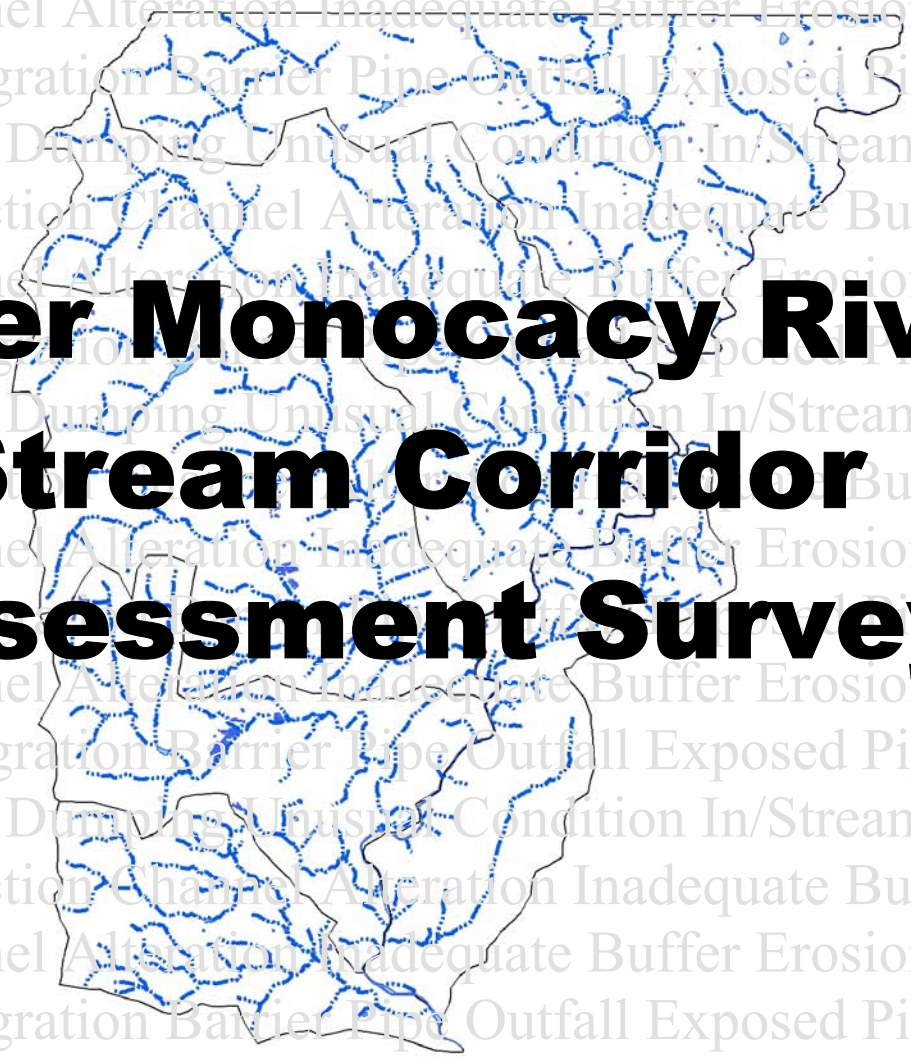

Upper Monocacy River Stream Corridor Assessment Survey

Watershed Assessment and Targeting Division
Watershed Services
Maryland Department of Natural Resources
November 2004

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UPPER MONOCACY RIVER STREAM CORRIDOR ASSESSMENT

BY

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Watershed Assessment and Targeting Division
Watershed Services Unit
Maryland Department of Natural Resources

2004

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.

SUMMARY

In 1998, the Maryland Clean Water Action Plan identified the Monocacy 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 Natural Resources (DNR) and Frederick County formed a partnership to develop a Watershed Restoration Action Strategy (WRAS) for the Lower Monocacy River (completed June 2004) and the Upper Monocacy River watershed (begun July 2004). The following Stream Corridor Assessment (SCA) survey is part of the WRAS development process for the Upper Monocacy River (Figure 1).

