Stream Corridor Assessment Survey for the Assawoman Bay Watershed, Worcester County, Maryland

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EXECUTIVE SUMMARY

In 1998, the Maryland Clean Water Action Plan identified the Assawoman Bay 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 Worcester County formed a partnership to develop a Watershed Restoration Action Strategy (WRAS) for the Assawoman Bay 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.

The SCA survey was done in both the Maryland and Delaware portion of the watershed. SCA survey fieldwork for the Assawoman Bay began in February 2005 and was completed by March 2005. There are approximately 80 miles of streams in the watershed. The field crews surveyed approximately 61 miles (76%) 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 103 potential environmental problem sites. At the time of the survey, the most frequently observed potential problem sites were channel alterations, reported at 45 sites. Other potential environmental problems recorded during the survey included: 44 inadequately forested stream buffers, 4 erosion sites, 4 pipe outfalls, 4 unusual conditions, 1 in/ near stream construction and 1 trash dumping site (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 11 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 Assawoman Bay Watershed WRAS committee, which is developing a Watershed Restoration Action Strategy for the Assawoman Bay. Information on the 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 Assawoman Bay watershed. The Maryland Department of Environment formed a partnership with Worcester County to assess and improve environmental conditions in the Assawoman Bay Watershed. The main goal of this partnership is to develop and implement a Watershed Restoration Action Strategy (WRAS) for the Assawoman Bay.

Located in northern Worcester County, Maryland (86%) and southern Sussex County, Delaware (14%), the watershed covers approximately 15,000 acres of land and water (23 square miles) 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 did not 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 Assawoman Bay sub-watersheds 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 Assawoman Bay Stream Corridor Assessment Survey and highlights potential restoration opportunities within the watershed based on the survey.

Survey teams walked approximately 61 miles of the 80 miles of streams in the Assawoman Bay stream network. The survey began February 2005 and was completed by March 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 Assawoman Bay 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 Assawoman Bay 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 Worcester County to develop a Watershed Restoration Action Strategy (WRAS) of the Assawoman Bay 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 Assawoman Bay. 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.

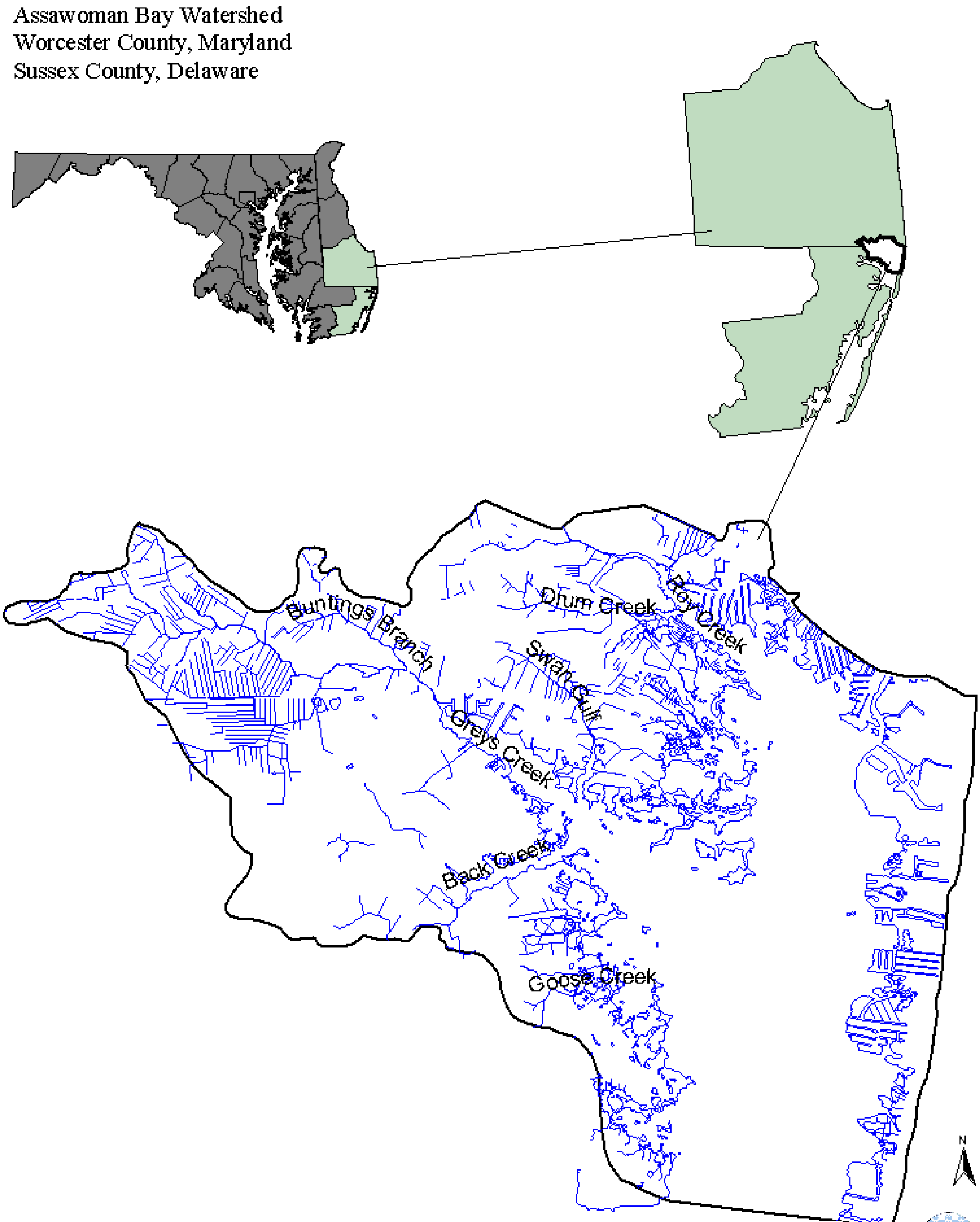

Figure 1: Map showing the location of the Assawoman Bay Watershed in Maryland and Delaware

