of walk-able streams in the watershed. Walk-able streams are those streams which are generally not in tidal areas. The field crews were given permission and walked approximately 30 miles (44%) of the watershed. Survey teams did not have access to all the watershed's streams and did not survey tidal areas.

Over the streams assessed, survey teams identified 66 potential environmental problem sites. At the time of the survey, the most frequently observed potential problem sites were inadequately forested stream buffers, reported at 28 sites. Other potential environmental problems recorded during the survey included: 11 pipe outfalls, 9 erosion sites, 7 channel alterations, 7 fish barriers, 3 unusual conditions, and one exposed pipe. (Table 1) Opportunities exist to restore potential problem sites in all categories to increase fish and wildlife habitat, other natural resources, and resource services. Additionally, crews recorded descriptive habitat condition data at 19 representative sites.

The Stream Corridor Assessment Survey is a rapid overview of the entire stream network in order to determine the location of potential environmental problems and to collect some basic habitat information about its streams. The value of the present survey is its help in placing individual stream problems into their watershed context and its potential common use among resource managers and land-use planners to cooperatively and consistently prioritize future restoration work. Results of the present survey will be given to the Miles River Watershed WRAS committee, which is developing a Watershed Restoration Action Strategy for the Miles River. Information on the Miles Watershed Action Strategy can be found on the Department of Natural Resources' website (www.dnr.maryland.gov/watersheds/wras).

INTRODUCTION

In 1998, Maryland's Clean Water Action Plan identified bodies of water that failed to meet water quality requirements or other natural resource goals. One of the areas identified in the report was the Miles River watershed. The Maryland Department of Environment formed a partnership with Talbot County to assess and improve environmental conditions in the Miles River Watershed. The main goal of this partnership is to develop and implement a Watershed Restoration Action Strategy (WRAS) for the Miles River.

Located in southern Talbot County, the watershed covers approximately 34,560 acres (54 square miles) of land and water in the Coastal Plain of Maryland (Figure 1). Figure 2 shows a digital orthophoto map of the watershed. Figure 3 shows the same watershed boundary superimposed on a 7.5 minute USGS topographic quadrangle maps. Figure 4 shows the areas of the watershed where the teams were not given permission to survey the streams.

The first step in developing a Restoration Action Strategy for this watershed is to complete an overall assessment of the condition of the watershed and the streams it contains. This initial step was accomplished using three approaches. First, a watershed characterization was completed that compiles and analyzes existing water quality, land use, and living resource data about the watershed (Bruckler, Ellis, 2006). Secondly, a synoptic water quality survey was conducted at selected stations throughout the Miles River to provide information on the present condition of aquatic resources (Primrose, 2006). Lastly, a Stream Corridor Assessment (SCA) survey was completed for the watershed's' non-tidal stream network to provide specific information on the present location of potential environmental problems and restoration opportunities. This report details the results of the Miles River Stream Corridor Assessment Survey and highlights potential restoration opportunities within the watershed based on the survey.

Survey teams walked approximately 30 miles of the 68 miles of streams available to be walked in the Miles stream network. The survey began June 2005 and was completed by November 2005. At each site during the survey, field crews collected descriptive data, recorded the location on field maps, and took a photograph to document each potential environmental problem observed. As an aid to prioritizing future restoration work, crews rated all problem sites on a scale of one to five in three categories: 1) how *severe* the problem is compared to others in its category; 2) how *correctable* the specific problem is using current restoration techniques; and 3) how *accessible* the site is for work crews and any machinery necessary to complete restoration work. In addition, field teams collect descriptive data for both in- and near-stream habitat conditions at representative sites spaced at approximately ½ to 1-mile intervals along the stream.

One of the main goals of the Miles River SCA survey is to compile a list of observable environmental problems in this watershed in order to most successfully target future restoration efforts. Once this list is compiled and distributed, county planners, resource managers, and others can initiate a dialog to cooperatively set the direction and goals for the watershed's' management and plan future restoration work at specific problem sites. All of the problems identified as part of the Miles River Stream Corridor Assessment survey can be addressed through existing State or Local government programs.

To this end, the Maryland Department of Environment is working with Talbot County to develop a Watershed Restoration Action Strategy (WRAS) of the Miles River Watershed. As part of this process, data collected during the SCA survey will be used to help define present environmental conditions and possible restoration opportunities in the watershed. This information, combined with the watershed characterization, synoptic water quality surveys, recent biological surveys, and local knowledge of the watershed will be used to develop a Watershed Restoration Action Strategy for the Miles River. The Watershed Restoration Action Strategy, in turn, will help guide future restoration efforts with the ultimate goals of restoring the area's natural resources and meeting State water quality standards.

Miles River Watershed
Talbot County, Maryland

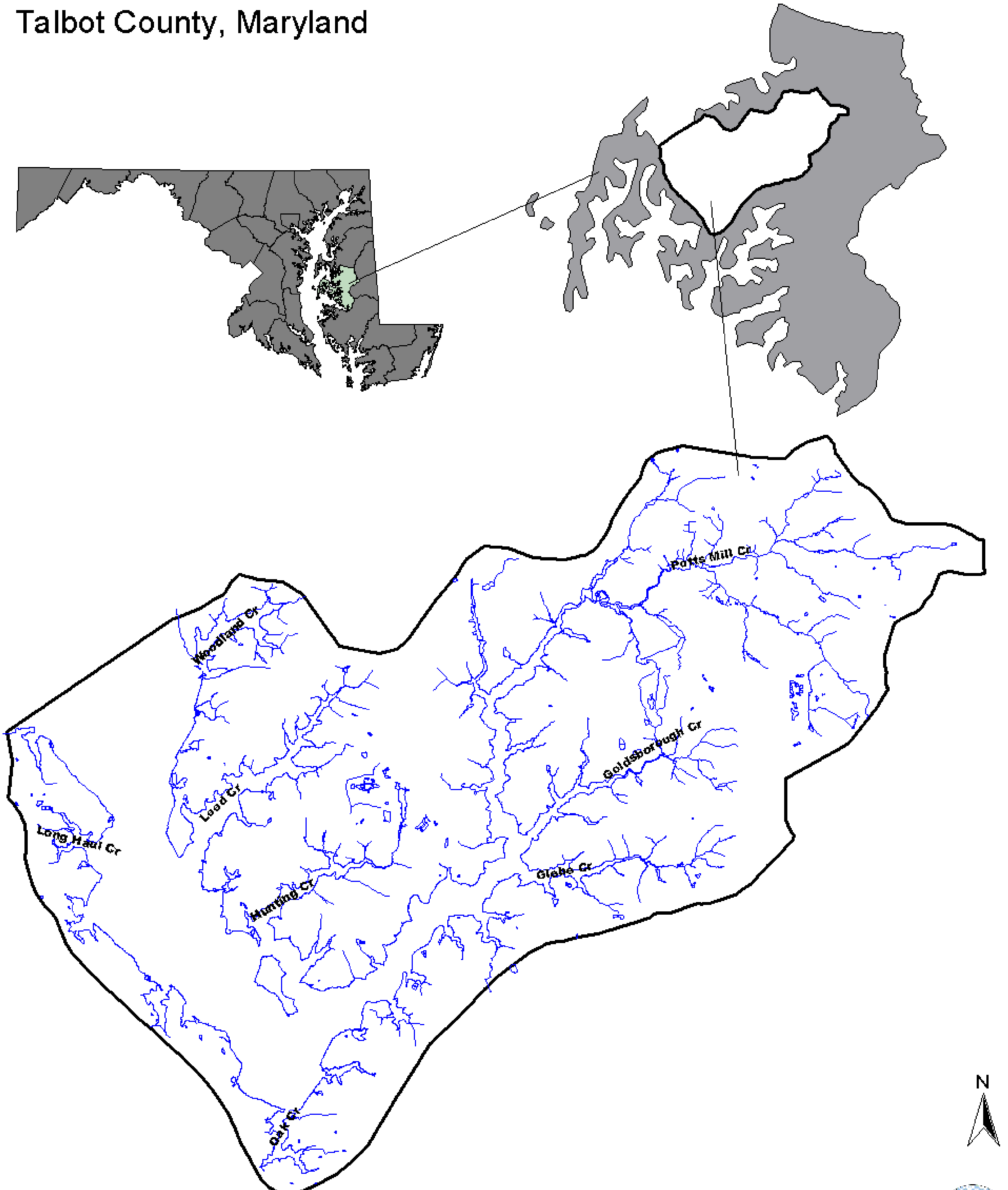


Figure 1: Map showing the location of the Miles River Watershed in Talbot County Maryland

MARYLAND

Robert L. Ehrlich, Jr., *Governor*
Michael S. Steele, *Lt. Governor*
Kendl P. Philbrick, *Secretary*
Jonas A. Jacobson, *Deputy Secretary*

MDE

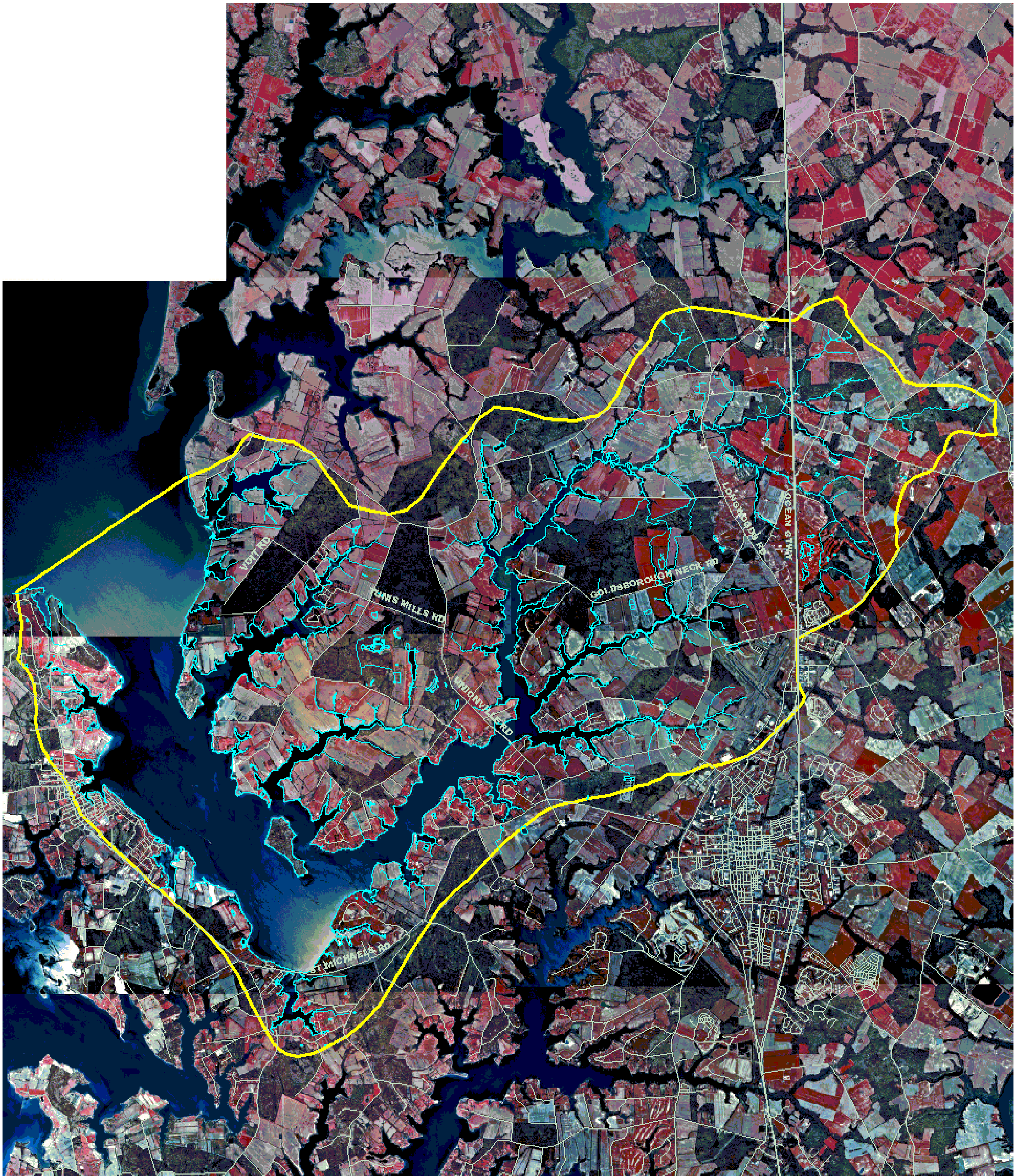


Figure 2: Miles River Watershed
Digital Orthophoto Quarter Quad

6000 0 6000 12000 Feet

N

MARYLAND

Robert L. Ehrlich, Jr., *Governor*
Michael S. Steele, *Lt. Governor*
Kendl P. Philbrick, *Secretary*
Jonas A. Jacobson, *Deputy Secretary*