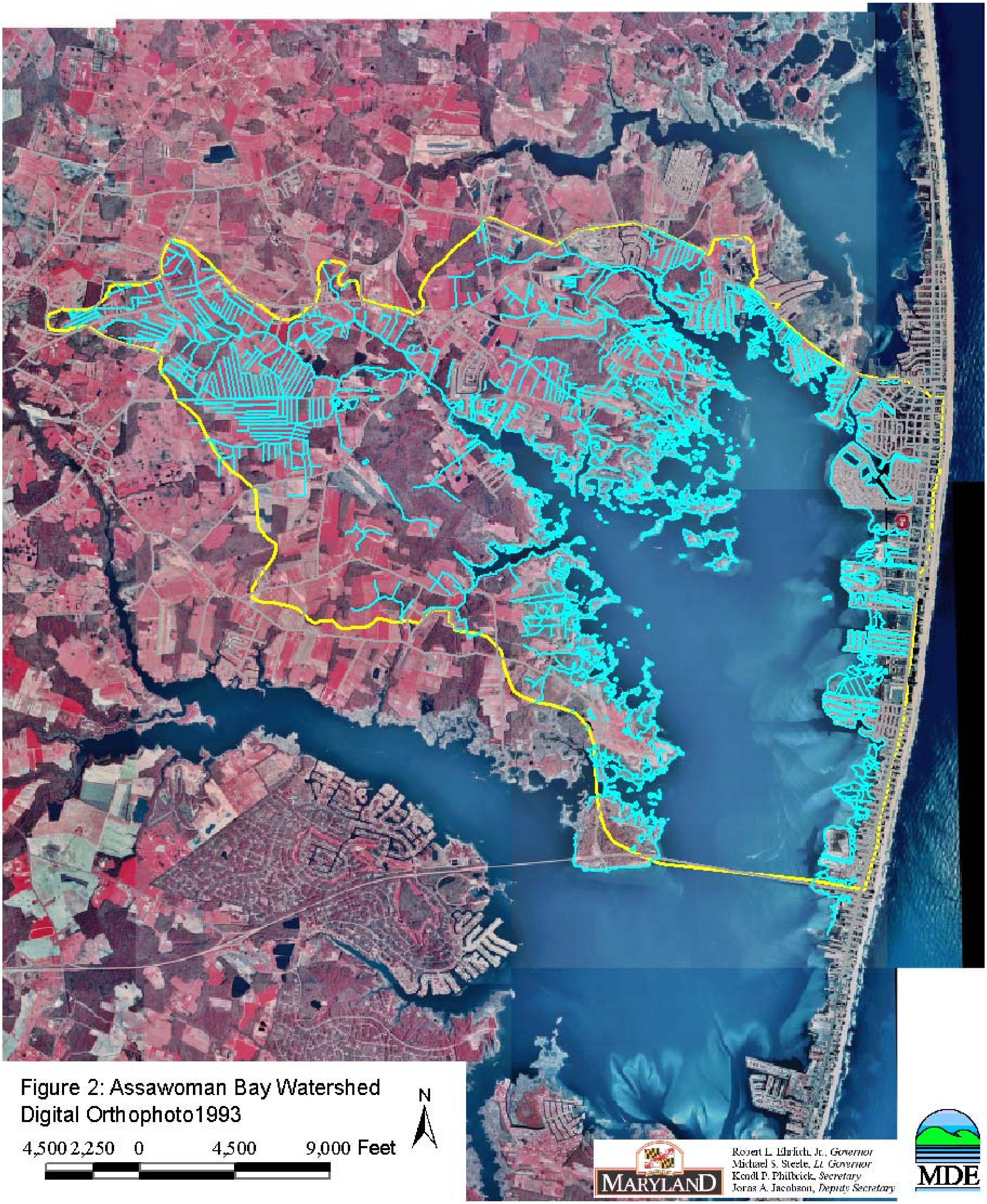

Figure 2: Assawoman Bay Watershed
Digital Orthophoto1993

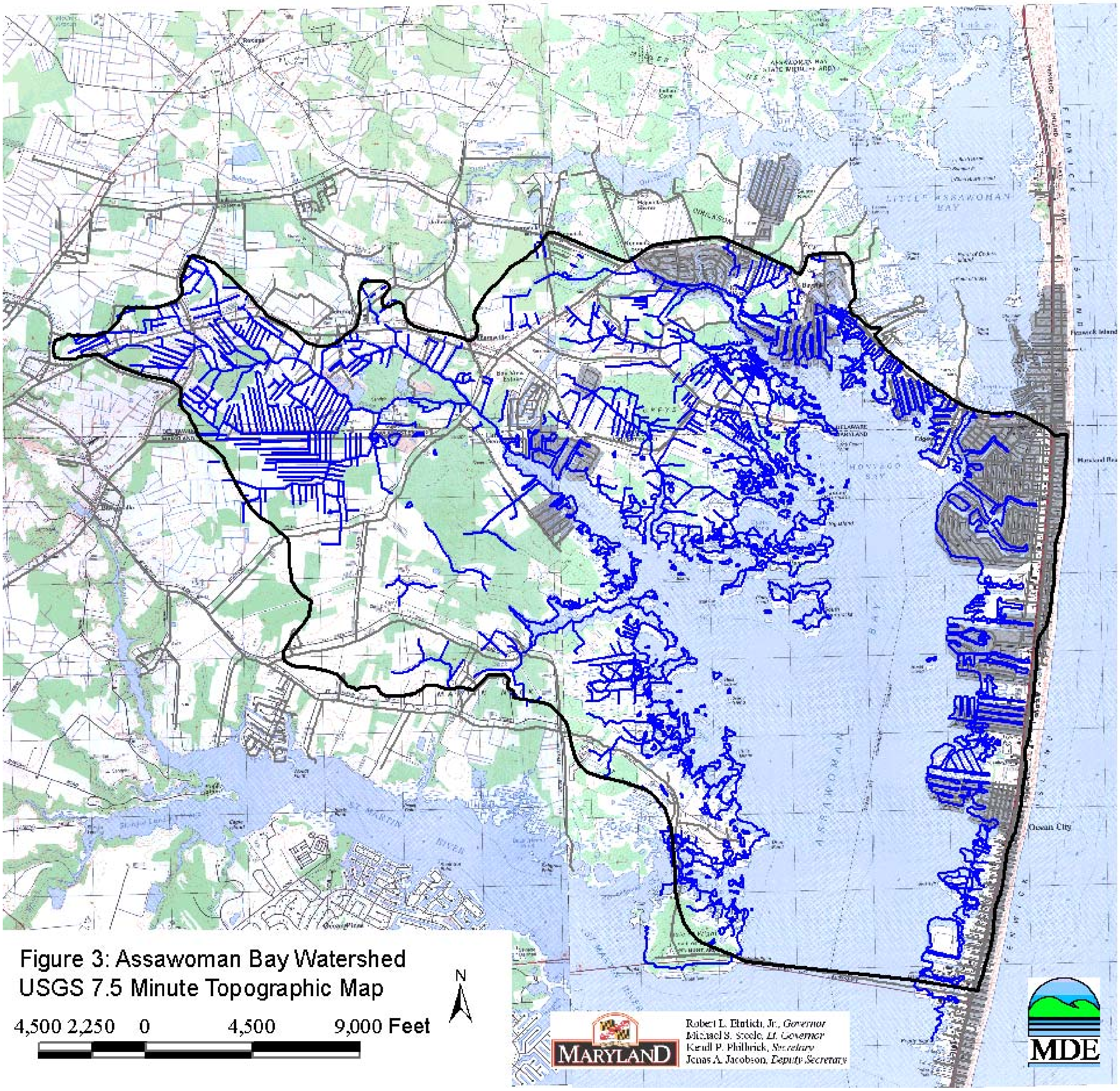

Figure 3: Assawoman Bay Watershed
USGS 7.5 Minute Topographic Map

Non Surveyed Areas

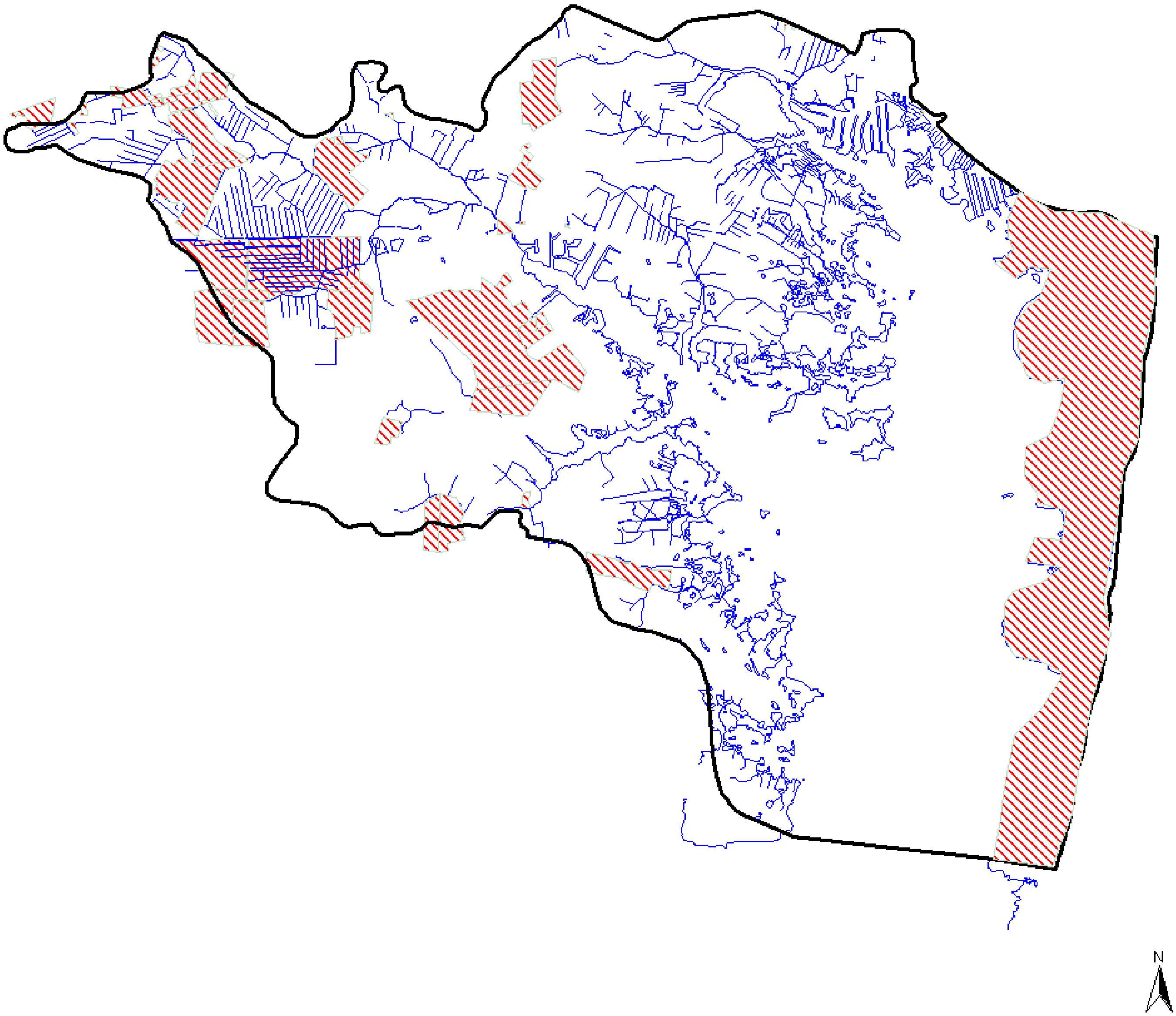

Figure 4: Map showing the location of the Areas that were not surveyed in the Assawoman Bay Watershed

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MDE

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 in order to make a preliminary determination of both the severity and correctability of each problem.

Sufficient data to prioritize restoration efforts.

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

While almost any group of dedicated volunteers can be trained to do a SCA survey, the Maryland Conservation Corps (MCC) has proven to be an ideal group to do this work in Maryland. The Maryland Conservation Corps is part of the AmeriCorps Program, initiated to promote greater involvement of young volunteers in their communities and the environment. The MCC program is managed by DNR's Forest and Park Service. Volunteers with the MCC are 17-25 years old and can have educational backgrounds ranging from high school to graduate degrees. With the proper training and supervision, MCC volunteers are able to significantly contribute to the State's efforts to inventory and evaluate water quality and habitat problems from a watershed perspective. For more information on the Maryland Conservation Corps call their main office in Annapolis at (410) 260-8166 or visit their web site at: www.dnr.maryland.gov/mcc.

Prior to the start of Assawoman Bay SCA Survey, the members of the MCC received 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 MCC's Lower Eastern Shore Crew received 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 MCC crew conducted field surveys of the Assawoman Bay Watershed from February 2005 to March 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. Field crews organized the photographs taken during the survey. 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 Worcester County Planning Department for their use in developing a Watershed Action Strategy for the Assawoman Bay Watershed.

RESULTS

The Stream Corridor Assessment Survey identified 103 potential environmental problem sites (Table 1). At the time of the survey, the most frequently observed potential problem sites were channel alterations, reported at 45 sites. Other potential environmental problems recorded during the survey included: 44 inadequately forested stream buffers, 4 erosion sites, 4 pipe outfalls, 4 unusual conditions, 1 in/ near stream construction and 1 trash dumping site. Additionally, crews recorded descriptive habitat condition data at 11 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 Assawoman Bay SCA Survey.

Potential Problems Identified	Number	Estimated Length	Very Severe	Severe	Moderate	Low Severity	Minor
Channel Alteration	45	216,950 ft (41 miles)	1	2	8	9	25
Inadequate Buffer	44	202,780 ft (38.4 miles)	1	2	3	18	20
Erosion	4	140 ft (0.027 miles)	-	-	-	1	3
Pipe Outfall	4		-	-	-	-	4
Unusual Condition	4		-	-	2	-	2
In/Near Stream Construction	1		-	-	-	-	1
Trash Dumping	1		-	-	-	-	1
Total	**103**		**2**	**4**	**13**	**28**	**56**
Comments	4						
Representative Sites	11						

Table 2. Summary of results by major stream reach.

Stream Segment	Channel Alteration	Erosion	In/Near Stream Construction	Inadequate Buffers	Pipe Outfalls	Trash Dumping	Unusual Conditions	Representative Sites	Comments	Total
Back Creek	6	1		6			1			14
Buntings Branch	3			3		1	1	1		9
Drum Creek	3			3				1	1	8
Goose Creek	1			1				1		3
Greys Creek	20	3		20	4		2	6		55
Roy Creek	8			7				1	2	18
Swan Gulf	4		1	4				1	1	11

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 two 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.

Results of this survey show recognizably altered stream channels at 45 sites. The severity and location of channel alteration sites is shown in Figure 5b. The total length of stream affected by channelization is estimated to be 216,950 feet (41 miles). Severity rankings for the sites are shown in Figure 5a.

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.

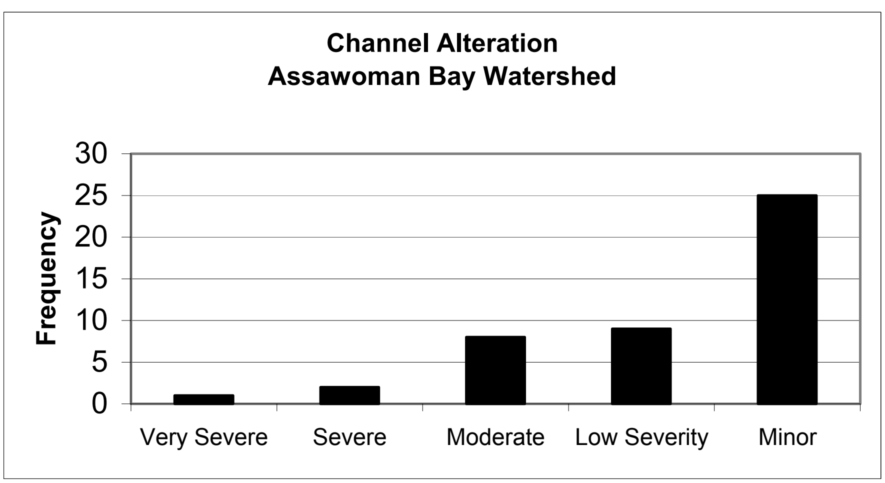

Figure 5a. Histograph showing the frequency of severity ratings given to channel alteration sites during the Assawoman Bay SCA survey.

Channel Alteration

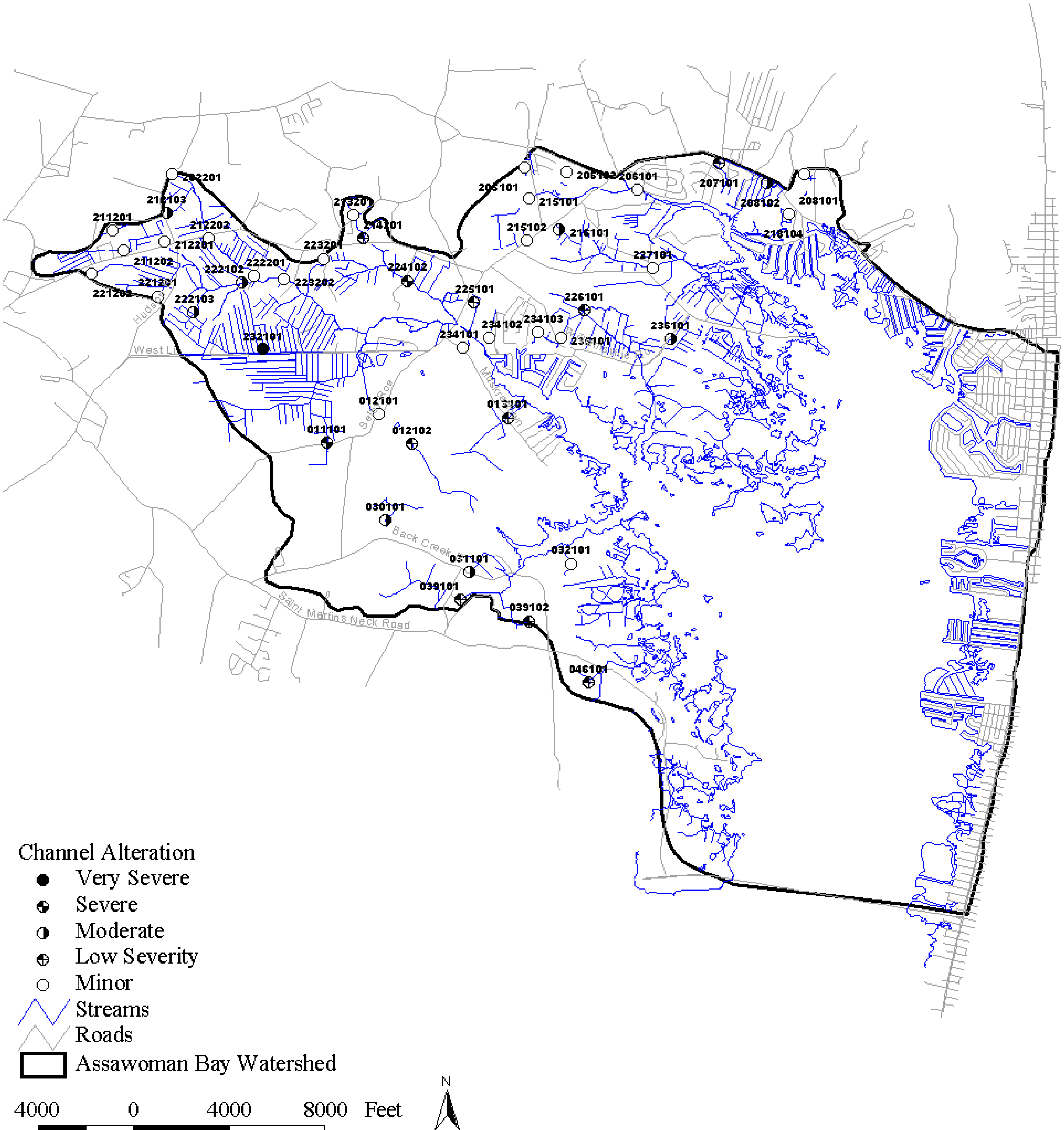

Figure 5b: Map showing the locations of the channel alterations in the Assawoman Bay Watershed

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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 ditches 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 44 inadequate buffer sites with a total length of 202,780 feet (38.4 miles). The severity and location of inadequate buffer sites is shown in Figure 6b. Three of these sites are ranked as very severe or severe, while the other sites are moderate, of low severity, or minor (Figure 6a). Land use along the stream at inadequate buffer sites, were reported as mostly crop fields.

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.

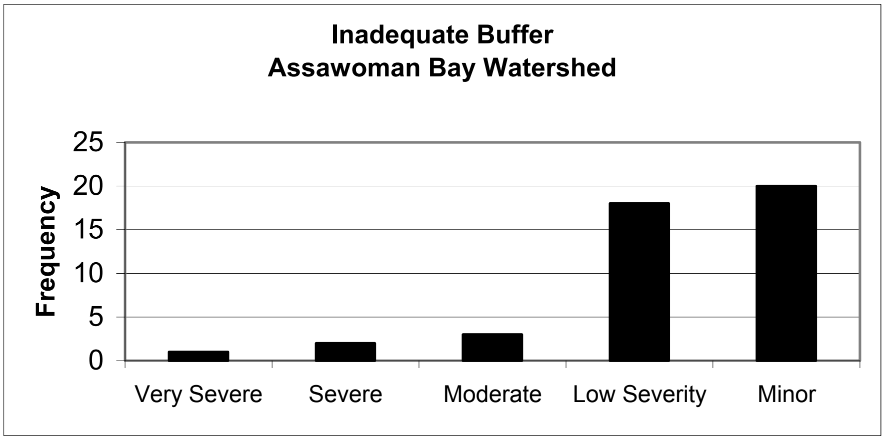

Figure 6a. Histograph showing the frequency of severity ratings given to inadequate buffer sites during the Assawoman Bay SCA survey.

Inadequate Buffers

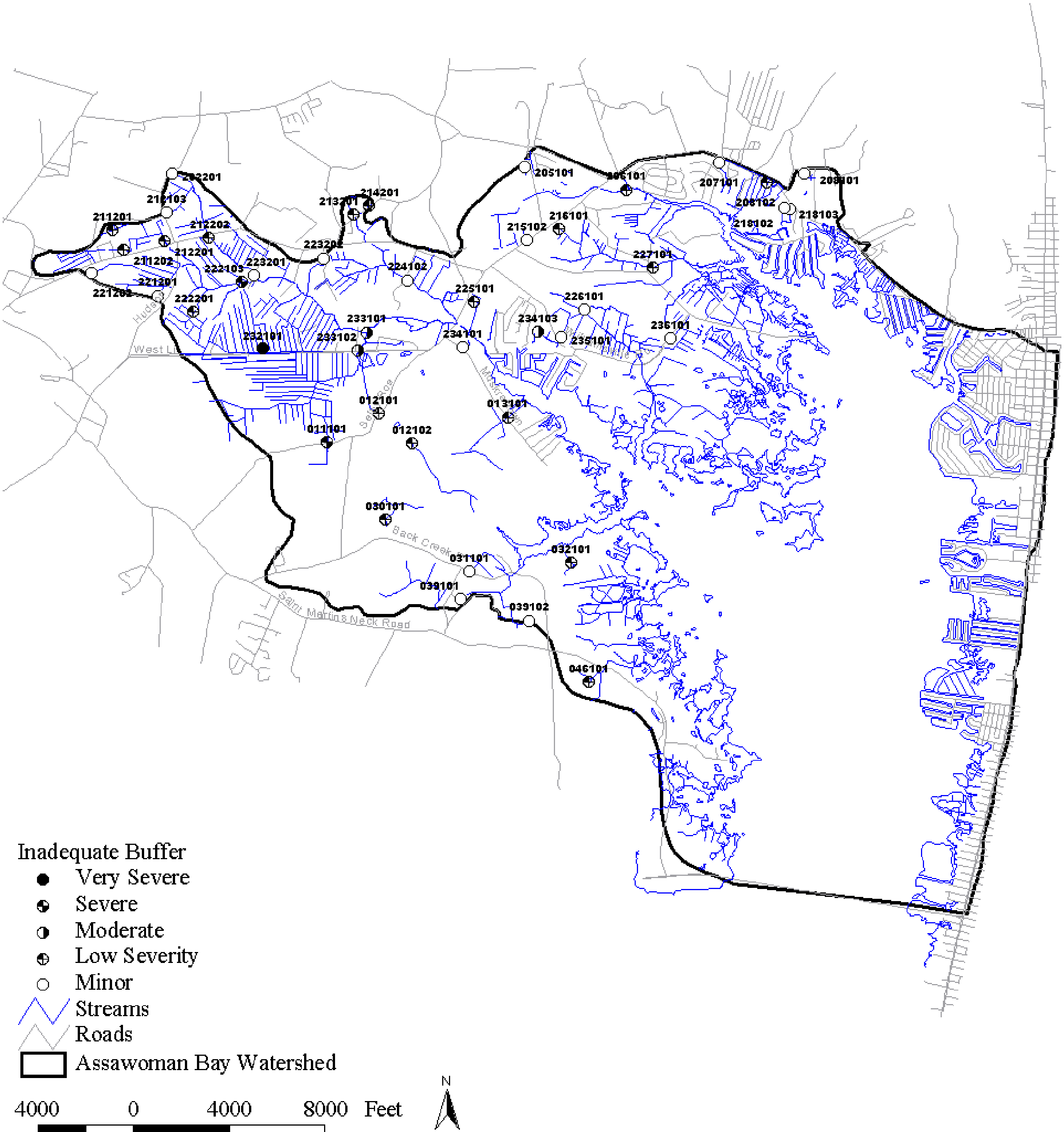

Figure 6b: Map showing the locations of the inadequate buffers in the Assawoman Bay Watershed

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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 4 eroding stream banks over the length of 140 feet (0.027 miles) of stream. The severity and location of erosion sites is shown in Figure 7b. The severity ratings are shown in Figure 7a.

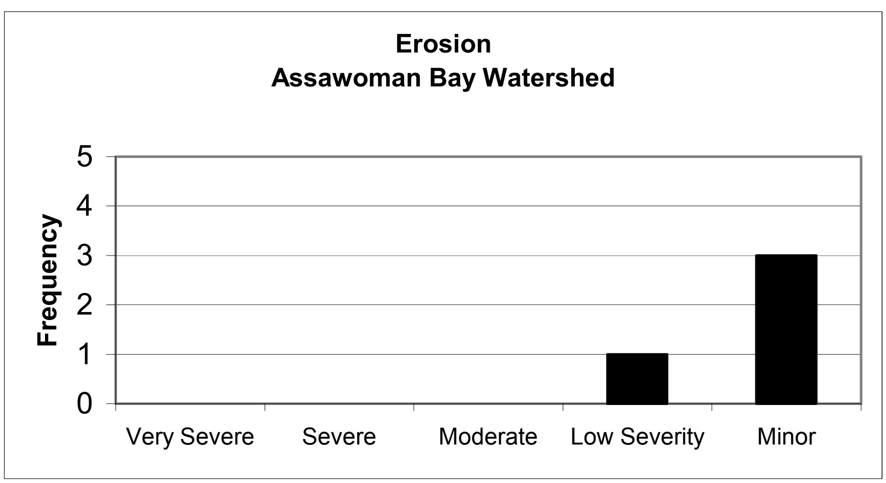

Figure 7a. Histograph showing the frequency of severity ratings given to erosion sites during the Assawoman Bay SCA survey.