MDE

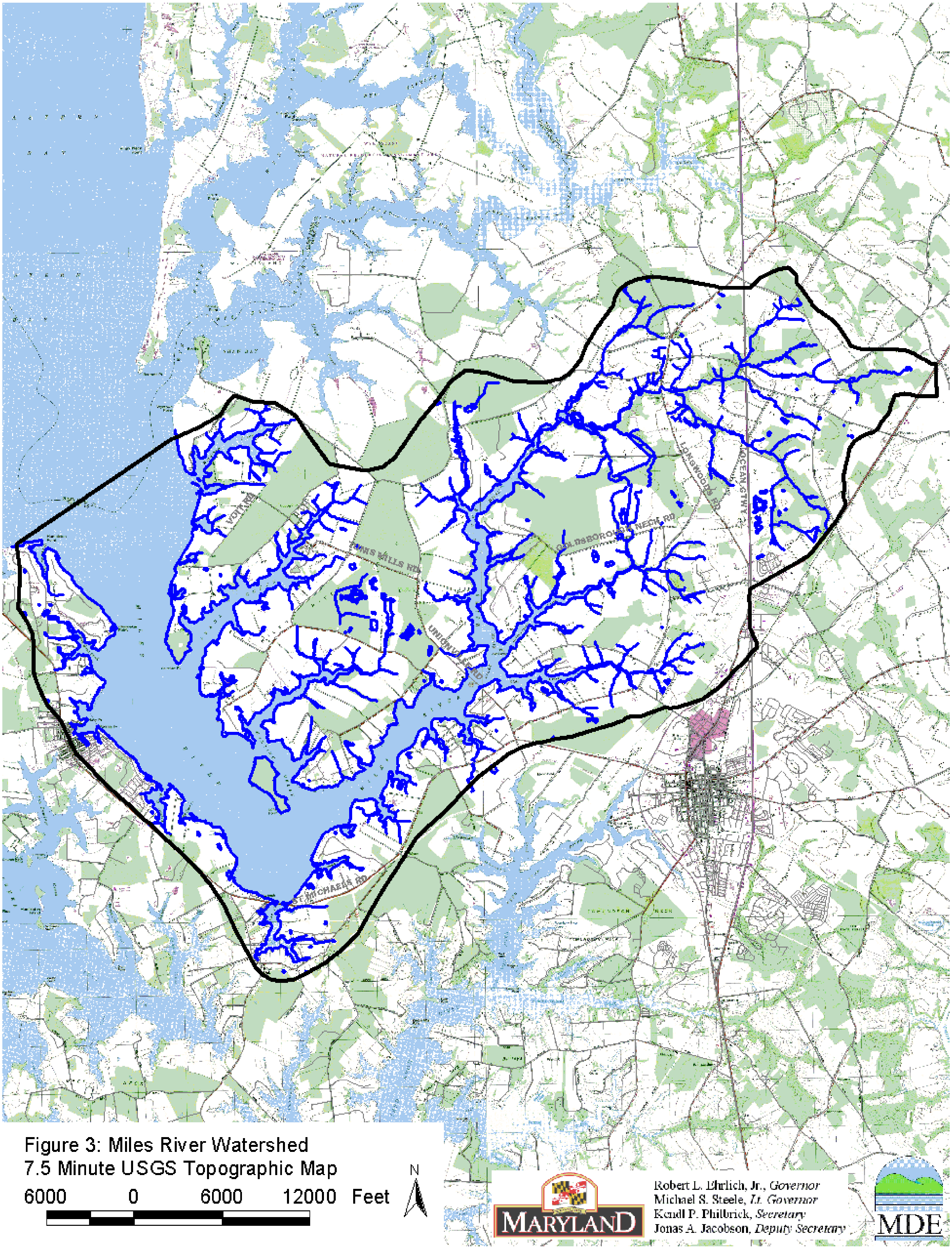
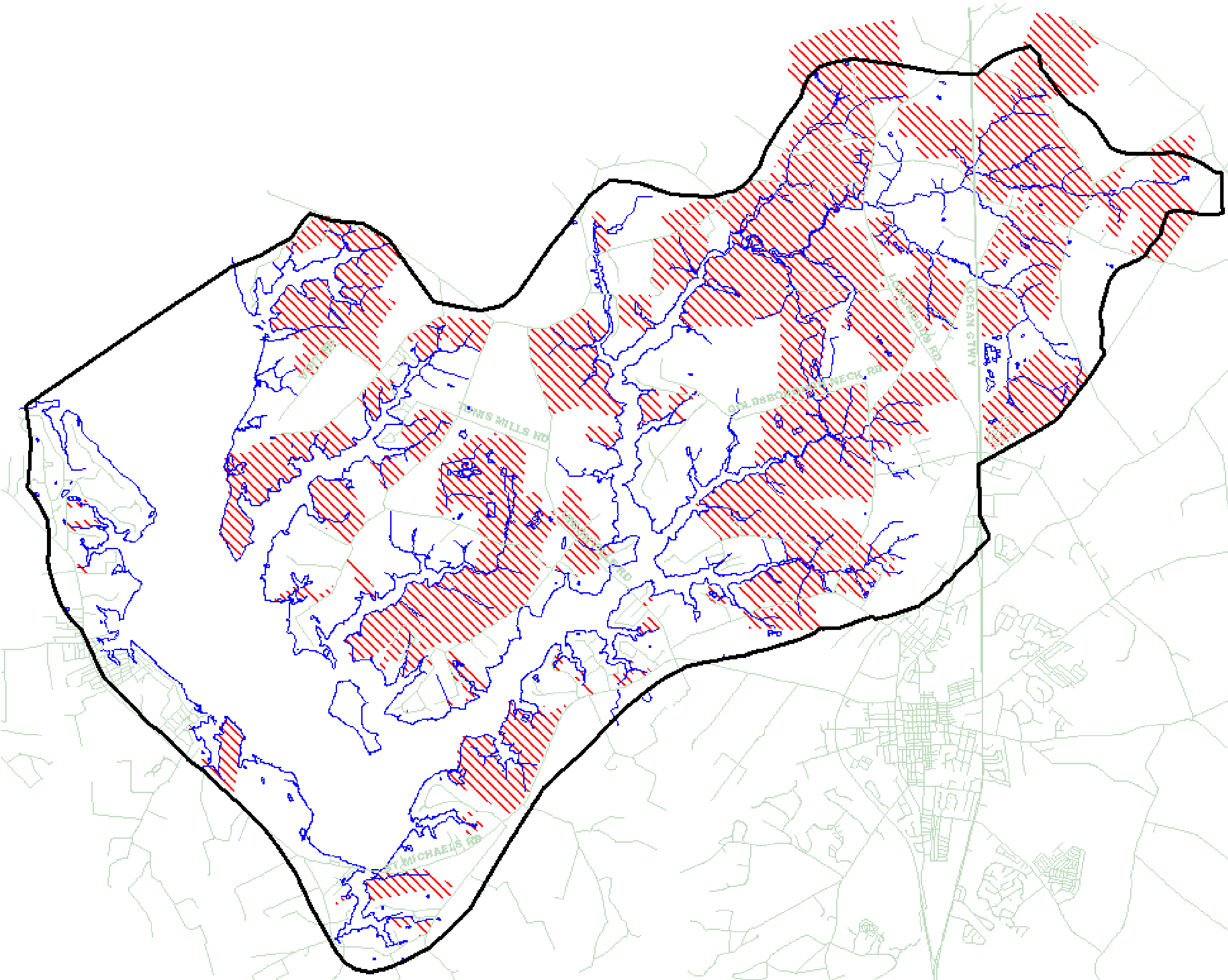


Figure 3: Miles River Watershed
7.5 Minute USGS Topographic Map
6000 0 6000 12000 Feet
N
MARYLAND
Robert L. Ehrlich, Jr., Governor
Michael S. Steele, Lt. Governor
Kendl P. Philbrick, Secretary
Jonas A. Jacobson, Deputy Secretary
MDE

Non- Surveyed Areas



N

Areas where the survey was not able to be conducted

Figure 4: Map showing the areas where the survey was not conducted.

Robert L. Ehrlich, Jr., *Governor*
Michael S. Steele, *Lt. Governor*
Kendl P. Philbrick, *Secretary*
Jonas A. Jacobson, *Deputy Secretary*

METHODOLOGY

Goals of the SCA Survey

To help identify some of the common problems that affect streams in a rapid and cost effective manner, the Watershed Services Unit of the Maryland Department of Natural Resources developed the Stream Corridor Assessment (SCA) survey. The four main objectives of the survey are to provide:

1. A list of observable environmental problems present within a stream system and along its riparian corridor;

2. Sufficient data on each problem to make a preliminary assessment of both severity and correctability;

3. Sufficient data to prioritize restoration efforts;

4. A quick assessment of both in- and near-stream habitat conditions to make comparisons of the conditions of different stream segments.

The SCA survey provides a rapid method of examining and cataloguing the observable environmental problems within an entire drainage network to better target future monitoring, management and/or conservation efforts. This survey is not a detailed scientific survey, nor will it replace chemical and biological surveys in determining overall stream conditions and health. One advantage of the SCA survey over chemical and biological surveys is that the SCA survey can be done on a watershed basis both quickly and at relatively low cost.

Maryland's SCA survey is both a refinement and systematization of an old approach – the stream walk survey. Many of the common environmental problems affecting streams can be straightforward to identify by an individual walking along a stream. These include: excessive stream bank erosion, blockages to fish migration, stream segments without trees along their banks, or a sewage pipeline exposed by stream bank erosion leaking sewage into the stream. With a limited amount of training, most people can correctly identify these common environmental problems.

Over the years, many groups standardized a stream walk survey approach for their particular purpose or interest. Many earlier approaches, such as EPA's, "Streamwalk Manual" (EPA, 1992), Maryland Save our Stream's "Conducting a Stream Survey," (SOS, 1970) and Maryland Public Interest Research Foundation "Streamwalk Manual" (Hosmer, 1988), focused on utilizing citizen volunteers with little or no training. While these surveys can be a good guide for citizens interested in seeing their community's streams, the data collected during these surveys can vary significantly based on the background of the surveyor. In the *Maryland Save our Stream* "Stream Survey," for example, training for citizen groups includes giving guidance on how to organize a survey and a slide show explaining how to complete the field work. After approximately one hour of training, citizen volunteers are sent out in groups to walk designated stream segments. During the survey, volunteers usually walk their assigned stream segment in under a few hours and return their data sheets to the survey organizers for analysis. While these surveys can help make communities more aware of the problems present in their local stream, citizen groups normally do not have the expertise or resources to properly analyze or fully interpret the collected information. In addition, the data collected from these surveys often only indicates that a potential environmental problem exists at a specific location, but it does not provide sufficient information to judge the severity of the problem.

Other visual stream surveys, such as the Natural Resources Conservation Service's "Stream Visual Assessment Protocols" (NRCS, 1998), are designed for use by trained professionals analyzing a very specific stream reach type, such as a stream passing through an individual farmer's property. While this survey can provide useful information on a specific stream segment, it is usually not carried out on a watershed basis.

The Maryland SCA survey bridges the gap between these two approaches. The survey is designed to be completed by a small group of well-trained individuals who walk the entire stream network in a watershed. While those working on the survey are usually not professional natural resource managers, they do receive several days of training in both stream ecology and SCA survey methods.

Field Training and Procedure

Prior to the start of any survey, the members of the field crew would receive training in assessing both environmental problem sites and habitat conditions in and along Maryland streams. For problem sites, crewmembers learned how to identify common problems observable within the stream corridor, record problem locations on survey maps, and accurately complete data sheets for each specific problem type. For habitat conditions, the crew learned and practiced assessing stream health based on established criteria indicating both favorable conditions for macroinvertebrates and fish and healthy riparian habitat. These reference sites for habitat condition are located at approximately 1/2- to 1-mile intervals along the stream. In addition, the field crew reviewed a standard procedure for assigning site numbers based on the 3-digit map number, 1-digit team number, and 2-digit problem number for each problem and reference site during the survey. Lastly, in order to have a visual record of existing conditions at the time of the SCA survey, the field crew would receive guidelines for taking photographs at all problem and reference sites.

Several weeks prior to the beginning of the survey, property owners along the stream reach received letters informing them of what the survey is and when it was to be completed. This letter also provided a phone number to call if individuals wanted more information and a postcard stating if the crews would have permission to access the streams on their property. In addition, survey crews were not to cross fence lines or enter any areas that are marked "No Trespassing" unless they had specific permission from the property owner.

The field crew conducted field surveys of the Miles River Watershed from June 2005 to November 2005. The survey teams walked the river's drainage network, collecting information on potential environmental problems. Those commonly identified during the SCA Survey include: inadequate stream buffers, excessive bank erosion, channelized stream sections, fish migration blockages, in or near stream construction, trash dumping sites, unusual conditions, and pipe outfalls. In addition, the survey recorded information on the general condition of in-stream and riparian habitats and the location of potential wetland creation sites.

More detailed information on the procedures used in the Maryland SCA survey can be found in, "Stream Corridor Assessment Survey – Survey Protocols" (Yetman, 2001). A copy of the survey protocols can found on DNR's web site at http://www.dnr.maryland.gov/streams/pubs/other.html. Hard copies of the protocols also can be obtained by contacting the Watershed Services Unit of the Maryland Department of Natural Resources, Annapolis, MD.

Overall Ranking System

The SCA survey field crews evaluate and score all problems on a scale of 1 to 5 in three separate areas: problem severity, correctability, and accessibility. A major part of the crew's training on survey methods is devoted to properly rating the different problems identified during the survey. This ranking system developed from an earlier survey that found 453 potential environmental problems along 96 miles of stream of the Swan Creek Watershed in Harford County. The most frequently reported problem during the survey was stream bank erosion, reported at 179 different locations (Yetman et. al., 1996). Follow-up surveys found that while stream bank erosion was a common problem throughout the watershed, the severity of the erosion problem varied substantially among the sites and that the erosion problems at many sites were minor in severity. Based on this experience and its goal of helping to prioritize restoration work, the SCA survey rates the severity, correctibility, and access of each problem site.

While the ratings are subjective, they have proven to be very valuable in providing a starting point for more detailed follow-up evaluations. Once the SCA survey is completed, the collected data can be used by different resource professionals to help target future restoration efforts. A regional forester, for example, can use data collected on inadequate stream buffers to help plan future riparian buffer plantings, while the local fishery biologist can use the data on fish blockages to help target future fish passage projects. The inclusion of a rating system in the survey gives the resource professional an idea of which sites the field crew believed were the most severe, easiest to correct and easiest to access. This information combined with photographs of the site can help resource managers focus their own follow up evaluations and fieldwork at the most important sites.

A general description of the rating system is given below. More specific information on the criteria used to rate each problem category is provided in the *SCA – Survey Protocol*s (Yetman, 2000). It is important to note that the rating system is designed to contrast problems within a specific problem category and is not intended to be applied across categories. When assigning a severity rating to a site with an inadequate stream buffer for example, the rating is only intended to compare the site to other in the State with inadequate stream buffers. A trash dumping site with a very severe rating may not necessarily be a more significant environmental problem than a stream bank erosion site that received a moderate severity rating.

The **severity** rating indicates how bad a specific problem is relative to others in the same problem category. It is often the most useful rating because it answers questions such as: where are the worst stream bank erosion sites in the watershed, or where is the largest section of stream with an inadequate buffer? The scoring is based on the overall impression of the survey team of the severity of the problem at the time of the survey, based on the established criteria for each problem category (Yetman, 2000).

* A very severe rating of 1 is used to identify problems that have a direct and wide reaching impact on the stream's aquatic resources. Within a specific problem category, a very severe rating indicates that the problem is among the worst that the field teams have seen or would expect to see. Examples include a discharge from a pipe that was discoloring the water over a long stream reach (greater than 1000 feet) or a long section of stream (greater than 1000 feet) with high raw vertical banks that are unstable and eroding at a rapid rate.

* A moderate severity rating of 3 identifies problems that have some adverse environmental impacts but the severity and/or length of affected stream is fairly limited. While a moderate severity rating would indicate that field crews did believe it was a significant problem, it also indicates that they have seen or would expect to see worse problems in the specific problem category. Examples include: a small fish blockage that is passable by strong swimming fish like trout, but a barrier to resident species such as sculpins or a site where several hundred feet of stream has an inadequate forest buffer.

* A minor severity rating of 5 identifies problems that do not have a significant impact on stream and aquatic resources. A minor rating indicates that a problem is present, but compared to other problems in the same category it is considered minor. One example of a site with a minor rating is an outfall pipe from a storm water management structure that is not discharging during dry weather and does not have an erosion problem at the outfall or immediately downstream. Another example is a section of stream with stable banks that has a partial forest buffer less than 50 feet wide along both banks.

The **correctability** rating provides a relative measure on how easily the field teams believe the problem can be corrected. The correctability rating can be helpful in determining which problems can be easily dealt with when developing a restoration plan for a drainage basin. One restoration strategy, for example, would initially target the severest problems that are the easiest to fix. The correctability rating also can be useful in identifying simple projects that can be done by volunteers, as opposed to projects that require more significant planning and engineering efforts to complete.

* A minor correctability rating of 1 indicates problems that can be corrected quickly and easily using hand labor, with a minimal amount of planning. These types of projects would usually not need any Federal, State or local government permits. It is a job that small group of volunteers (10 people or less) could fix in a day or two without using heavy equipment. Examples include removing debris from a blocked culvert pipe, removing less than two pickup truck loads of trash from an easily accessible area or planting trees along a short stretch of stream.

* A moderate correctability rating of 3 indicates sites that may require a small piece of equipment, such as a backhoe, and some planning to correct the problem. This would not be the type of project that volunteers would usually do alone, although volunteers could assist in some aspects of the project, such as final landscaping. This type of project would usually require a week or more to complete. The project may require some local, State or Federal government notification or permits. However, environmental disturbance would be small and approval should be easy to obtain.

* A very difficult correctability rating of 5 indicates problems that would require a large expensive effort to correct. These projects would usually require heavy equipment, significant amount of funding ($100,000 or more), and construction could take a month or more. The amount of disturbance would be large and the project would need to obtain a variety of Federal, State and/or local permits. Examples include a potential restoration area where the stream has deeply incised several feet over a long distance (i.e., several thousand feet) or a fish blockage at a large dam.

The **accessibility** rating provides a relative measure of how difficult it is to reach a specific problem site. The rating is made at the site by the field survey team, using a survey map and field observations. While factors such as land ownership and surrounding land use can enter into the field judgments of accessibility, the rating assumes that access to the site could be obtained if requested from the property owner.

* A very easy accessibility rating of 1 indicates sites that are readily accessible both by car and on foot. Examples include a problem in an open area inside a public park where there is sufficient room to park safely near the site.

* A moderate accessibility rating of 3 indicates sites that are easily accessible by foot but not easily accessible by a vehicle. Examples would include a stream section that can be reached by crossing a large field or a site that is accessible only by 4-wheel drive vehicles.

A very difficult accessibility rating of 5 is assigned to sites that are difficult to reach both on foot and by a vehicle. To reach the site it would be necessary to hike at least a mile, and if equipment were needed to do the restoration work, an access road would need to be built through rough terrain. Examples include a site where there are no roads or trails nearby.

Data Analysis and Presentation

Following the completion of the survey, crews entered and information from the field data sheets into a Microsoft Access database and verified the accuracy of the data. Members of the Department of Environment's Technical and Regulatory Services Administration incorporated the map location, recorded data, and digitized photographs into the ArcGIS computer software. The GIS project is an electronic database that integrates all the collected problem locations and descriptive data by site number, links photographs to each potential problem site, and produces the maps presented in this report. This data can then be used alongside of other digital geographic datasets available for features within the watershed. A final copy of the ArcView files was given to the Talbot County Planning Department for their use in developing a Watershed Action Strategy for the Miles River Watershed.

RESULTS

The Stream Corridor Assessment Survey identified 66 potential environmental problem sites. At the time of the survey, the most frequently observed potential problem sites were inadequately forested stream buffers, reported at 28 sites. Other potential environmental problems recorded during the survey included: 11 pipe outfalls, 9 erosion sites, 7 channel alterations, 7 fish barriers, 3 unusual conditions, and one exposed pipe. (Table 1) Additionally, crews recorded descriptive habitat condition data at 19 representative sites.

Table 1 presents a summary of survey results and Table 2 is a summary by stream reach. Appendices A and B list the data collected during the survey. Appendix A provides a listing of information by site number and location, referenced by both tributary name and the X, Y coordinates using Maryland State Plane 83 meters. Information in this format is useful to determine what problems are present along a specific stream reach. In Appendix B, the data is presented by problem type and lists the collected descriptive data. Presenting the data by problem type allows the reader to see which problems are rated as most severe or easiest to correct within each category. Result categories are discussed further in order of those with the greatest number of sites to those with the least.

Table 1. Summary of results from the Miles River SCA Survey.

Potential Problems Identified	Number	Estimated Length	Very Severe	Severe	Moderate	Low Severity	Minor
Inadequate Buffers	28	34,650 feet (6.6 miles)	7	4	8	3	6
Pipe Outfalls	11		0	0	6	0	5
Erosion	9	6,360 feet (1.2 miles)	0	0	6	0	3
Channel Alteration	7	14,800 feet (2.8 miles)	3	0	4	0	0
Fish Barriers	7		0	0	3	0	4
Unusual Conditions	3		0	0	2	0	1
Exposed Pipes	1	4 feet	0	0	1	0	0
Total	**66**		**10**	**4**	**30**	**3**	**19**
Representative Sites	19						

Table 2. Summary of results by major stream reach.

Stream Segment	Channel Alteration	Exposed Pipes	Erosion	Fish Barriers	Inadequate Buffers	Pipe Outfalls	Representative Sites	Unusual Conditions	Total
Chapel Cove	1				1				2
Glebe Creek					1				1
Goldsborough Creek				1	1		2		4
Hunting Creek					4		2		6
Leed Creek	1				6		2		9
Long Haul Creek	1			1	1			2	5
Miles River				1	1		2		4
Oak Creek	1				1				2
Potts Mill Creek	3	1	9	4	11	11	11	1	51
Woodland Creek					1				1

Inadequate Buffers

Forests are the historically occurring ecosystem around Maryland streams and are very important for maintaining stream health in Maryland. Forested buffer areas along streams play a crucial role in increasing water quality, stabilizing stream banks, trapping sediment, mitigating floods, and providing the required habitat for all types of stream life, including fish. Tree roots capture and remove pollutants and excess nutrients from shallow flowing water, and their structure helps prevent erosion and slow down water flow, reducing sediment load and the risk of flooding. Shading from the tree canopy provides the cooler water temperatures necessary for most stream life, especially cold-water species like trout. In smaller streams such as those surveyed, terrestrial plant material falling into the stream is the primary source of plant food for stream life. Tree leaves provide seasonal, instant food for stream life, while fallen tree branches and trunks provide a more consistent, slow-release food source throughout the year. Tree roots and snags also provide necessary fish habitat. Maintaining healthy streams and forest buffers are important to reducing the nutrient and sediment loadings to the Chesapeake Bay.

While there is no single minimum standard for how wide a stream buffer should be in Maryland, for the purposes of this study a forest buffer is considered inadequate if it is less than 50 feet wide, measured from the edge of the stream. The severity of inadequate forest buffers is based on both the length and width of the site. Those sites over 1,000 feet long with no forest on either side of the stream rank as the most severe. For streams on the Eastern Shore there is also the consideration of whether or not the channel is a drainage ditch. Drainage ditched with little to no water in the entire ditch is considered less severe than a ditch with water. A fourth ranking, wetland potential, rates if there is a potential of creating a wetland. The rating is based on bank height and slope of the areas.

Survey crews identified 28 inadequate buffer sites with a total length of 34,650 feet (6.6 miles), or approximately 22 percent of the 30 miles streams surveyed. The severity and location of inadequate buffer sites is shown in Figure 5b. Eleven of these sites are ranked as very severe or severe, while the other fifteen sites are moderate, of low severity, or minor (Figure 5a). Land uses along the stream at inadequate buffer sites were reported as mostly crop fields and golf course.

Any inadequate buffer site would benefit from the restoration of trees along both stream banks. For sites on agricultural land, farmers also may qualify for federal and state government financial incentives for allowing 50-foot forest buffers to grow on their farmland. Those sites that may have particular natural resource value are headwater streams, or those that form gaps in existing forested buffer areas.

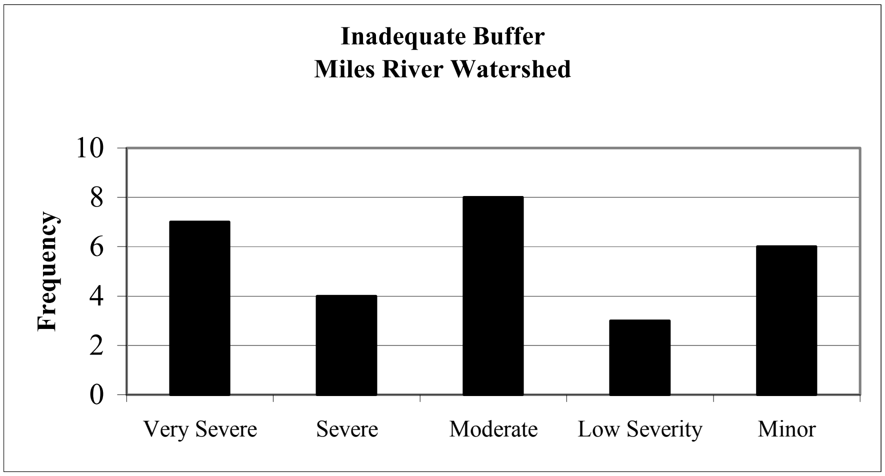


Figure 5a. Histograph showing the frequency of severity ratings given to inadequate buffer sites during the Miles River SCA survey.

Inadequate Buffers

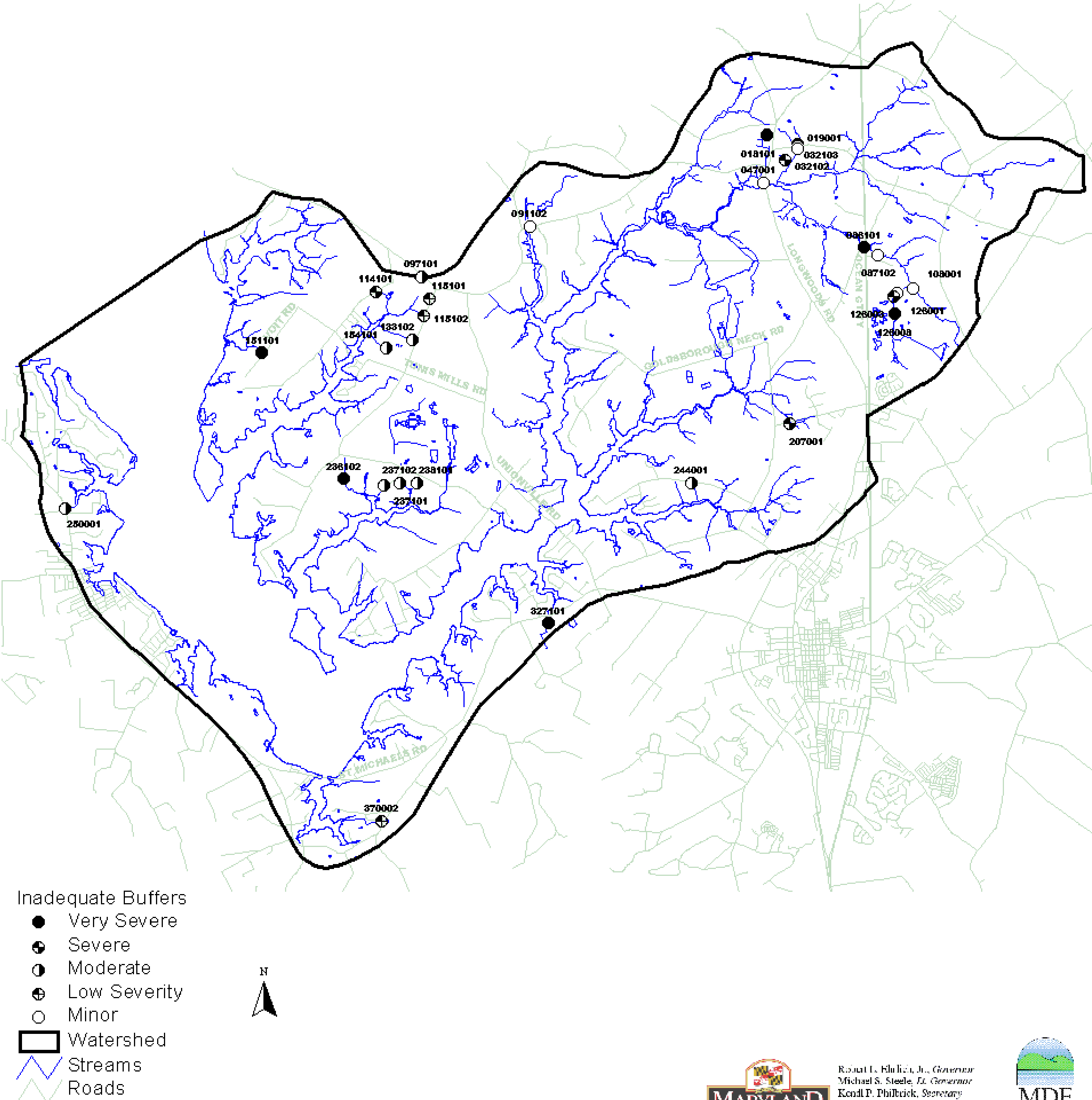


Figure 5b: Map showing the locations of the Inadequate Buffer sites in the Miles River Watershed

Robert L. Ehrlich, Jr., Governor
Michael S. Steele, Lt. Governor
Kendl P. Philbrick, Secretary
Jonas A. Jacobson, Deputy Secretary

5000 0 5000 10000 Feet

Pipe Outfalls

Pipe outfalls include any pipes or small, constructed 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**.**

The survey crew identified a total of 11 pipe outfalls. The severity and location of pipe outfall sites is shown in Figure 6b. Six of the pipes had a discharge. All were clear with no odor. The pipes were rated as moderate. The remaining pipes did not have any discharge.