Erosion Sites

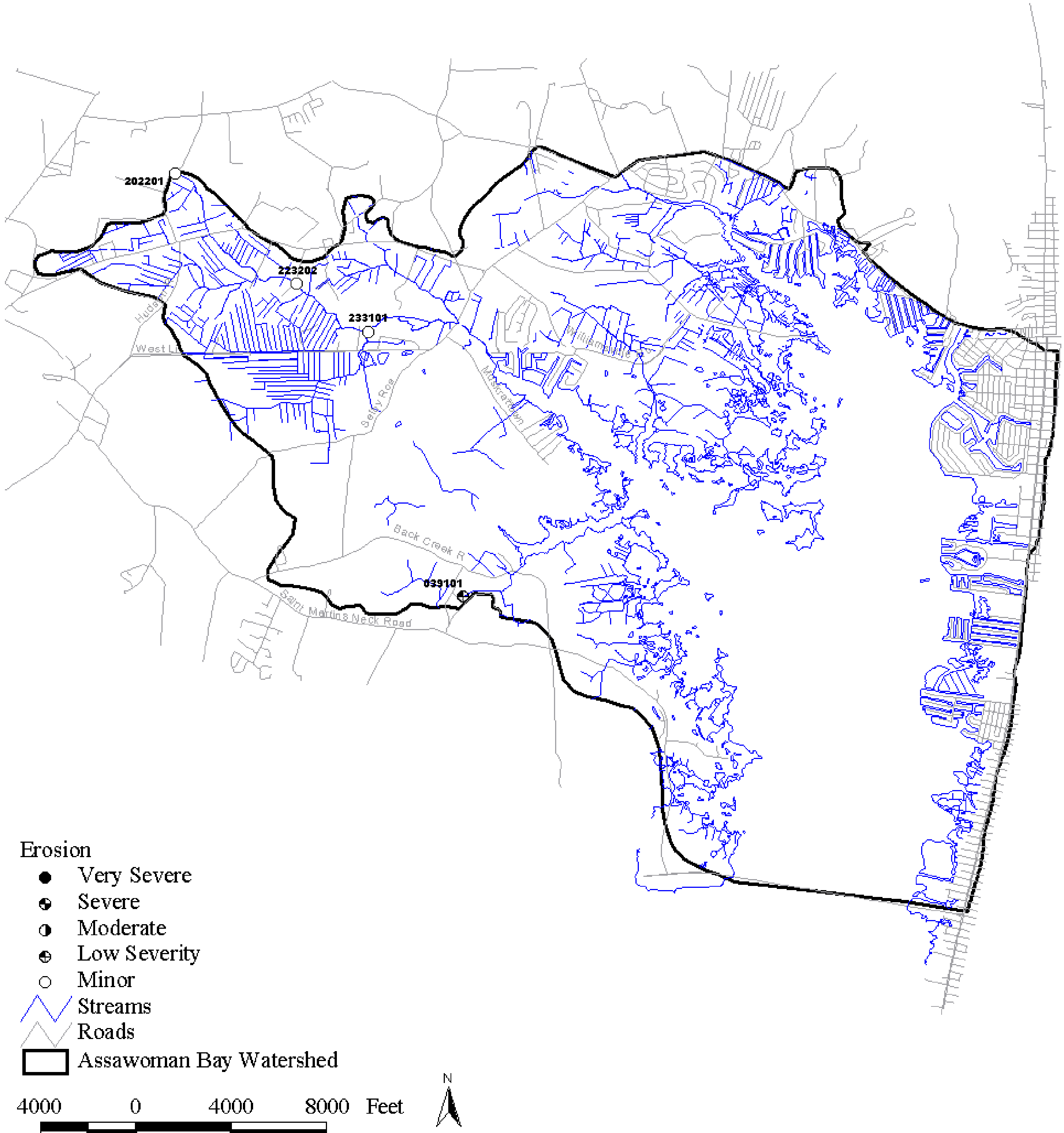

Figure 7b: Map showing the locations of the erosion sites in the Assawoman Bay Watershed

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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 4 pipe outfalls. The severity and location of pipe outfall sites is shown in Figure 8b. None of the pipes had a discharge. All of the pipes were rated as minor (Figure 8a). All the pipes appear to be for stormwater discharges.

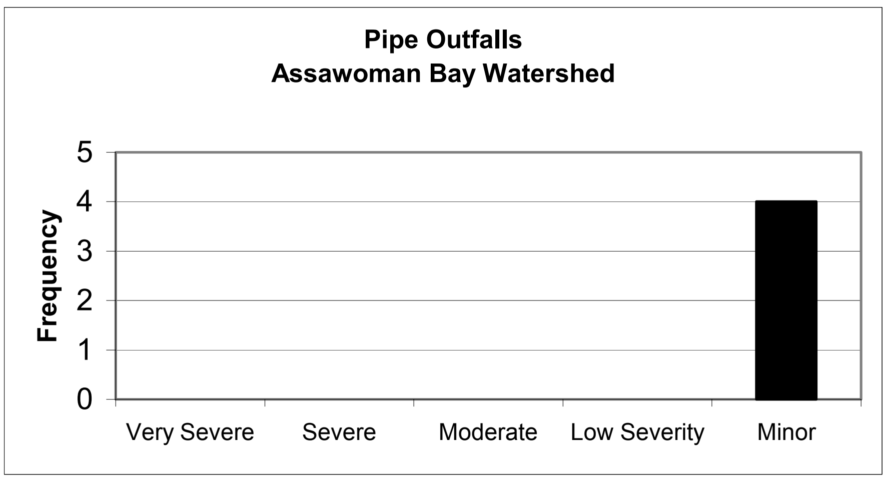

Figure 8a. Histograph showing the frequency of severity ratings given to pipe outfalls sites during the Assawoman Bay SCA survey.

Pipe Outfalls

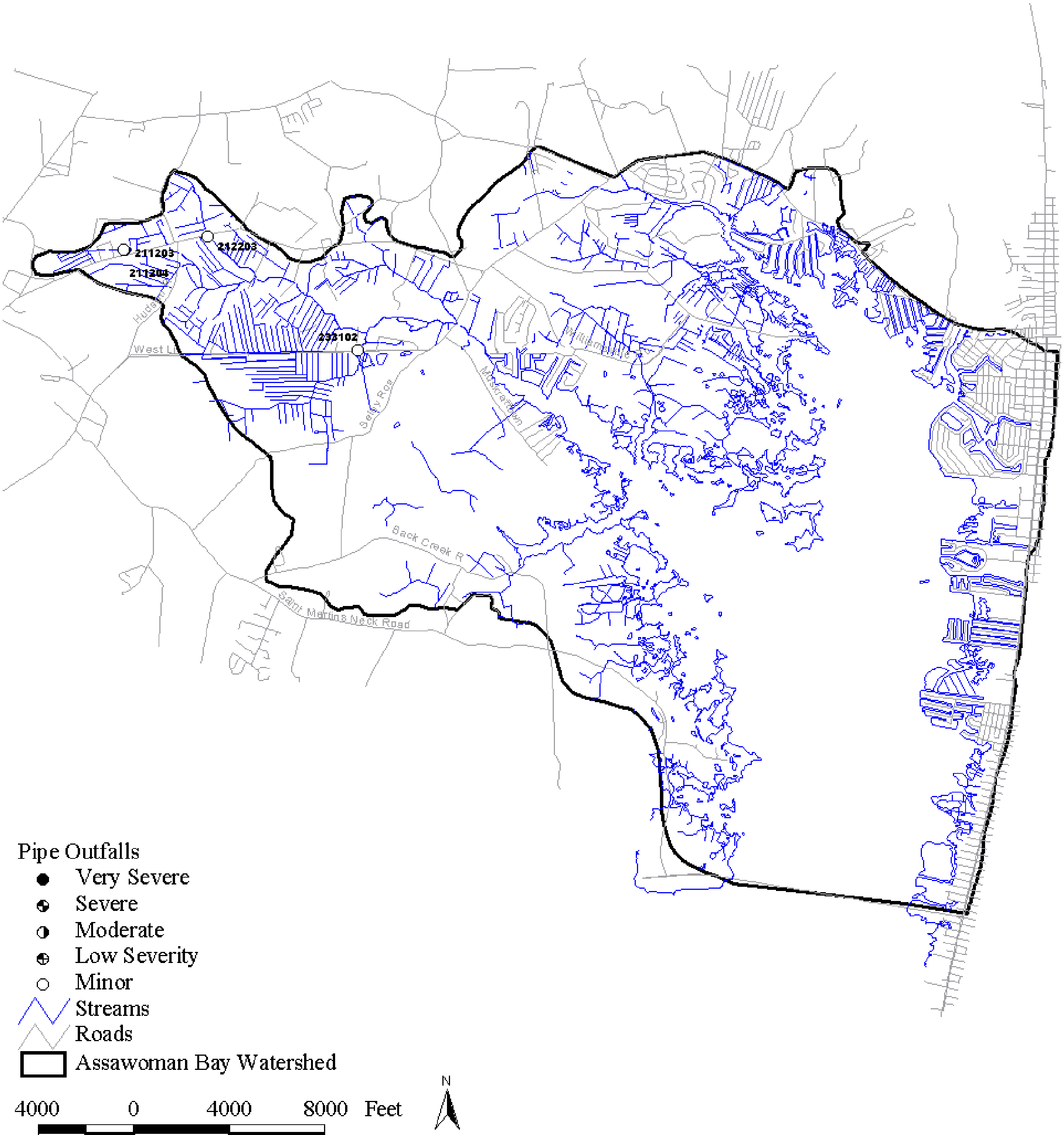

Figure 8b: Map showing the locations of the pipe outfalls in the Assawoman Bay Watershed

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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 4 unusual conditions and 4 comments throughout the Assawoman Bay watershed. The severity and location of unusual condition sites is shown in Figure 9b. The four unusual conditions sites were where there was excessive algae.

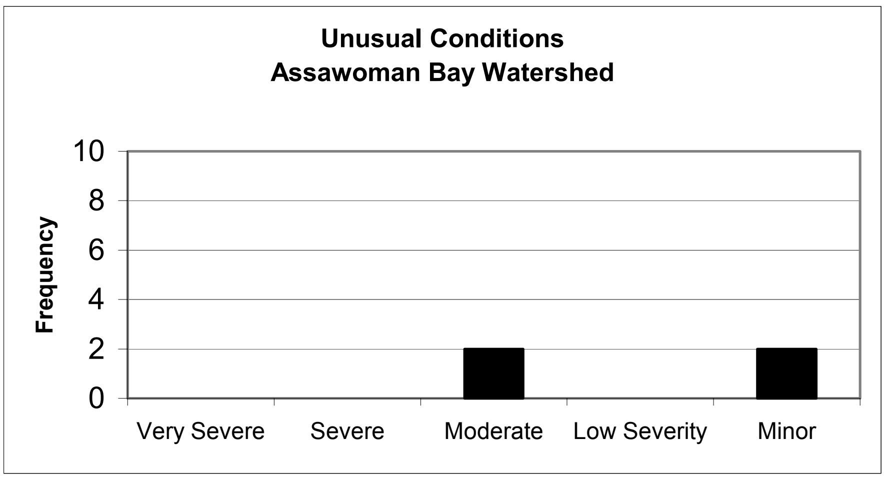

Figure 9a. Histograph showing the frequency of severity ratings given to unusual condition sites during the Assawoman Bay SCA survey.