No immediate follow up actions were taken as part of this study to determine the source of the color coming from the pipe. In addition, we made no estimate of the amount of fluid released from the pipes.

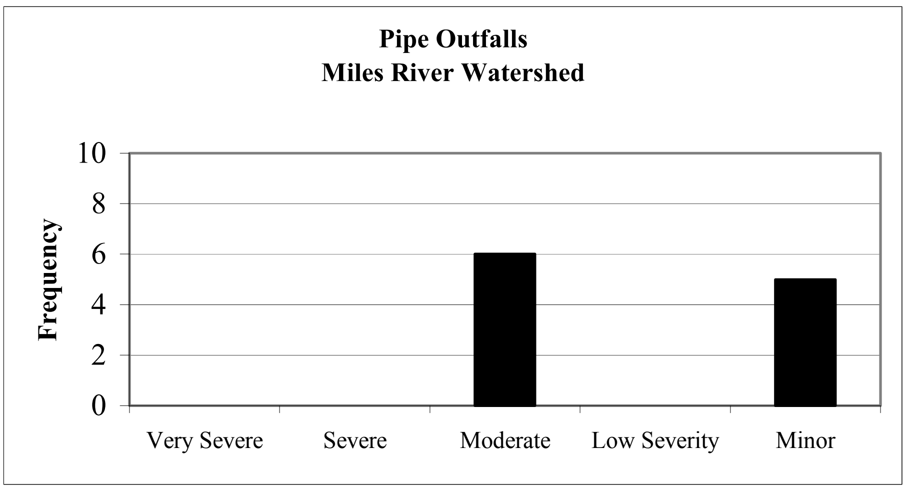


Figure 6a. Histograph showing the frequency of severity ratings given to pipe outfalls sites during the Miles River SCA survey.

Pipe Outfalls

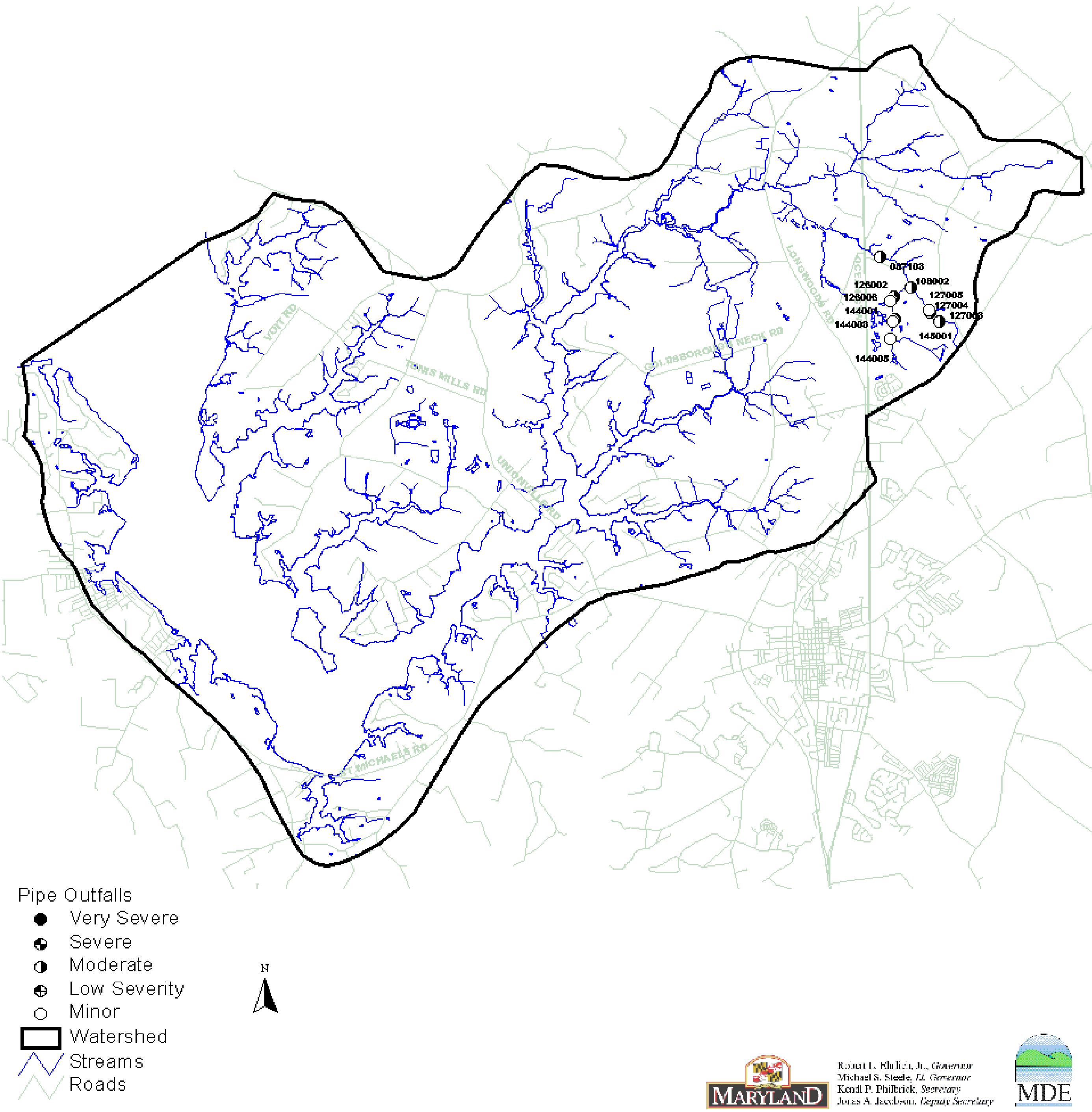


Figure 6b: Map showing the locations of the Pipe Outfall sites in the Miles River Watershed

5000 0 5000 10000 Feet

Erosion Sites

Erosion is a natural process necessary to maintain good aquatic habitat. Too much erosion, however, can have the opposite effect on the stream by destabilizing stream banks, destroying in-stream habitat, and causing significant sediment pollution problems downstream. Erosion problems occur when either a stream's hydrology and/or sediment supply are significantly altered. This often occurs below a specific alteration, such as a pipe outfall or road crossing, or when land use in a watershed changes. For example, as a watershed becomes more urbanized, forest and agricultural fields are developed into residential housing complexes and commercial properties. As a result, the amount of impervious surface, or land area where rainwater cannot seep into the groundwater directly, increases in a drainage basin. This causes the amount of runoff entering a stream to increase. Over time, a stream channel will adjust to the greater rain-induced flows by eroding the streambed and banks to raise water-carrying capacity. This channel readjustment can extend over decades, during which time excessive amounts of sediment from unstable eroding stream banks can have very detrimental impacts on a stream's aquatic resources.

In this survey, unstable eroding streams are defined as areas where the stream banks are almost vertical, and the vegetative roots along the stream are unable to hold the soil onto the banks. While survey teams are asked to visually assess whether the stream was down cutting, widening, or headcutting at a specific site, the only way to evaluate the full significance of the erosion processes at a specific site is to do more detailed monitoring over time.

The SCA survey found 9 eroding stream banks over the length of 6,360 feet (1.2 miles) of stream, or about 4 percent of the 30 miles streams surveyed. The severity and location of erosion sites is shown in Figure 7b. All the sites were ranked either moderate or minor in severity. (Figure 7a)

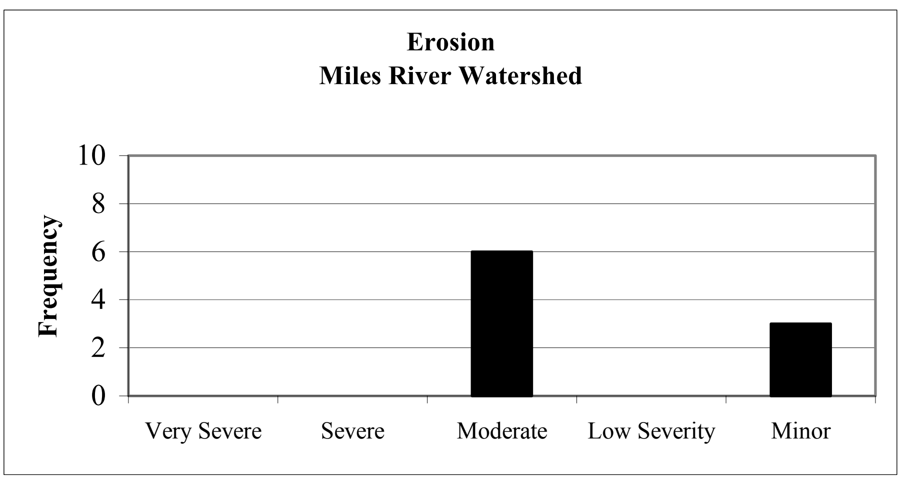


Figure 7a. Histograph showing the frequency of severity ratings given to erosion sites during the Miles River SCA survey.

Erosion

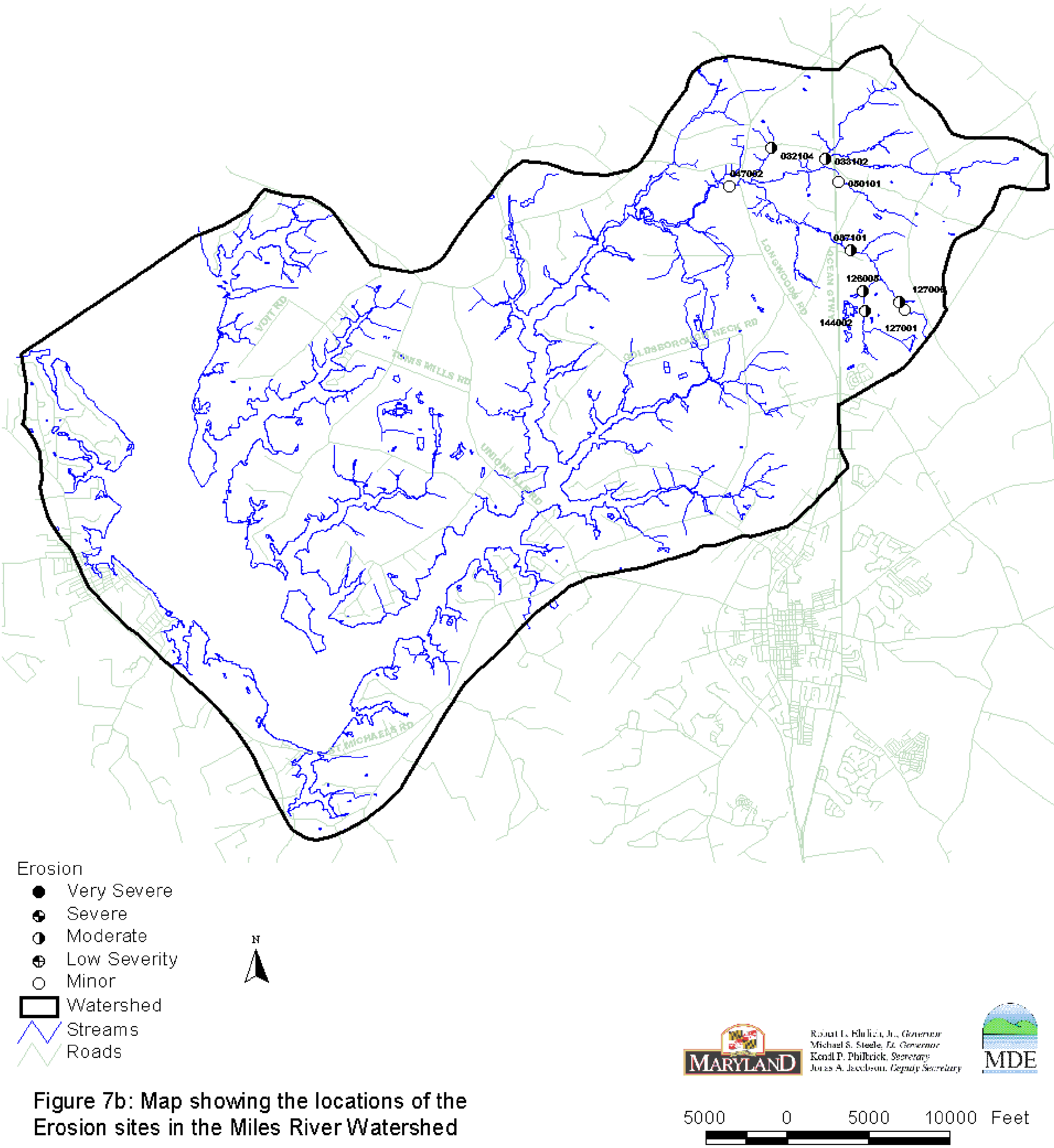


Figure 7b: Map showing the locations of the Erosion sites in the Miles River Watershed

Channel Alterations

Channel alterations are sections where the stream's banks or channel are significantly altered from their naturally occurring structure or condition. These channelized streams are straightened, deepened, and/or the banks hardened using rock, gabion baskets or concrete over a significant length of stream (usually 100 feet or more). Most frequently, channels are altered to decrease the likelihood of flooding by increasing the stream velocity through an area, making stream channelization more common near development or roadways. On Maryland's Eastern Shore, earth channels also are created for drainage purposes.