Unusual Conditions

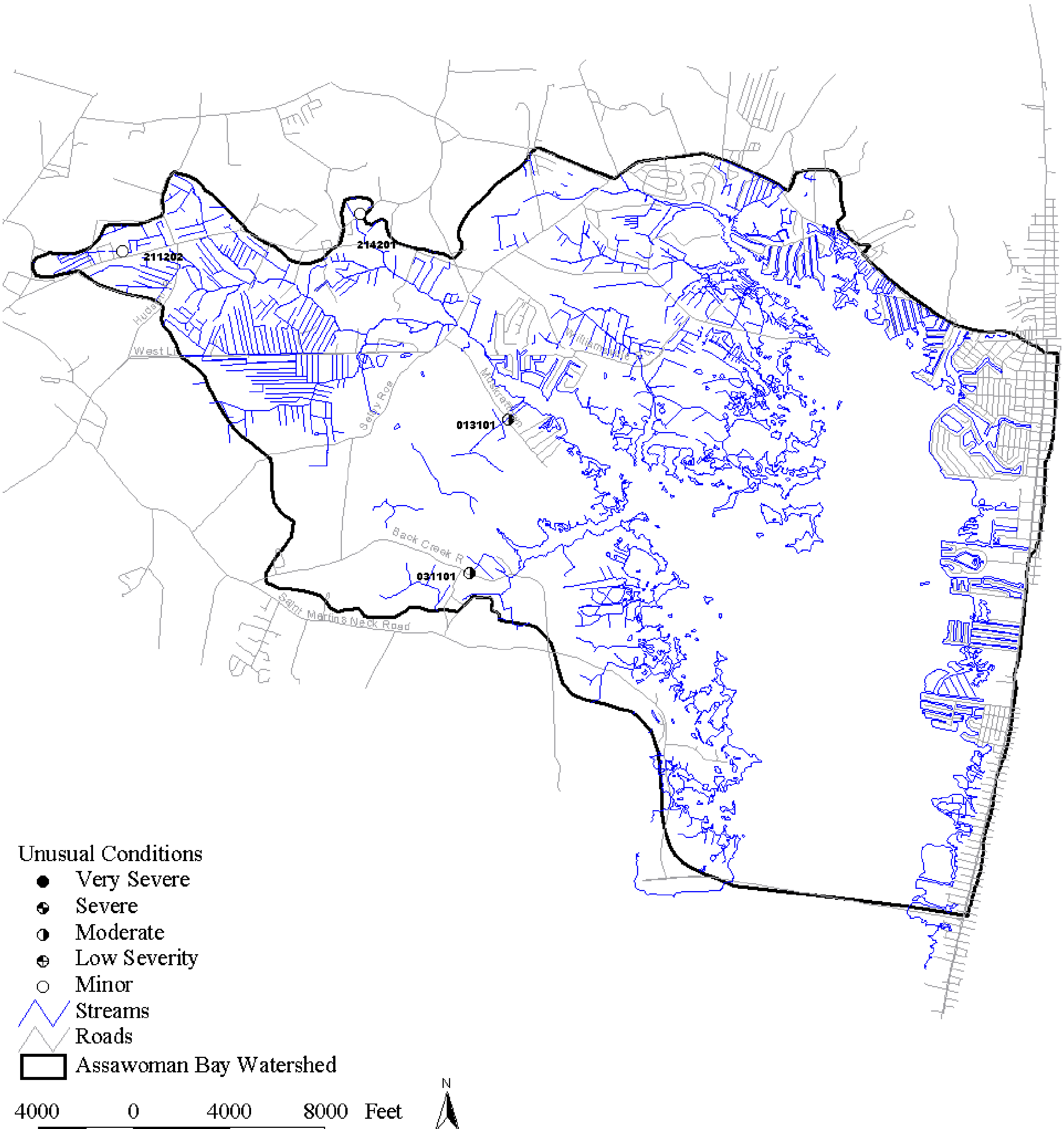

Figure 9b: Map showing the locations of the unusual condition sites in the Assawoman Bay Watershed

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In/Near Stream Construction Sites

If in or near stream construction projects cause major disturbances inside or near the stream corridor at the time of the survey, field teams note their location and record any effect on the stream corridor. Survey teams report evidence of inadequate sediment control measures and any sediment pollution from the site affecting the stream. Locations of in- or near-stream construction site is shown in Figure 10a.

Only one construction sites affected a nearby stream during the time of the survey. This is the site of a new golf course. The site was rated minor in severity and the location is shown in Figure 10.

Construction

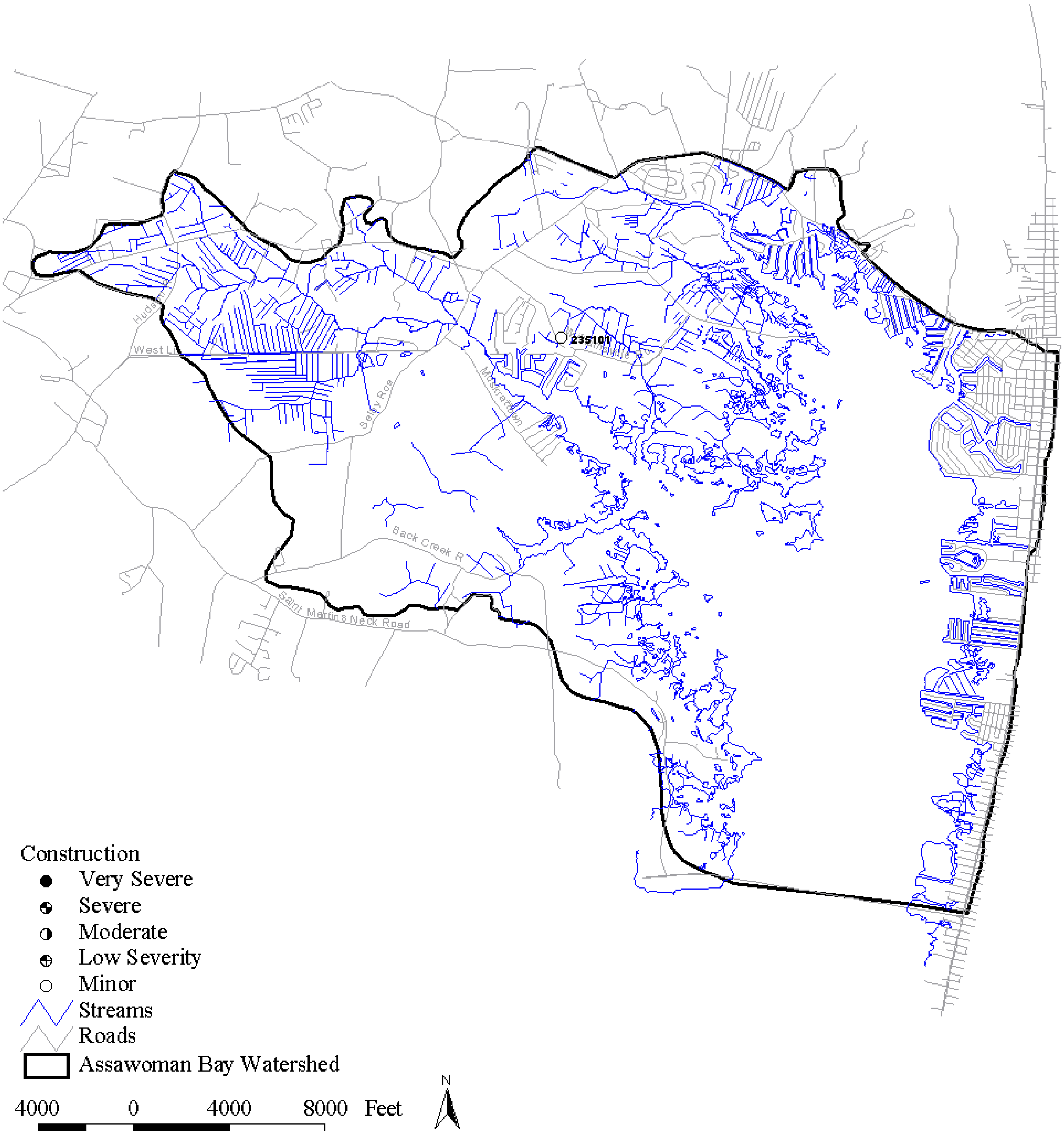

Figure 10: Map showing the locations of the construction site in the Assawoman Bay Watershed

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Trash Dumping

Trash dumping sites are places where large amounts of trash are inside the stream corridor, either as a site of deliberate dumping or as a place where trash tends to accumulate (often a result of storm drainage). Site severity rankings are based on size, contents of trash, and potential impact on the stream.

Survey crews found one trash dumping site (Figure 11). Site 224101 was construction trash. It was rated minor in severity.

Trash Dumping

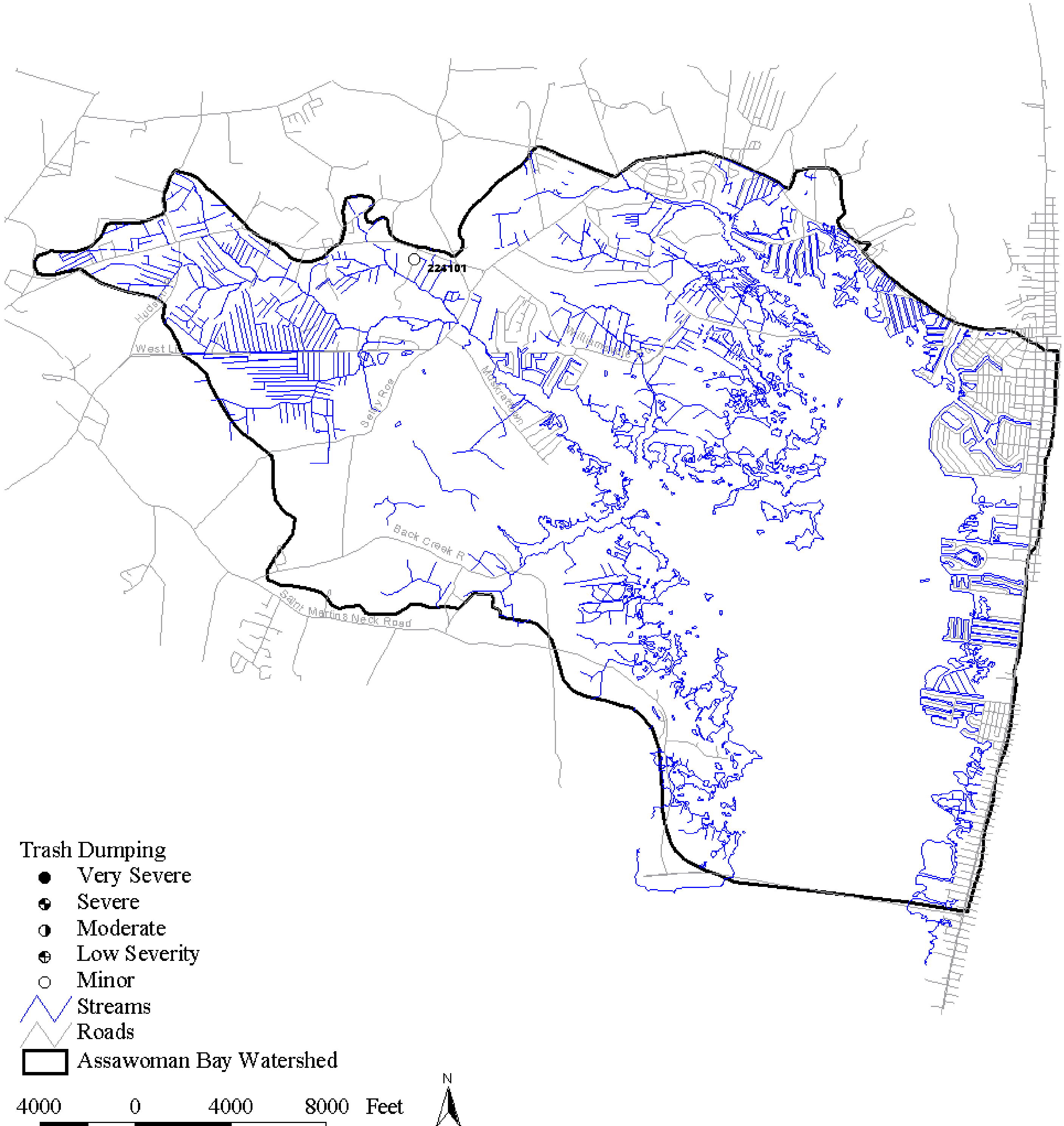

Figure 11: Map showing the locations of the trash dumping sites in the Assawoman Bay Watershed

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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
* Shelter for Fish
* Sediment Deposition
* Channel Flow Status
* Condition of Banks
* Embeddedness
* Channel Alteration
* Velocity and Depth Regime
* Bank Vegetation Protection
* 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 11 representative sites in the Assawoman Bay watershed.

Attachment sites for macroinvertebrates was averaged to be marginal to poor. In coastal plain streams there are limited gravel riffles for the macroinvertebrates. Embeddedness was found to be marginal to poor. The bottom substrate of the streams was sand or silt. Shelter for fish was marginal to suboptimal in most streams. Channel Alteration rates the amount of man-made changes to the stream channel. The streams in this watershed were found to be altered at most sites, though it was indicated that some areas may have been altered in the past but were no longer maintained. There was sediment deposition at a few of the representative sites. The condition of the banks were rated to be mostly optimal. There were a few areas of erosion present at some of the sites but these were small and healed over. For riparian vegetative zone width the sites were rated to be mostly marginal or poor. This indicates in the spots where the representative sites were, the areas were mostly not forested.

Representative Sites

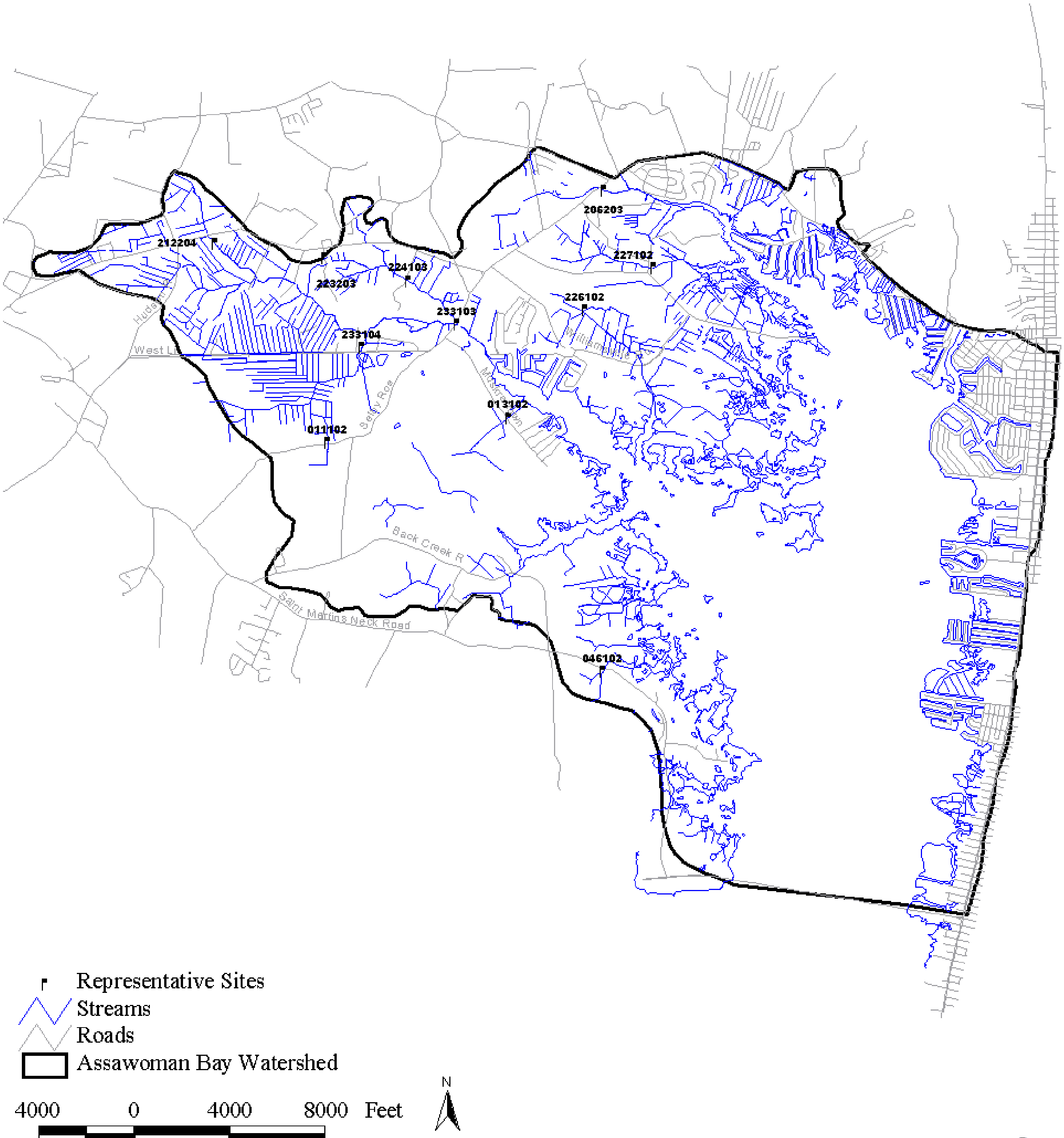

Figure 12: Map showing the locations of the representative sites in the Assawoman Bay Watershed

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DISCUSSION

The results of the Assawoman Bay 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 Worcester County to develop a Watershed Restoration Action Strategy (WRAS) for the Assawoman Bay 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 Assawoman Bay Watershed WRAS committee, which is developing a Watershed Restoration Action Strategy for the Assawoman Bay. Information on the Assawoman Bay Watershed Action Strategy can be found on the Department of Natural Resources' website (www.dnr.maryland.gov/wras).

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ACKNOWLEDGEMENTS

Without the hard work and dedication of the Maryland Conservation Corps, this survey would not have been possible. The crew chief during the survey was Angela Baldwin. The crewmembers were Melissa Markee, Claudia Padilla, Heidi Hanson, and Dan Sullivan.

Appendix A: Listing of Sites by Site Number

Appendix A- Assawoman Bay

Site	Problem	Severity	Correctability	Access	X- Coordinate	Y- Coordinate	Stream
011101	Channel Alteration	2	2	1	560871.69795	87558.22447	Greys Creek
011101	Inadequate Buffer	2	1	1	560871.69795	87558.22447	Greys Creek
011102	Representative Site				560871.69795	87558.22447	Greys Creek
012101	Channel Alteration	5	2	1	561533.18750	87927.24219	Greys Creek
012101	Inadequate Buffer	4	2	1	561533.18750	87927.24219	Greys Creek
012102	Channel Alteration	4	2	2	561948.11288	87551.84888	Back Creek
012102	Inadequate Buffer	4	2	2	561948.11288	87551.84888	Back Creek
013101	Channel Alteration	4	2	1	563162.46399	87878.08008	Greys Creek
013101	Inadequate Buffer	4	2	1	563162.46399	87878.08008	Greys Creek
013101	Unusual Condition	3	3	3	563162.46399	87878.08008	Greys Creek
013102	Representative Site				563162.46399	87878.08008	Greys Creek
030101	Channel Alteration	3	3	1	561618.72272	86592.05057	Back Creek
030101	Inadequate Buffer	4	2	1	561618.72272	86592.05057	Back Creek
031101	Channel Alteration	3	1	1	562685.49132	85936.13359	Back Creek
031101	Inadequate Buffer	5	1	1	562685.49132	85936.13359	Back Creek
031101	Unusual Condition	3	3	2	562685.49132	85936.13359	Back Creek
032101	Channel Alteration	5	2	1	563966.32390	86040.88994	Back Creek
032101	Inadequate Buffer	4	1	1	563966.32390	86040.88994	Back Creek
039101	Channel Alteration	4	1	1	562572.93787	85582.16324	Back Creek
039101	Erosion	4	1	1	562588.63102	85599.09605	Back Creek
039101	Inadequate Buffer	5	1	1	562572.93787	85582.16324	Back Creek
039102	Channel Alteration	4	1	2	563424.83597	85308.73930	Back Creek
039102	Inadequate Buffer	5	1	2	563424.83597	85308.73930	Back Creek
046101	Channel Alteration	4	3	1	564189.47489	84534.01869	Goose Creek
046101	Inadequate Buffer	4	3	1	564189.47489	84534.01869	Goose Creek
046102	Representative Site				564354.85328	84667.07296	Goose Creek
202201	Channel Alteration	5	1	2	558900.99260	90979.73490	Greys Creek
202201	Erosion	5	3	4	558917.65249	90975.37871	Greys Creek
202201	Inadequate Buffer	5	2	2	558900.99260	90979.73490	Greys Creek
205101	Channel Alteration	5	2	1	563375.04635	91055.84222	Roy Creek
205101	Inadequate Buffer	5	2	1	563375.04635	91055.84222	Roy Creek
206101	Channel Alteration	5	1	2	564811.04327	90777.92690	Roy Creek
206101	Inadequate Buffer	4	2	2	564668.37588	90771.37636	Roy Creek
206102	Channel Alteration	5	1	1	563900.30936	91005.19184	Roy Creek
206203	Representative Site				564370.29862	90769.17626	Roy Creek
207101	Channel Alteration	4	3	1	565838.52428	91116.72752	Roy Creek
207101	Inadequate Buffer	5	3	1	565838.52428	91116.72752	Roy Creek
208101	Channel Alteration	5	1	1	566921.07154	90978.64871	Roy Creek
208101	Inadequate Buffer	5	1	1	566921.07154	90978.64871	Roy Creek
208102	Channel Alteration	3	2	2	566447.27992	90859.04868	Roy Creek
208102	Inadequate Buffer	4	1	2	566447.27992	90859.04868	Roy Creek
211201	Channel Alteration	5	2	2	558147.11029	90260.59435	Greys Creek
211201	Inadequate Buffer	4	1	1	558147.11029	90260.59435	Greys Creek
211202	Channel Alteration	5	2	2	558283.45637	90006.49560	Greys Creek
211202	Inadequate Buffer	4	2	1	558283.45637	90006.49560	Greys Creek
211202	Unusual Condition	5	3	1	558273.42066	90004.47698	Greys Creek
211203	Pipe Outfall	5	1	1	558305.88926	90005.30057	Greys Creek
211204	Pipe Outfall	5	1	1	558287.04745	90007.26125	Greys Creek
212103	Channel Alteration	3	1	1	558832.04458	90486.50789	Greys Creek
212103	Inadequate Buffer	5	1	1	558832.04458	90486.50789	Greys Creek
212201	Channel Alteration	5	2	1	558807.51618	90116.55826	Greys Creek