For the purposes of this survey, there are three types of channel alternations *not* recorded. The first are tributaries where the entire stream branch is piped underground and storm drains replace the stream channel. While these stream sections are significantly altered, it is not possible to know precisely where this was done by walking the stream corridor. Secondly, crews do not specifically record road crossings unless a significant portion of the stream above or below the road is channelized. Lastly, the survey does not report places where a small section of only one side of the stream bank is stabilized to reduce erosion.

Results of this survey show recognizably altered stream channels at 7 sites. The severity and location of channel alteration sites is shown in Figure 8b. The total length of stream affected by channelization is estimated to be 14, 800 feet (2.8 miles). Severity rankings for the sites range from very severe to moderate (Figure 8a).

Restoring channel alteration sites can increase fish and wildlife habitat and may allow for more time for nutrient uptake in the waterway. In its simplest form, restoration for earth channels would include allowing vegetation and/or tree roots to stabilize the sediment along the channel, causing sinuosity to re-form naturally. This sinuosity may reform within the bed of the channelization or along its banks, depending on the site and the depth of the channel alteration.

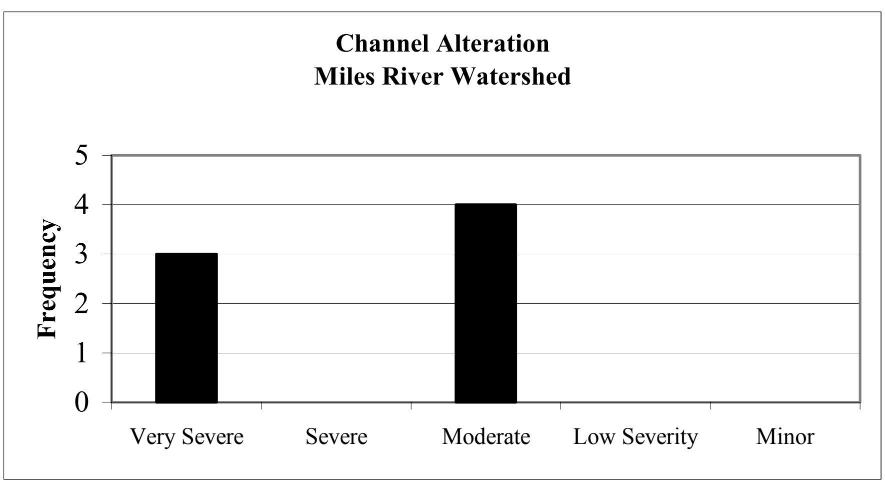
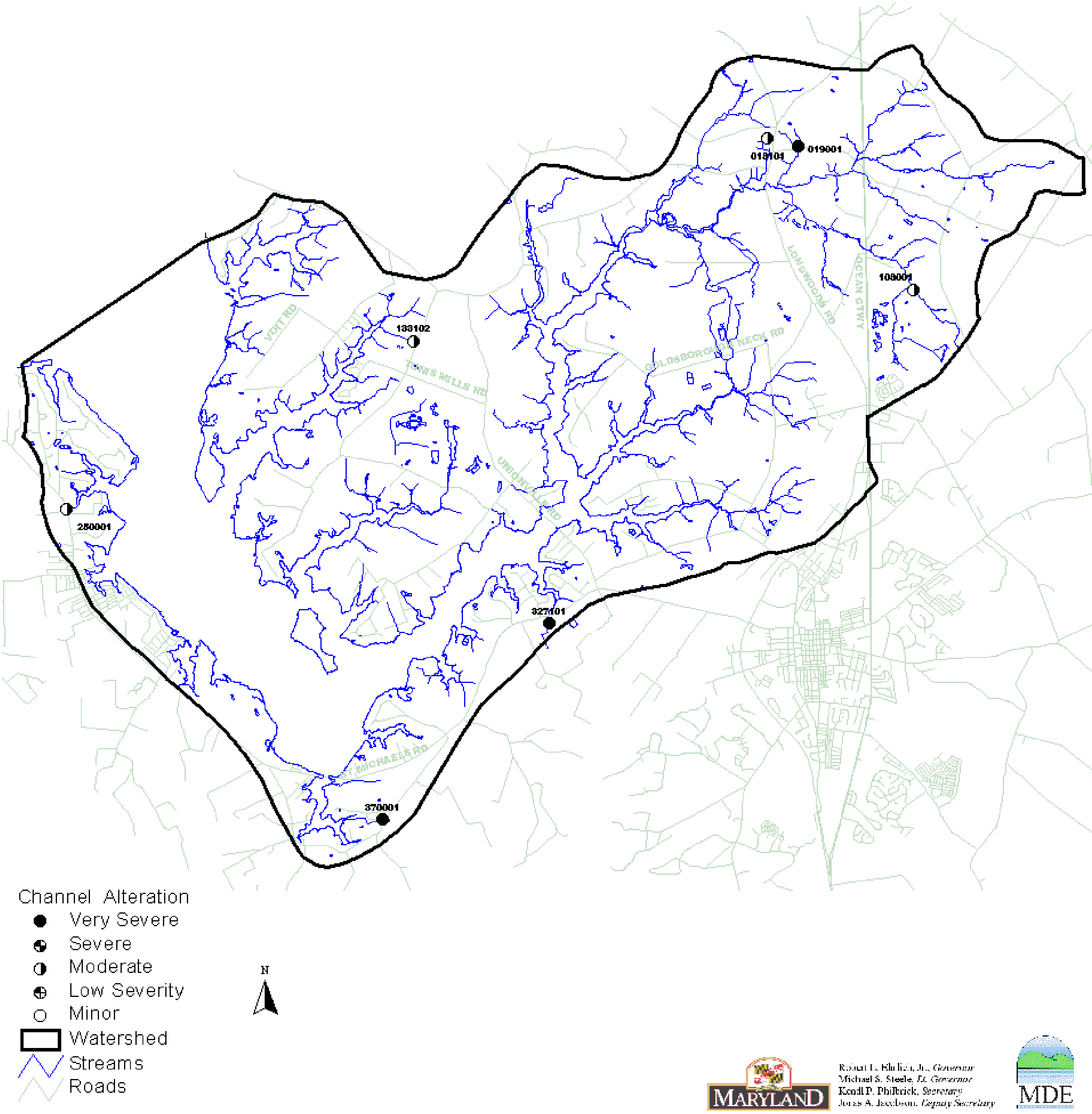


Figure 8a. Histograph showing the frequency of severity ratings given to channel alteration sites during the Miles River SCA survey.

Channel Alteration



Robert L. Ehrlich, Jr., *Governor*
Michael S. Steele, *Lt. Governor*
Kendl P. Philbrick, *Secretary*
Jonas A. Jacobson, *Deputy Secretary*

Figure 8b: Map showing the locations of the Channel Alteration sites in the Miles River Watershed

5000 0 5000 10000 Feet

Fish Migration Barriers

Fish migration barriers include anything in the stream that significantly interferes with the free, upstream movement of fish. Unimpeded fish passage is especially important for anadromous fish that live most of their lives in tidal waters but must migrate into non-tidal rivers and streams to spawn. Unobstructed upstream movement is also important for resident fish species, many of which also travel both up and down stream during different parts of their life cycle. In addition, without free fish passage, certain sections in a stream network become isolated from others. This becomes detrimental to species survival when a disturbance occurs in an isolated stretch of stream. A sediment discharge from a construction project, for example, or a sewage line break discharging into a small tributary can eliminate some or all of the fish species in an isolated stream stretch. With a fish blockage present, there is no avenue for fish to repopulate the inaccessible section. As a result, the disturbance will reduce diversity of the fish community in the area, and the remaining biological community may deviate from its natural balance and composition.

Fish blockages can be caused by man-made structures such as dams or road culverts and by natural features such as waterfalls or beaver dams. A structure becomes a blockage for fish if the stream water over or under it is too high, shallow, or fast. First, a vertical water drop such as a dam can be too high for fish to migrate over the obstacle. A vertical drop of 6 inches may cause a fish passage problem for some resident fish species, while anadromous fish can usually move through water drops of up to one foot, providing there is sufficient water flow and depth. Second, water too shallow for fish passage can occur in channelized stream sections or at road crossings, where the entire stream volume is spread over a large, flat area. Finally, a structure may be a fish blockage if the water is moving too fast through it for fish to swim through. This can occur at road crossings where the culvert pipe is placed at a steep angle, and the water moving through the pipe has a velocity higher than a fish's swimming ability.

In restoration work, priority is given to removing fish barriers that will yield access to the greatest quality and quantity of upstream habitat per dollar spent. The mainstem is ideally kept as barrier-free as possible, allowing anadromous fish to migrate to spawn and a source of fish species for tributaries in the event of a disturbance. Restoration planning includes targeting barriers for removal that isolate entire tributaries, those that isolate significant portions of the upper tributary, and those that isolate quality fish habitat. The best restoration sites also are far from other existing fish barriers.

The Miles River SCA survey found 7 fish migration barriers. The locations of fish blockages are shown in Figure 9b. Fish barriers in this watershed are due to road crossings (6), and debris dams (1). Three of these sites received a moderate rating (033001, 033002, 049001). They were all at road crossings. The three moderate sites were all underpasses of Route 50 (Ocean Gateway) north of Easton.

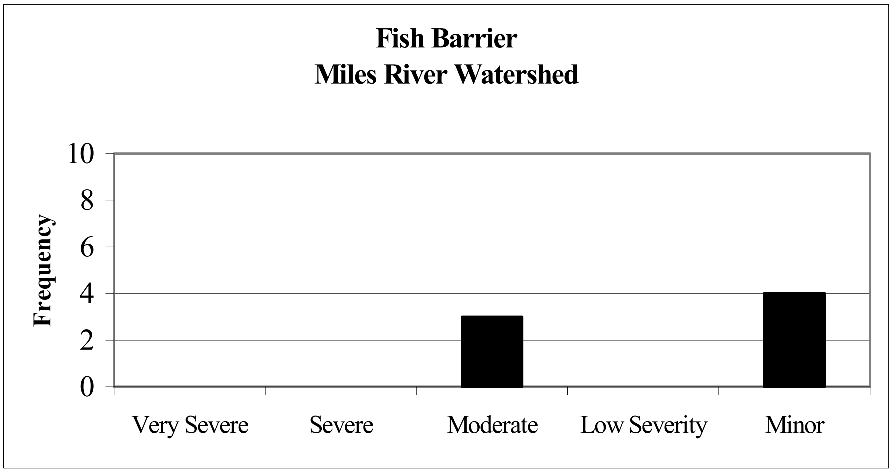


Figure 9a. Histograph showing the frequency of severity ratings given to fish barrier sites during the Miles River SCA survey.

Fish Barriers

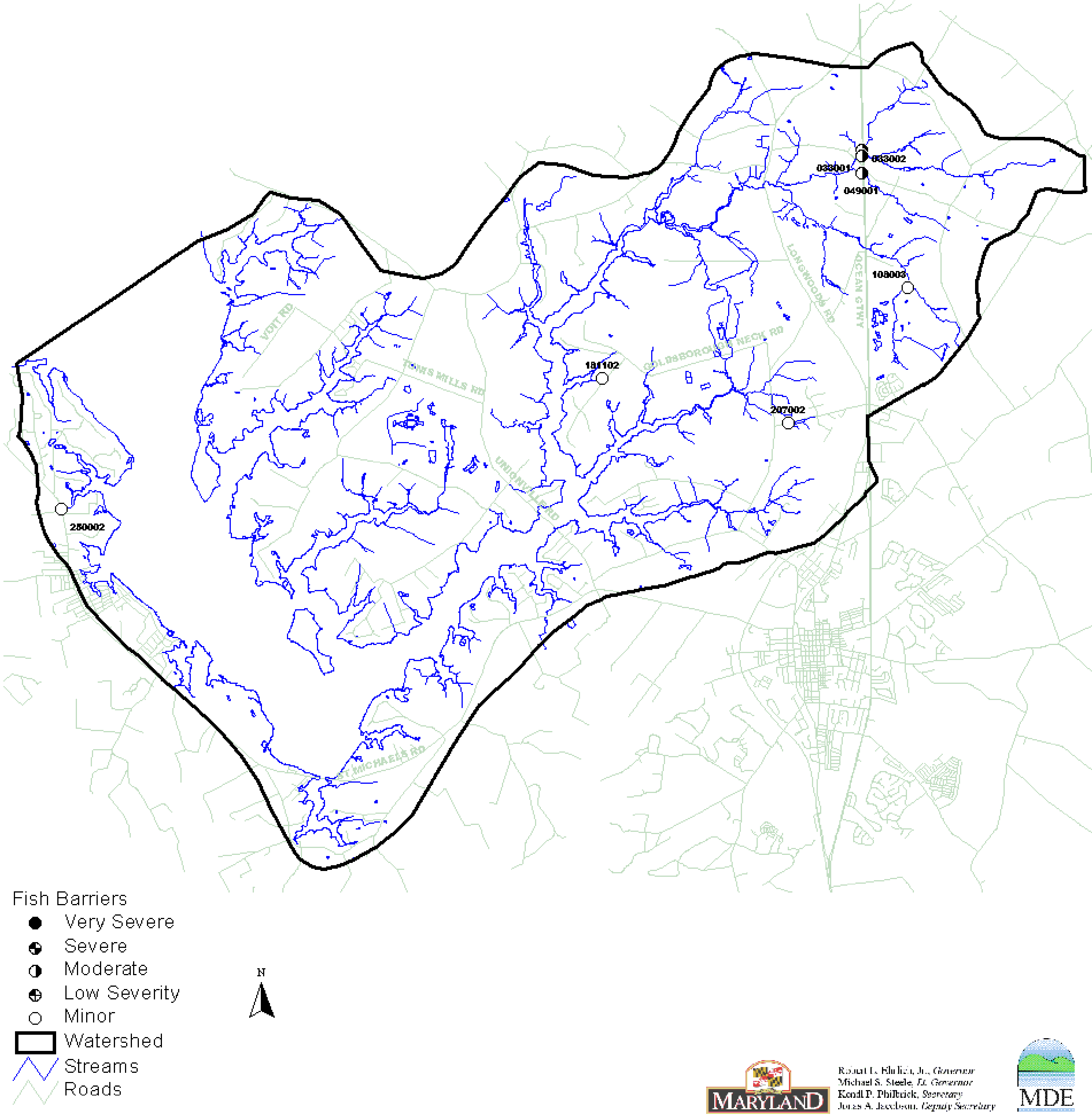


Figure 9b: Map showing the locations of the Fish Barrier sites in the Miles River Watershed

Unusual Conditions or Comments

Survey teams record unusual conditions or comments to note the location of anything out of the ordinary observed during the survey or to provide additional written comments on a specific problem site.