Appendix A- Assawoman Bay

Site	Problem	Severity	Correctability	Access	X- Coordinate	Y- Coordinate	Stream
212201	Inadequate Buffer	4	2	1	558807.51618	90116.55826	Greys Creek
212202	Channel Alteration	5	1	1	559374.29724	90160.56387	Greys Creek
212202	Inadequate Buffer	4	3	1	559374.29724	90160.56387	Greys Creek
212203	Pipe Outfall	5	1	1	559355.38748	90180.48262	Greys Creek
212204	Representative Site				559434.42169	90090.78329	Greys Creek
213201	Channel Alteration	5	1	1	561204.17315	90459.64541	Buntings Branch
213201	Inadequate Buffer	4	2	2	561204.17315	90459.64541	Buntings Branch
214201	Channel Alteration	4	1	1	561340.96159	90155.54856	Buntings Branch
214201	Inadequate Buffer	4	2	2	561403.07818	90564.87819	Buntings Branch
214201	Unusual Condition	5	3	2	561292.87497	90480.73725	Buntings Branch
215101	Channel Alteration	5	1	1	563424.59516	90666.06045	Roy Creek
215102	Channel Alteration	5	1	1	563401.18425	90129.30732	Drum Creek
215102	Inadequate Buffer	5	1	1	563401.18425	90129.30732	Drum Creek
216101	Channel Alteration	3	1	1	563811.72068	90270.19066	Drum Creek
216101	Inadequate Buffer	4	1	1	563811.72068	90270.19066	Drum Creek
217101	Comment				565381.89158	90525.43196	Drum Creek
218101	Comment				567191.42788	90328.75485	Roy Creek
218102	Inadequate Buffer	5	3	1	566740.94948	90528.63151	Roy Creek
218103	Inadequate Buffer	5	2	1	566679.75639	90542.19768	Roy Creek
218104	Channel Alteration	5	2	2	566736.68486	90472.07706	Roy Creek
221201	Channel Alteration	5	1	1	558722.76538	89421.95149	Greys Creek
221201	Inadequate Buffer	5	1	1	558722.76538	89421.95149	Greys Creek
221202	Channel Alteration	5	4	1	557877.47106	89709.95452	Greys Creek
221202	Inadequate Buffer	5	3	1	557877.47106	89709.95452	Greys Creek
222102	Channel Alteration	3	2	1	559795.14229	89599.70276	Greys Creek
222103	Channel Alteration	3	2	1	559179.64494	89214.50524	Greys Creek
222103	Inadequate Buffer	2	2	1	559795.14229	89599.70276	Greys Creek
222201	Channel Alteration	5	2	2	559945.81846	89685.21316	Greys Creek
222201	Inadequate Buffer	4	2	2	559179.64494	89214.50524	Greys Creek
223201	Channel Alteration	5	1	2	560828.54287	89902.08646	Greys Creek
223201	Inadequate Buffer	5	1	1	559945.81846	89685.21316	Greys Creek
223202	Channel Alteration	5	1	2	560329.54319	89639.19739	Greys Creek
223202	Erosion	5	4	2	560471.81302	89568.75379	Greys Creek
223202	Inadequate Buffer	5	2	1	560828.54287	89902.08646	Greys Creek
223203	Representative Site				560828.54287	89902.08646	Greys Creek
224101	Trash Dumping	5	1	1	561971.25584	89880.27284	Buntings Branch
224102	Channel Alteration	2	1	1	561891.84452	89618.68731	Buntings Branch
224102	Inadequate Buffer	5	1	1	561891.84452	89618.68731	Buntings Branch
224103	Representative Site				561891.84452	89618.68731	Buntings Branch
225101	Channel Alteration	4	1	1	562744.85549	89351.03890	Greys Creek
225101	Inadequate Buffer	4	1	1	562744.85549	89351.03890	Greys Creek
226101	Channel Alteration	4	2	2	564132.69006	89247.52557	Swan Gulf
226101	Inadequate Buffer	5	2	2	564132.69006	89247.52557	Swan Gulf
226102	Representative Site				564132.69006	89247.52557	Swan Gulf
227101	Channel Alteration	5	3	1	565003.48240	89786.11244	Drum Creek
227101	Inadequate Buffer	4	3	2	565003.48240	89786.11244	Drum Creek
227102	Representative Site				565003.48240	89786.11244	Drum Creek
229101	Comment				567910.35131	89711.58441	Roy Creek
232101	Channel Alteration	1	2	1	560060.49467	88746.90317	Greys Creek
232101	Inadequate Buffer	1	2	1	560060.49467	88746.90317	Greys Creek
233101	Erosion	5	1	4	561372.51854	88959.39148	Greys Creek

Appendix A- Assawoman Bay

Site	Problem	Severity	Correctability	Access	X- Coordinate	Y- Coordinate	Stream
233101	Inadequate Buffer	3	1	4	561372.51854	88959.39148	Greys Creek
233102	Inadequate Buffer	3	2	1	561271.74183	88727.81387	Greys Creek
233102	Pipe Outfall	5	1	1	561271.74183	88727.81387	Greys Creek
233103	Representative Site				562514.68421	89065.88654	Greys Creek
233104	Representative Site				561303.66041	88773.16209	Greys Creek
234101	Channel Alteration	5	1	1	562595.06760	88771.55702	Greys Creek
234101	Inadequate Buffer	5	1	1	562595.06760	88771.55702	Greys Creek
234102	Channel Alteration	5	1	2	562938.59229	88893.70416	Greys Creek
234103	Channel Alteration	5	1	2	563544.47427	88971.21836	Swan Gulf
234103	Inadequate Buffer	3	3	2	563544.47427	88971.21836	Swan Gulf
234104	Comment				563491.96268	88859.50955	Swan Gulf
235101	Channel Alteration	5	2	1	563831.53755	88892.82454	Swan Gulf
235101	Construction			5	563835.33635	88903.64423	Swan Gulf
235101	Inadequate Buffer	5	2	1	563831.53755	88892.82454	Swan Gulf
236101	Channel Alteration	3	1	1	565225.08176	88887.03206	Swan Gulf
236101	Inadequate Buffer	5	1	1	565225.08176	88887.03206	Swan Gulf

Appendix B: Listing of Sites by Problem Category

Channel Alterations

Problem	Site	Type	Bottom Width(in)	Length(ft)	Perennial Flow	Sedimentation	Veg in Channel	Road Crossing	Length Above(ft)	Length Below(ft)	Severity	Correctability	Access
Channel Alteration	232101	Earth channel	60	52000	No	No	Yes	No			1	2	1
Channel Alteration	011101	Earth channel	36	14600	No	No	Yes	No			2	2	1
Channel Alteration	224102	Earth channel	24	16000	Yes	Yes	Yes	No			2	1	1
Channel Alteration	030101	Earth channel	48	3600	Yes	Yes	Yes	No			3	3	1
Channel Alteration	031101	Earth channel	36	4500	Yes	Yes	Yes	No			3	1	1
Channel Alteration	208102	Earth channel	48	12000	No	No	Yes	No			3	2	2
Channel Alteration	212103	Earth channel	36	4000	Yes	Yes	Yes	No			3	1	1
Channel Alteration	216101	Earth channel	72	4600	Yes	No	Yes	No			3	1	1
Channel Alteration	222102	Earth channel	24	6000	Yes	No	No	No			3	2	1
Channel Alteration	222103	Earth channel	24	6300	Yes	No	No	No			3	2	1
Channel Alteration	236101	Earth channel	48	7000	Yes	No	Yes	No			3	1	1
Channel Alteration	012102	Earth channel	48	2700	Yes	Yes	Yes	No			4	2	2
Channel Alteration	013101	Earth channel	48	2700	Yes	Yes	Yes	No			4	2	1
Channel Alteration	039101	Earth channel	60	3200	Yes	Yes	No	No			4	1	1
Channel Alteration	039102	Earth channel	36	2700	Yes	Yes	Yes	No			4	1	2
Channel Alteration	046101	Earth channel	60	3500	Yes	No	No	No			4	3	1
Channel Alteration	207101	Earth channel	60	2400	Yes	No	No	No			4	3	1
Channel Alteration	214201	Earth channel	24	3100	Yes	No	No	No			4	1	1
Channel Alteration	225101	Earth channel	24	2300	No	Yes	Yes	No			4	1	1
Channel Alteration	226101	Earth channel	96	3600	Yes	Yes	Yes	No			4	2	2
Channel Alteration	012101	Earth channel	48	3500	No	No	Yes	No			5	2	1
Channel Alteration	032101	Earth channel	48	750	Yes	Yes	Yes	No			5	2	1
Channel Alteration	202201	Earth channel	24	2000	Yes	No	No	No			5	1	2
Channel Alteration	205101	Earth channel	30	1700	Yes	No	No	No			5	2	1
Channel Alteration	206101	Earth channel	48	3500	Yes	Yes	Yes	No			5	1	2
Channel Alteration	206102	Earth channel	24	560	No	No	Yes	No			5	1	1
Channel Alteration	208101	Earth channel	60	1000	No	Yes	Yes	No			5	1	1
Channel Alteration	211201	Earth channel	48	1600	Yes	No	No	No			5	2	2
Channel Alteration	211202	Earth channel	48	2200	Yes	No	Yes	No			5	2	2
Channel Alteration	212201	Earth channel	24	1200	Yes	No	No	No			5	2	1
Channel Alteration	212202	Earth channel	36	6600	Yes	Yes	Yes	No			5	1	1
Channel Alteration	213201	Earth channel	18	600	Yes	No	No	No			5	1	1
Channel Alteration	215101	Earth channel	30	2100	Yes	No	No	No			5	1	1
Channel Alteration	215102	Earth channel	65	440	Yes	No	Yes	No			5	1	1
Channel Alteration	218104	Earth channel	60	2300	Yes	Yes	No	No			5	2	2
Channel Alteration	221201	Earth channel	36	3000	Yes	No	No	No			5	1	1
Channel Alteration	221202	Earth channel	24	2200	Yes	No	Yes	No			5	4	1