The survey crew identified 3 unusual conditions throughout the Miles River watershed. The severity and location of unusual condition sites is shown in Figure 10. The three unusual conditions sites were excessive grass clippings in the stream, a pond covered in algae, and where rubber tubing was laid along side of the road.

Unusual Conditions

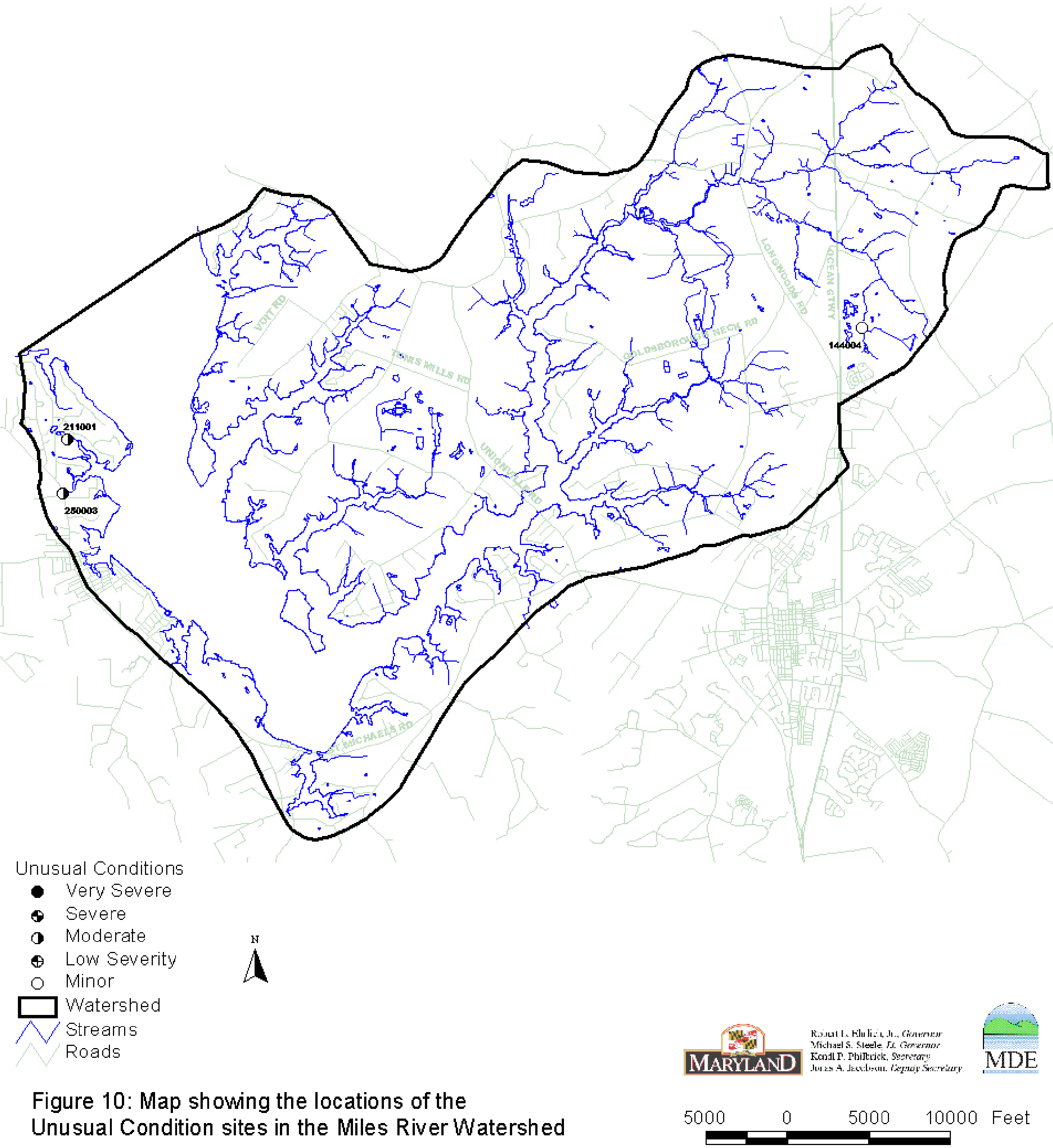


Figure 10: Map showing the locations of the Unusual Condition sites in the Miles River Watershed

Exposed Pipes

Any pipes that are in the stream or along the stream's immediate banks that could be damaged by a high flow event are recorded as exposed pipes in the SCA survey. Exposed pipes include: 1) manhole stacks in or along the edge of the stream channel, 2) pipes that are exposed along the stream banks, 3) pipes that run under the stream bed and were exposed by stream down-cutting, and 4) pipes built over a stream that are low enough to be affected by frequent high storm flows. Exposed pipes do not include pipe outfalls, where only the open end of the pipe is exposed to the streambed.

In urban areas, it is very common for pipelines and other utilities to be placed in the stream corridor. This is especially true for gravity sewage lines, which depend on the continuous downward slope of the pipeline to move sewage to a pumping station or treatment plant. Since streams flow through the lowest points of the local landscape, engineers often build sewage lines paralleling streams to collect sewage from adjacent neighborhoods. While the pipelines are stationary, streams migrate to different areas within the floodplain. Over time, this variance in stream location can expose previously buried pipelines, making them vulnerable to puncture by debris in the stream. Fluids in the pipelines can be discharged into the stream, causing a serious water quality problem.

Field crews observed 1 exposed pipe during the survey. It was rated moderate. The pipe was rated as moderate because it is located along the stream bottom were it may be damaged by debris. It was reported not to have any discharge at the time of the survey. Location of the site is shown in Figure 11.

Exposed Pipes

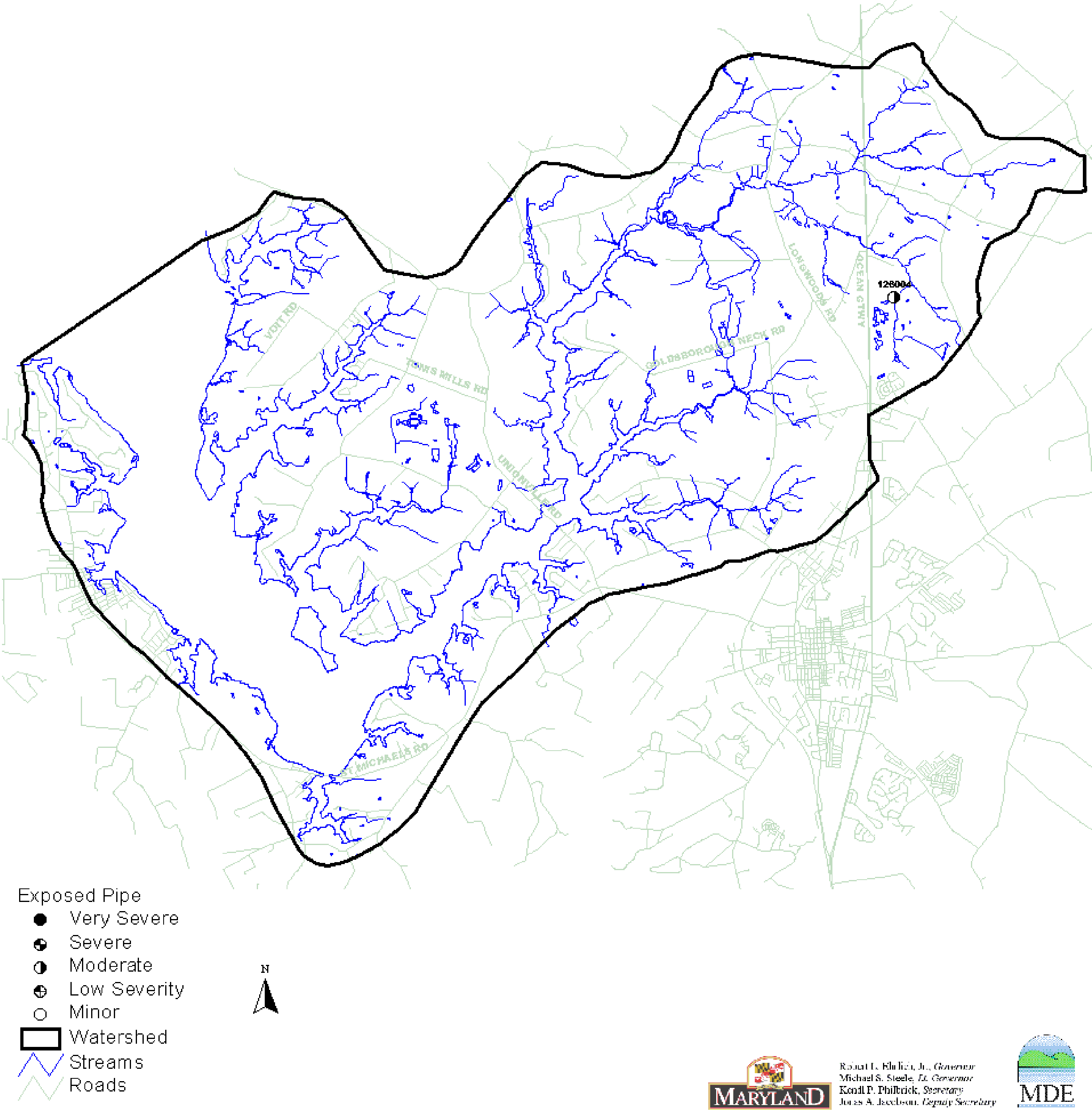


Figure 11: Map showing the location of the Exposed Pipe site in the Miles River Watershed

5000 0 5000 10000 Feet

Representative Sites

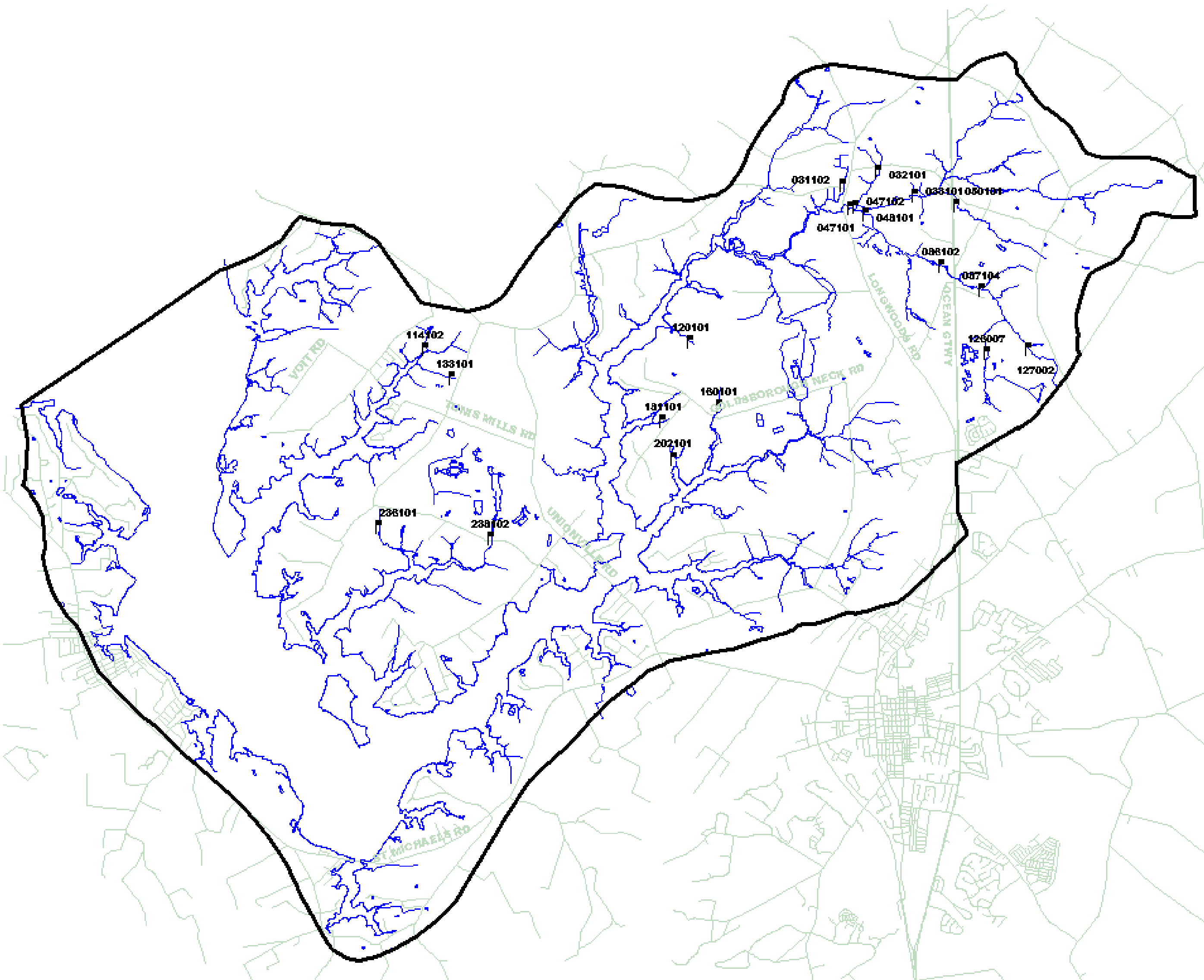
Representative sites are used to document the general condition of both in-stream habitat and the adjacent riparian corridor (including and up to 50 feet beyond the stream bank). The SCA survey's representative site evaluations are based on the habitat assessment procedures outlined in EPA's rapid bioassessment protocols (Plafkin, et. al., 1989), and they are very similar to the habitat evaluations of Maryland Save-Our-Stream's Heartbeat Program. At each representative site, the following 10 separate categories related to stream habitat health are evaluated:

* Attachment Sites for Macroinvertebrates	* Embeddedness
* Shelter for Fish	* Channel Alteration
* Sediment Deposition	* Velocity and Depth Regime
* Channel Flow Status	* Bank Vegetation Protection
* Condition of Banks	* Riparian Vegetative Zone Width

Under each category, field crews base a rating of optimal, suboptimal, marginal or poor on established grading criteria developed to reflect ideal wildlife habitat for rocky bottom streams. In addition to the habitat ratings, teams collect data on the stream's wetted width and pool depths at both runs and riffles at each representative site. Depth measurements are taken along the stream thalweg (main flow channel). At representative sites, field crews also indicate whether the bottom sediments are primarily silt, sand, gravel, cobble, boulder, or bedrock. Representative sites are located at approximately ½- to one-mile intervals along the stream. Survey crews evaluated 19 representative sites in the Miles River watershed and the locations are shown in Figure 12.

Attachment sites for macroinvertebrates rated mostly marginal to poor. In coastal plain streams there are limited gravel riffles for the macroinvertebrates to exist. Embeddedness was found to be mostly poor. The bottoms of the streams were mostly sand or silt. Shelter for fish was varied from stream to stream but was found to be poor in several areas. Channel alteration rates the amount of man-made changes to the stream channel. Nearly half of the representative sites indicate that there was some alteration to the channel. In some cases the channel had been altered at some point in the past and is no longer maintained. There was some sediment deposition at most of the representative sites. The condition of the banks were rated to be mostly optimal or suboptimal with a few marginal or poor areas. This indicates that there were a few areas of erosion but these were small. For riparian vegetative zone width the sites were rated to be optimal to poor. The areas where the rating was marginal or poor, was mostly in the altered areas.

Representative Sites



Representative Sites
Watershed
Streams
Roads

N

Figure 12: Map showing the locations of the Representative sites in the Miles River Watershed

MARYLAND

Robert L. Ehrlich, Jr., *Governor*
Michael S. Steele, *Lt. Governor*
Kendl P. Philbrick, *Secretary*
Jonas A. Jacobson, *Deputy Secretary*

MDE

5000 0 5000 10000 Feet

DISCUSSION

The results of the Miles River SCA survey list, summarize, and show the location of the observable environmental problems along the stream corridor network in this watershed. Each potential problem site has a corresponding ranking for severity, correctibility, and access and a photograph of the site. The data from this effort can be used to target future restoration efforts. After this list of potential problem sites is compiled and distributed, county planners, resource managers, and others can initiate a dialog to cooperatively set the direction and goals for the watersheds' management and plan future restoration work at specific problem sites. In addition, this data can be combined with other GIS data and local information to prioritize areas for restoration.

The GIS and attribute data for the sites described in the SCA survey can be combined with other existing GIS datasets to even further prioritize areas for restoration. Projects can be further targeted to restoring areas where rare or threatened species, gaps in continuous forest or the state's Green Infrastructure, or quality fish and wildlife habitat are found. In addition, sites can be prioritized for restoration based on their location in headwater areas, streams that deposit directly into the Chesapeake Bay, areas of specific local interest, or sites where the surrounding land use is particularly suited to restoration projects.

As mentioned earlier, the Maryland Department of Environment has formed a partnership with Talbot County to develop a Watershed Restoration Action Strategy (WRAS) for the Miles River watershed. Results from this survey will be combined with other GIS data and local information about the area to help establish priorities for the types and location of restoration projects that will be pursued in the watershed in the future. The value of the present survey is its help in placing individual stream problems into their watershed context and its potential common use among resource managers and land-use planners to cooperatively and consistently prioritize future restoration work. Results of the present survey will be given to the Miles River Watershed WRAS committee, which is developing a Watershed Restoration Action Strategy for the Miles River. Information on the Miles Watershed Action Strategy can be found on the Department of Natural Resources' website (www.dnr.maryland.gov/wras).

REFERENCES

Bruckler, R., Ellis, K. 2006. Miles River Watershed Characterization Maryland Department of Environment Baltimore MD.

Hosmer, A.W. 1988. MaryPIRG'S Streamwalk manual. Univ. of Maryland, College Park.

Maryland Clean Water Action Plan. 1998. Maryland Department of Natural Resources, Annapolis. MD.

Maryland Department of Planning. Land use data. 2000.

Maryland Clean Water Action Plan. 1998. Maryland Department of Natural Resources, Annapolis. MD. Available at http://www.dnr.maryland.gov/cwap/index.html

Maryland Save Our Streams (SOS). 1970. Conducting a stream survey. Maryland Department of Natural Resource's Adopt-A-Stream Program. Annapolis, MD.

Natural Resources Conservation Service (NRCS). 1998. Stream visual assessment protocols. National Water and Climate Center Technical Note 99-1.

Plafken, J., M. T. Barbour, K. D. Porter, S. K. Gross and R. M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers. U.S. Environmental Protection Agency (EPA), Office of Water, EPA/444/4-89-001.

Primrose, N. 2006.Report on Nutrient Synoptic Surveys in the Miles River Watershed Maryland Department of Environment Baltimore MD.

United States Environmental Protection Agency EPA (USEPA), 1992. Streamwalk Manual. Water Division Region 10, Seattle WA. EPA 910/9-92-004.

Yetman, K.T, 2001. *Stream corridor assessment survey – survey protocols*. Maryland Department of Natural Resources, Annapolis. MD.

Yetman, K. T., D. Bailey, C. Buckley, P. Sneeringer, M. Colosimo, L. Morrison and J. Bailey. 1996. *Swan Creek watershed assessment and restoration*. Proceedings Watershed '96. June 8 - 12, 1996 Baltimore, MD. Prepared by Tetra Tech Inc. under contract to EPA.

ACKNOWLEDGEMENTS

Without the hard work and dedication of Niles Primrose, Kevin Coyne, and Jennifer Rusko of the Maryland Department of Environment this survey would not have been possible.

Appendix A: Listing of sites by site number

Appendix A

Site	Problem	Severity	Correctability	Access	X_COORD	Y_COORD	STREAM
018101	Channel Alteration	3	3	1	479819.92171	132450.87216	Potts Mill Creek
018101	Inadequate Buffer	1	3	1	479819.92171	132450.87216	Potts Mill Creek
019001	Channel Alteration	1	3	1	480364.64669	132289.41738	Potts Mill Creek
019001	Inadequate Buffer	1	3	1	480364.64669	132289.41738	Potts Mill Creek
031102	Representative Site				479765.50947	131959.73817	Potts Mill Creek
032101	Representative Site				480354.23140	132179.73870	Potts Mill Creek
032102	Inadequate Buffer	2	1	1	480141.58322	132008.31709	Potts Mill Creek
032103	Inadequate Buffer	5	1	1	480360.30284	132225.86697	Potts Mill Creek
032104	Erosion	3	4	3	480360.51499	132227.47316	Potts Mill Creek
033001	Fish Barrier	3	3	1	481514.02165	132202.47506	Potts Mill Creek
033002	Fish Barrier	3	3	1	481515.61266	132094.02739	Potts Mill Creek
033101	Representative Site				480941.25791	131790.73792	Potts Mill Creek
033102	Erosion	3	5	5	481376.20373	132018.05610	Potts Mill Creek
047001	Inadequate Buffer	5	2	1	479753.14105	131609.72836	Potts Mill Creek
047002	Erosion	5	3	3	479589.15716	131513.10500	Potts Mill Creek
047101	Representative Site				479885.93857	131581.96300	Potts Mill Creek
047102	Representative Site				479979.40058	131599.00274	Potts Mill Creek
048101	Representative Site				480149.31300	131477.29123	Potts Mill Creek
049001	Fish Barrier	3	3	1	481523.18943	131798.98504	Potts Mill Creek
050101	Erosion	5	3	5	481630.15000	131590.89800	Potts Mill Creek
050101	Representative Site				481630.82668	131619.53935	Potts Mill Creek
086101	Inadequate Buffer	1	3	1	481556.18377	130443.66953	Potts Mill Creek
086102	Representative Site				481367.65591	130648.49249	Potts Mill Creek
087101	Erosion	3	4	2	481840.35683	130304.78429	Potts Mill Creek
087102	Inadequate Buffer	5	1	1	481812.48098	130307.34904	Potts Mill Creek
087103	Pipe Outfall	3	3	2	481859.59260	130303.79765	Potts Mill Creek
087104	Representative Site				482025.61672	130253.74585	Potts Mill Creek
091102	Inadequate Buffer	5	3	1	475545.52365	130830.77598	Miles River
097101	Inadequate Buffer	3	2	1	473625.22040	129923.42631	Leed Creek
108001	Channel Alteration	3	3	3	482449.57031	129716.02806	Potts Mill Creek
108001	Inadequate Buffer	5	4	3	482449.57031	129716.02806	Potts Mill Creek
108002	Pipe Outfall	3	3	3	482414.13889	129746.73498	Potts Mill Creek
108003	Fish Barrier	5	2	3	482331.77754	129742.83314	Potts Mill Creek
114101	Inadequate Buffer	2	2	1	472796.72487	129662.53242	Leed Creek
114102	Representative Site				472987.55785	129292.05895	Leed Creek
115101	Inadequate Buffer	4	2	1	473770.75187	129532.38960	Leed Creek
115102	Inadequate Buffer	4	1	1	473665.24195	129218.71279	Leed Creek
120101	Representative Site				477289.70500	129407.06300	Miles River
126001	Inadequate Buffer	5	2	3	482153.37188	129624.17934	Potts Mill Creek
126002	Pipe Outfall	3	3	3	482113.92488	129585.05417	Potts Mill Creek
126003	Inadequate Buffer	2	4	3	482103.60022	129577.31481	Potts Mill Creek
126004	Exposed Pipe	3	4	3	482079.70342	129553.50857	Potts Mill Creek
126005	Erosion	3	3	3	482076.58774	129546.18604	Potts Mill Creek
126006	Pipe Outfall	5	1	3	482057.82440	129504.02665	Potts Mill Creek
126007	Representative Site				482114.31114	129218.11299	Potts Mill Creek
126008	Inadequate Buffer	1	4	3	482110.92927	129243.72942	Potts Mill Creek
127001	Erosion	5	3	3	482859.09282	129197.76191	Potts Mill Creek
127002	Representative Site				482785.70799	129278.69508	Potts Mill Creek
127003	Pipe Outfall	3	3	3	482764.75328	129305.11794	Potts Mill Creek
127004	Pipe Outfall	5	1	1	482745.88338	129335.28336	Potts Mill Creek
127005	Pipe Outfall	5	1	1	482745.75999	129335.55070	Potts Mill Creek

Appendix A

Site	Problem	Severity	Correctability	Access	X_COORD	Y_COORD	STREAM
127006	Erosion	3	3	1	482742.84399	129351.07979	Potts Mill Creek
133101	Representative Site				473411.52006	128812.38119	Leed Creek
133102	Channel Alteration	3	3	1	473462.52048	128798.93270	Leed Creek
133102	Inadequate Buffer	3	2	1	473462.52048	128798.93270	Leed Creek
144001	Pipe Outfall	3	3	3	482127.82364	129170.32254	Potts Mill Creek
144002	Erosion	3	3	3	482123.21169	129181.64221	Potts Mill Creek
144003	Pipe Outfall	5	1	3	482099.52622	129139.15912	Potts Mill Creek
144004	Unusual Condition	5	3	3	482062.58513	128848.21814	Potts Mill Creek
144005	Pipe Outfall	5	1	3	482061.41628	128829.24747	Potts Mill Creek
145001	Pipe Outfall	3	3	3	482934.33890	129141.09869	Potts Mill Creek
151101	Inadequate Buffer	1	1	1	470752.67952	128545.10207	Woodland Creek
154101	Inadequate Buffer	3	2	1	472976.69347	128643.23663	Leed Creek
160101	Representative Site				477754.02647	128353.24029	Goldsborough Creek
181101	Representative Site				476839.57746	128103.99914	Miles River
181102	Fish Barrier	5	3	1	476868.84589	128118.44755	Miles River
202101	Representative Site				477018.79205	127517.62117	Goldsborough Creek
207001	Inadequate Buffer	2	3	1	480214.00845	127305.52996	Goldsborough Creek
207002	Fish Barrier	5	3	1	480200.46541	127328.40211	Goldsborough Creek
211001	Unusual Condition	3	3	2	467281.39187	126800.22905	Long Haul Creek
236101	Representative Site				472230.69594	126404.58389	Hunting Creek
236102	Inadequate Buffer	1	2	1	472227.37407	126306.43055	Hunting Creek
237101	Inadequate Buffer	3	2	1	472941.67000	126198.45000	Hunting Creek
237102	Inadequate Buffer	3	2	1	473230.77623	126244.46198	Hunting Creek
238101	Inadequate Buffer	3	2	1	473529.80023	126243.35223	Hunting Creek
238102	Representative Site				474056.45862	126222.33362	Hunting Creek
244001	Inadequate Buffer	3	3	3	478449.72934	126247.34564	Glebe Creek
250001	Channel Alteration	3	3	1	467199.06360	125797.14859	Long Haul Creek
250001	Inadequate Buffer	3	3	1	467199.06360	125797.14859	Long Haul Creek
250002	Fish Barrier	5	3	1	467199.33086	125797.16631	Long Haul Creek
250003	Unusual Condition	3	3	1	467198.45653	125797.10835	Long Haul Creek
327101	Channel Alteration	1	3	1	475881.57764	123717.81445	Chapel Cove
327101	Inadequate Buffer	1	3	1	475881.57764	123717.81445	Chapel Cove
370001	Channel Alteration	1	3	1	472896.51175	120174.47058	Oak Creek
370002	Inadequate Buffer	4	3	1	472896.51175	120174.47058	Oak Creek