Channel Alterations

Problem	Site	Type	Bottom Width(in)	Length(ft)	Perennial Flow	Sedimentation	Veg in Channel	Road Crossing	Length Above(ft)	Length Below(ft)	Severity	Correctability	Access
Channel Alteration	222201	Earth channel	28	5400	Yes	No	No	No			5	2	2
Channel Alteration	223201	Earth channel	12	2400	Yes	No	No	No			5	1	2
Channel Alteration	223202	Earth channel	24	2000	Yes	No	No	No			5	1	2
Channel Alteration	227101	Earth channel	120	8500	Yes	Yes	Yes	No			5	3	1
Channel Alteration	234101	Earth channel	24	700	Yes	Yes	Yes	No			5	1	1
Channel Alteration	234102	Earth channel	60	1700	Yes	Yes	No	No			5	1	2
Channel Alteration	234103	Earth channel	36	2200	Yes	Yes	Yes	No			5	1	2
Channel Alteration	235101	Earth channel	40	2000	Yes	No	Yes	No			5	2	1

Inadequate Buffers

Problem	Site	Sides	Unshaded	WidthLeft(ft)	WidthRight(ft)	LengthLeft(ft)	LengthRight(ft)	Land Use Left	Land Use Right	Recently Buffer?	Livestock	Severity	Correctability	Access	Wetland
Inadequate Buffer	232101	Both	Both	4	4	52710	52710	Crop field	Crop field	No	No	1	2	1	3
Inadequate Buffer	011101	Both	Both	3	3	6800	14000	Crop field	Crop field	No	No	2	1	1	3
Inadequate Buffer	222103	Both	Both	0	0	6000	6000	Crop field	Crop field	No	No	2	2	1	4
Inadequate Buffer	233101	Right	Right		0	1200	1200	Forest	Shrubs/Small trees	No	No	3	1	4	4
Inadequate Buffer	233102	Left	Left	3			2100	Crop field	Forest	No	No	3	2	1	3
Inadequate Buffer	234103	Right	Right		0		2200	Forest	Crop field	No	No	3	3	2	2
Inadequate Buffer	012101	Both	Right	10	1	3500	3500	Crop field	Crop field	No	No	4	2	1	3
Inadequate Buffer	012102	Right	Right		3		2000	Forest	Crop field	No	No	4	2	2	3
Inadequate Buffer	013101	Both	Left	25	5	2500	2500	Shrubs/Small trees	Crop field	No	No	4	2	1	3
Inadequate Buffer	030101	Both	Both	4	4	3600	3600	Crop field	Crop field	No	No	4	2	1	3
Inadequate Buffer	032101	Both	Both	2	2	600	600	Crop field	Crop field	No	No	4	1	1	3
Inadequate Buffer	046101	Left	Left	0		3500		Other	Forest	No	No	4	3	1	2
Inadequate Buffer	206101	Both	Both	10	10	1200	1200	Lawn	Lawn	No	No	4	2	2	2
Inadequate Buffer	208102	Both	Both	0	0	12000	12000	Crop field	Crop field	No	No	4	1	2	2
Inadequate Buffer	211201	Right	Right		10		1700	Forest	Lawn	No	No	4	1	1	2
Inadequate Buffer	211202	Both	Neither	0	0	2200	2200	Lawn	Shrubs/Small trees	No	No	4	2	1	3
Inadequate Buffer	212201	Both	Both	0	0	1000	1000	Crop field	Lawn	No	No	4	2	1	3
Inadequate Buffer	212202	Both	Both	0	0	6600	6600	Crop field	Crop field	No	No	4	3	1	3
Inadequate Buffer	213201	Both	Right	0	0	500	500	Crop field	Shrubs/Small trees	No	No	4	2	2	3
Inadequate Buffer	214201	Right	Right		0		800	Forest	Paved	No	No	4	2	2	3
Inadequate Buffer	216101	Both	Both	0	0	4600	4600	Crop field	Crop field	No	No	4	1	1	3
Inadequate Buffer	222201	Right	Right		0		5400	Forest	Crop field	No	No	4	2	2	4
Inadequate Buffer	225101	Both	Both	0	0	2300	2300	Crop field	Crop field	No	No	4	1	1	4
Inadequate Buffer	227101	Both	Both	3	3	8500	8500	Other	Other	No	No	4	3	2	2
Inadequate Buffer	031101	Both	Both	0	0	4500	4500	Crop field	Crop field	No	No	5	1	1	2
Inadequate Buffer	039101	Right	Left		0		3200	Forest	Lawn	No	No	5	1	1	3
Inadequate Buffer	039102	Right	Right		0		2700	Forest	Lawn	No	No	5	1	2	2
Inadequate Buffer	202201	Both	Both	0	0	2000	2000	Crop field	Crop field	No	No	5	2	2	5
Inadequate Buffer	205101	Both	Both	0	0	1600	1600	Crop field	Paved	No	No	5	2	1	2
Inadequate Buffer	207101	Both	Both	5	5	2300	2300	Lawn	Paved	No	No	5	3	1	4
Inadequate Buffer	208101	Both	Both	0	0	850	850	Crop field	Crop field	No	No	5	1	1	3
Inadequate Buffer	212103	Both	Neither	2	2	4000	4000	Pasture	Crop field	No	Horses	5	1	1	1
Inadequate Buffer	215102	Both	Both	0	0	440	440	Crop field	Crop field	No	No	5	1	1	3
Inadequate Buffer	218102	Both	Both	0	0	880	880	Lawn	Lawn	No	No	5	3	1	3
Inadequate Buffer	218103	Right	Right		0		1200	Forest	Lawn	No	No	5	2	1	3
Inadequate Buffer	221201	Both	Both	0	0	2400	2400	Crop field	Crop field	No	No	5	1	1	3
Inadequate Buffer	221202	Both	Both	0	0	2200	2200	Crop field	Crop field	No	Yes	5	3	1	4

Inadequate Buffers

Problem	Site	Sides	Unshaded	WidthLeft(ft)	WidthRight(ft)	LengthLeft(ft)	LengthRight(ft)	Land Use Left	Land Use Right	Recently Buffer?	Livestock	Severity	Correctability	Access	Wetland
Inadequate Buffer	223201	Both	Both	0	0	2400	2400	Crop field	Lawn	No	No	5	1	1	3
Inadequate Buffer	223202	Both	Both	0	0	2000	2000	Crop field	Crop field	No	No	5	2	1	3
Inadequate Buffer	224102	Both	Left	0	25	16000	16000	Crop field	Crop field	No	No	5	1	1	1
Inadequate Buffer	226101	Both	Both	3	3	3600	3600	Crop field	Lawn	No	No	5	2	2	3
Inadequate Buffer	234101	Both	Neither	15	15	700		Crop field	Shrubs/Small trees	No	No	5	1	1	2
Inadequate Buffer	235101	Both	Both	0	0	2000	2000	Crop field	Other	No	No	5	2	1	3
Inadequate Buffer	236101	Both	Both	0	0	7100	7100	Shrubs/Small trees	Paved	No	No	5	1	1	1

Erosion

Problem	Site	Type	Possible Cause	Length(ft)	Height(ft)	Land use left	Land use right	Infrastructure Threatened?	Describe	Severity	Correctability	Access
Erosion	039101	Widening	Unknown	50	5	Forest	Lawn	No		4	1	1
Erosion	202201	Downcutting	Below channelization	30	4	Crop field	Crop field	No		5	3	4
Erosion	223202	Widening	Below channelization	50	4	Crop field	Crop field	No		5	4	2
Erosion	233101	Downcutting	Bend at steep slope	10	9	Forest	Shrubs/Small trees	No		5	1	4

Pipe Outfalls

Problem	Site	Outfall Type	Pipe Type	Location of Pipe	Diameter (in)	Channel Width	Discharge	Color	Odor	Severity	Correctability	Access
Pipe Outfall	211203	Stormwater	Plastic	Left bank	4		No			5	1	1
Pipe Outfall	211204	Stormwater	Corrugated Metal	Right bank	12		No			5	1	1
Pipe Outfall	212203	Stormwater	Corrugated Metal	Left bank	18		No			5	1	1
Pipe Outfall	233102	Stormwater	Plastic	Left bank	12		No			5	1	1

Unusual Conditions

Type	Site	Describe	Description	Potential Cause	Severity	Correctability	Access
Unusual Condition	013101	Algae			3	3	3
Unusual Condition	031101	Algae			3	3	2
Unusual Condition	211202	Excessive algae			5	3	1
Unusual Condition	214201	Excessive Algae			5	3	2
Comment	217101		Tidal area, pond feeds into Roy Creek				
Comment	218101		TIDAL MARSH				
Comment	229101		TIDAL MARSH				
Comment	234104		Channel no longer exists, wooded leaf pack in dry shallow ditch				

In/Near Stream Construction

Problem	Site	Type of Activity	Sediment Control	Why, if inadequate	Excess Sediment?	Length	Company	Location	Severity
Construction	235101	Golf Course	Adequate		No	1900	CMF	Off Road 395	5

Trash Dumping

Problem	Site	Type	Truckloads	Other measure	Extent	Volunteer Project?	Owner Type	Owner Name	Severity	Correctability	Access
Trash Dumping	224101	Construction	1		Single	No	Unknown		5	1	1

Representative Sites A

Problem	Site	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Bank Vegetation	Bank Condition	Riparian Vegetation
Buntings Branch											
Representative Site	224103	Poor	Marginal	Suboptimal	Marginal	Suboptimal	Marginal	Optimal	Suboptimal	Optimal	Marginal
Drum Creek											
Representative Site	227102	Marginal	Marginal	Marginal	Marginal	Optimal	Marginal	Optimal	Optimal	Optimal	Poor
Goose Creek											
Representative Site	046102	Poor	Poor	Marginal	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal
Greys Creek											
Representative Site	011102	Poor	Poor	Poor	Poor	Optimal	Marginal	Suboptimal	Optimal	Optimal	Poor
Representative Site	013102	Marginal	Poor	Marginal	Suboptimal	Optimal	Marginal	Optimal	Suboptimal	Suboptimal	Marginal
Representative Site	212204	Poor	Poor	Marginal	Poor	Poor	Poor	Marginal	Optimal	Optimal	Poor
Representative Site	223203	Marginal	Marginal	Poor	Poor	Optimal	Marginal	Optimal	Suboptimal	Suboptimal	Poor
Representative Site	233103	Marginal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal
Representative Site	233104	Marginal	Marginal	Suboptimal	Marginal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Marginal
Roy Creek											
Representative Site	206203	Poor	Poor	Marginal	Marginal	Poor	Poor	Dry	Optimal	Optimal	Poor
Swan Gulf											
Representative Site	226102	Poor	Poor	Suboptimal	Suboptimal	Optimal	Marginal	Optimal	Optimal	Optimal	Marginal

Representative Sites B

Problem	Site	Width Riffle	Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
Buntings Branch								
Representative Site	224103		36			5		Sand
Drum Creek								
Representative Site	227102		120			24		Sand
Goose Creek								
Representative Site	046102		40			24		Silts
Greys Creek								
Representative Site	011102		24			3		Silts
Representative Site	013102		48	36		3	8	Sand
Representative Site	212204		54	54		6	24	Silts
Representative Site	223203		60			10		Sand
Representative Site	233103	300			36			Sand
Representative Site	233104		75			12		Silts
Roy Creek								
Representative Site	206203							Silts
Swan Gulf								
Representative Site	226102			72			14	Sand