Appendix B: Listing of sites by problem category

Inadequate Buffers

Problem	Site	Sides	Unshaded	WidthLeft(ft)	WidthRight(ft)	LengthLeft(ft)	LengthRight(ft)	Land Use Left	Land Use Right	Recentlyestablished	Livestock	Severity	Correctability	Access	Wetland
Inadequate Buffer	018101	Both	Both	0	0	3800	3800	Crop field	Crop field	No	No	1	3	1	3
Inadequate Buffer	019001	Both	Both	0	0	3000	3000	Crop field	Crop field	No	No	1	3	1	1
Inadequate Buffer	086101	Both	Both	0	0	2600	2600	Crop field	Shrubs/small trees	No	No	1	3	1	3
Inadequate Buffer	126008	Both	Both	0	0	1700	1700	Golf Course	Golf Course	No	No	1	4	3	3
Inadequate Buffer	151101	Both	Both	0	0	1000	1000	Crop field	Crop field	No	Yes	1	1	1	2
Inadequate Buffer	236102	Both	Both	0	0	1300	1300	Crop field	Crop field	No	No	1	2	1	1
Inadequate Buffer	327101	Both	Both	0	0	2000	2000	Crop field	Crop field	No	No	1	3	1	2
Inadequate Buffer	032102	Both	Both	0	0	700	700	Crop field	Crop field	No	No	2	1	1	2
Inadequate Buffer	114101	Both	Both	0	0	600	600	Crop field	Crop field	No	No	2	2	1	3
Inadequate Buffer	126003	Both	Both	0	0	800	500	Golf Course	Golf Course	No	No	2	4	3	2
Inadequate Buffer	207001	Both	Both	0	0	3000	3000	Airport	Airport	No	No	2	3	1	5
Inadequate Buffer	097101	Both	Neither	5	5	2000	2000	Crop field	Crop field	No	No	3	2	1	4
Inadequate Buffer	133102	Both	Neither	10	10	1800	1800	Crop field	Crop field	No	No	3	2	1	4
Inadequate Buffer	154101	Both	Neither	10	10	1200	1200	Crop field	Crop field	No	No	3	2	1	4
Inadequate Buffer	237101	Both	Both	0	0	500	500	Lawn	Crop field	No	No	3	2	1	4
Inadequate Buffer	237102	Both	Both	0	0	500	500	Crop field	Crop field	No	No	3	2	1	2
Inadequate Buffer	238101	Both	Both	0	0	500	500	Crop field	Crop field	No	No	3	2	1	2
Inadequate Buffer	244001	Both	Both	0	0	500	500	Crop field	Crop field	No	No	3	3	3	3
Inadequate Buffer	250001	Both	Neither	5	20	600	600	Lawn	Shrubs/small trees	No	No	3	3	1	4
Inadequate Buffer	115101	Both	Neither	10	10	800	800	Crop field	Crop field	No	No	4	2	1	4
Inadequate Buffer	115102	Both	Neither	15	5	900	900	Crop field	Crop field	No	No	4	1	1	4
Inadequate Buffer	370002	Both	Neither	10	40	3200	3200	Crop field	Shrubs/small trees	Yes	No	4	3	1	3
Inadequate Buffer	032103	Left	Neither	10		500		Crop field	Forest	No	No	5	1	1	5
Inadequate Buffer	047001	Both	Right	0	0	200	200	Shrubs/small trees	Shrubs/small trees	No	No	5	2	1	2
Inadequate Buffer	087102	Right	Neither		25		250	Forest	Crop field	No	No	5	1	1	3
Inadequate Buffer	091102	Both	Both	10	40	300	300	Lawn	Lawn	No	No	5	3	1	3
Inadequate Buffer	108001	Both	Both	0	0	200	200	Golf Course	Golf Course	No	No	5	4	3	3
Inadequate Buffer	126001	Both	Neither	20	5	200	200	Crop field	Lawn	No	No	5	2	3	2

Pipe Outfalls

Problem	Site	Outfall Type	Pipe Type	Location of Pipe	Diameter (in)	Channel Width	Discharge	Color	Odor	Severity	Correctability	Access
Pipe Outfall	087103	Pond Drainage	Corrugated Metal	Left bank	12		Yes	Clear	None	3	3	2
Pipe Outfall	108002	Golf Course Drainage	Plastic	Left bank	12		Yes	Clear	None	3	3	3
Pipe Outfall	126002	Golf Course Drainage	Plastic	Right bank	12		Yes	Clear	None	3	3	3
Pipe Outfall	127003	Stormwater	Earth Channel	Left bank		2	Yes	Clear	None	3	3	3
Pipe Outfall	144001	Golf Course Drainage	Plastic	Right bank	12		Yes	Clear	None	3	3	3
Pipe Outfall	145001	Stormwater	Earth Channel	Left bank		2	Yes	Clear	None	3	3	3
Pipe Outfall	126006	Pond Drainage	Earth Channel	Left bank		2	No			5	1	3
Pipe Outfall	127004	Stormwater	Earth Channel	Right bank		1.5	No			5	1	1
Pipe Outfall	127005	Stormwater	Earth Channel	Left bank		1.5	No			5	1	1
Pipe Outfall	144003	Golf Course Drainage	Plastic	Right bank	4		No			5	1	3
Pipe Outfall	144005	Golf Course Drainage	Plastic	Left bank	3		No			5	1	3

Erosion

Problem	Site	Type	Possible Cause	Length(ft)	Height(ft)	Land use left	Land use right	Infrastructure Threatened?	Describe	Severity	Correctability	Access
Erosion	032104	Widening	Below road crossing	400	4	Crop field	Crop field	No		3	4	3
Erosion	033102	Widening	Below road crossing	2600	3	Forest	Forest	No		3	5	5
Erosion	087101	Widening	Bend at steep slope	400	3	Forest	Crop field	No		3	4	2
Erosion	126005	Widening	Bend at steep slope	400	5	Golf Course	Golf Course	No		3	3	3
Erosion	127006	Downcutting	Land use change upstream	700	3	Forest	Forest	No		3	3	1
Erosion	144002	Widening	Unknown	1400	3	Golf Course	Golf Course	No		3	3	3
Erosion	047002	Widening	Bend at steep slope	100	4	Forest	Forest	No		5	3	3
Erosion	050101	Widening	Bend at steep slope	60	5	Forest	Forest	No		5	3	5
Erosion	127001	Downcutting	Unknown	300	2	Shrubs & Small Trees	Forest	No		5	3	3

Channel Alterations

Problem	Site	Type	BottomWidth(in)	Length(ft)	Perennial Flow	Sedimentation	Veg in Channel	Road Crossing	LengthAbove(ft)	LengthBelow(ft)	Severity	Correctability	Access
Channel Alteration	019001	Earth channel	24	3000	Yes	Yes	Yes	No			1	3	1
Channel Alteration	327101	Earth Channel	60	2000	Yes	No	No	No			1	3	1
Channel Alteration	370001	Earth channel	50	3300	Yes	No	Yes	No			1	3	1
Channel Alteration	018101	Earth channel	12	3900	No	No	Yes	No			3	3	1
Channel Alteration	108001	Rip-rap	36	200	Yes	No	No	No			3	3	3
Channel Alteration	133102	Earth channel	36	1800	Yes	No	No	No			3	3	1
Channel Alteration	250001	Earth channel	12	600	Yes	No	Yes	Below			3	3	1

Fish Barriers

Problem	Site	Blockage	Type	Reason	Drop(In)	Depth(In)	Severity	Correctability	Access
Fish Barrier	033001	Total	Road crossing	Too high	4		3	3	1
Fish Barrier	033002	Total	Road crossing	Too high	6		3	3	1
Fish Barrier	049001	Total	Road crossing	Too shallow		0.5	3	3	1
Fish Barrier	108003	Temporary	Debris dam	Too high	24		5	2	3
Fish Barrier	181102	Total	Road crossing	Too high	12		5	3	1
Fish Barrier	207002	Total	Road crossing	Too high	24		5	3	1
Fish Barrier	250002	Total	Road crossing	Too high	4		5	3	1

Unusual Conditions

Problem	Site	Describe	Description	Potential Cause	Severity	Correctability	Access
Unusual Condition	211001	Excessive Algae	Pond Covered in Algae	Fertilizers?	3	3	2
Unusual Condition	250003	Exposed Tubing	Rubber Tubing laid along side of road	Cable?	3	3	1
Unusual Condition	144004		Excessive Grass Clippings in stream	Mowing	5	3	3

Exposed Pipes

Problem	Site	Location of Pipe	Type	Diameter(in)	Length(ft)	Purpose	Discharge	Color	Odor	Severity	Correctability	Access
Exposed Pipe	126004	Exposed across bottom of stream	plastic	3	4	Unknown	No			3	4	3

Representative Sites A

Problem	Site	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation
Goldsborough Creek											
Representative Site	160101	Poor	Poor	Poor	Poor	Poor	Dry	Dry	Optimal	Optimal	Suboptimal
Representative Site	202101	Poor	Poor	Poor	Poor	Poor	Dry	Dry	Optimal	Optimal	Optimal
Hunting Creek											
Representative Site	236101	Poor	Poor	Poor	Optimal	Poor	Dry	Dry	Optimal	Optimal	Optimal
Representative Site	238102	Poor	Poor	Optimal	Optimal	Poor	Poor	Marginal	Optimal	Optimal	Suboptimal
Leed Creek											
Representative Site	114102	Poor	Poor	Poor	Optimal	Poor	Marginal	Marginal	Poor	Poor	Poor
Representative Site	133101	Poor	Poor	Poor	Poor	Poor	Marginal	Suboptimal	Marginal	Suboptimal	Suboptimal
Miles River											
Representative Site	120101	Poor	Poor	Poor	Optimal	Marginal	Dry	Dry	Optimal	Optimal	Suboptimal
Representative Site	181101	Poor	Poor	Poor	Suboptimal	Poor	Poor	Poor	Suboptimal	Optimal	Suboptimal
Potts Mill Creek											
Representative Site	031102	Marginal	Marginal	Suboptimal	Poor	Marginal	Marginal	Suboptimal	Suboptimal	Optimal	Marginal
Representative Site	032101	Suboptimal	Marginal	Suboptimal	Optimal	Marginal	Suboptimal	Optimal	Suboptimal	Marginal	Optimal
Representative Site	033101	Marginal	Marginal	Suboptimal	Optimal	Poor	Marginal	Optimal	Suboptimal	Suboptimal	Optimal
Representative Site	047101	Marginal	Poor	Marginal	Optimal	Marginal	Marginal	Suboptimal	Optimal	Optimal	Optimal
Representative Site	047102	Marginal	Marginal	Optimal	Optimal	Marginal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal
Representative Site	048101	Marginal	Poor	Suboptimal	Optimal	Poor	Suboptimal	Suboptimal	Optimal	Optimal	Optimal
Representative Site	050101	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Suboptimal	Optimal	Suboptimal	Optimal
Representative Site	086102	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Poor
Representative Site	087104	Marginal	Poor	Suboptimal	Optimal	Poor	Suboptimal	Suboptimal	Suboptimal	Marginal	Optimal
Representative Site	126007	Marginal	Marginal	Suboptimal	Suboptimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Marginal
Representative Site	127002	Poor	Poor	Poor	Suboptimal	Optimal	Marginal	Optimal	Optimal	Suboptimal	Optimal

Representative Sites B

Problem	Site	Width Riffle	Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
Goldsborough Creek								
Representative Site	160101							Silt
Representative Site	202101							Silt
Hunting Creek								
Representative Site	236101							Silt
Representative Site	238102		36	120		3	6	Sand
Leed Creek								
Representative Site	114102							Sand
Representative Site	133101	12	16	20	1	2	5	Sand
Miles River								
Representative Site	120101							Silt
Representative Site	181101	3	12	40	0.25	0.25	6	Silt
Potts Mill Creek								
Representative Site	031102	12	12	15	1	2	3	Silt/Sand
Representative Site	032101	18	34	36	1.5	3	10	Sand/Gravel
Representative Site	033101	24	60	90	4	5	20	Silt/Sand
Representative Site	047101	18	24	30	1.5	3	5	Silt/Gravel
Representative Site	047102	72	60	96	3	6	24	Sand
Representative Site	048101	60	80	90	3	5	16	Sand/Gravel
Representative Site	050101	48	36	120	3	6	24	Sand/Gravel
Representative Site	086102	45	60	36	0.5	6	12	Sand
Representative Site	087104	18	24	48	2	3	16	Sand/Gravel
Representative Site	126007		60	48		4	36	Gravel
Representative Site	127002	14	24		0.25	3		Sand