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 Unit, the survey is a watershed management tool to identify environmental problems and helps 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 Upper Monocacy River began in March 2004 and was completed by April 2004. The Upper Monocacy River watershed is divided into six subwatersheds: Fishing Creek (25.5 mi^2), Glade Creek (23.1 mi^2), Hunting Creek (41.06 mi^2), Owens Creek (46.06 mi^2), Toms Creek (45.9 mi^2), and Tuscarora Creek (15.28 mi^2). To complete the survey, field crews walked over 130 miles of streams within these subwatersheds. Due to the size of the watershed, the Upper Monocacy WRAS committee chose to conduct the SCA on specific stream reaches in each subwatershed (Figure 1a): Fishing Creek (19.52 miles), Glade Creek (18.02 miles), Hunting Creek (37.16 miles), Owens Creek (15.57 miles), Toms Creek (28.50 miles), and Tuscarora Creek (21.04 miles).

Over the streams assessed, survey teams identified 251 potential environmental problem sites. At the time of the survey, the most frequently observed potential problem sites were inadequately forested stream buffers, reported at 102 sites (67.51 miles on the left bank and 67.81 miles on the right bank), and erosion sites, reported at 49 sites (or 22.74 miles of stream). Both inadequate buffers and erosion sites ranked from very severe to minor in severity. Other potential environmental problems recorded during the survey included: 33 fish barriers, 24 pipe outfalls, 17 trash dumping sites, 11 channel alterations, 8 unusual conditions, 7 exposed pipes, and no in- or near-stream construction sites (Table 1). These sites all ranked from very severe to minor in severity. 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 54 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. Its potential common use among resource managers and land-use planners is to target specific sites for more in-depth upstream and upland analysis used to develop community restoration and Capital Improvement Projects. Results of

the present survey will be given to the Upper Monocacy Watershed WRAS committee, which is developing a Watershed Restoration Action Strategy. Information on the Upper Monocacy River Watershed Restoration Action Strategy can be found on the Department of Natural Resources' website http://www.dnr.maryland.gov/watersheds/wras.

ACKNOWLEDGEMENTS

Without the hard work and dedication of the National Civilian Community Corps, this survey would not have been possible. The crew chief during the survey was Stefanie Warner. The crewmembers were Sara Lander, Meuy Saechao, Nisa Karimi, Ali Nguyen, Micah Coach, Adam Malgren, Neal Schmidt, Emily "Danger" Scott-Texler, Dana Siebers, and Laura Hale.

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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 Monocacy River watershed. The Monocacy River watershed is contained within three counties in Maryland (Frederick, Carroll, and Montgomery) and one county in Pennsylvania (Adams). Within Frederick County, the watershed is divided into two subwatersheds: the Upper and the Lower Monocacy. The Lower Monocacy WRAS was completed in June 2004. The project area for the Upper Monocacy River watershed encompasses approximately 126,107 acres in Frederick County (Figure 1). It is further divided into six subwatersheds: Fishing Creek (16,340 acres), Glade Creek (14,785 acres), Hunting Creek (26,283 acres), Owens Creek (29,480 acres), Toms Creek (29,379 acres) and Tuscarora Creek (9,840 acres) (Figure 1a). In response to the findings of the Maryland Clean Water Action Plan, the Maryland Department of Natural Resources formed a partnership with Frederick County to assess and improve environmental conditions in the Upper Monocacy River watershed. The main goal of this partnership is to develop and implement a Watershed Restoration Action Strategy (WRAS) for the Upper Monocacy River.

According to Maryland Department of Planning land use data (2002), the land use in the Upper Monocacy River Watershed is approximately 45 percent forest, 45 percent agricultural land, and 10 percent developed. According to Table 7-12 from the 2003 Frederick County Annual Report for NPDES Storm Sewer System Permit # MD0068357, 8 percent of Fishing Creek, 12.3 percent of Glade Creek, 5.1 percent of Hunting Creek, 5.4 percent of Owens Creek, 8 percent of Toms Creek, and 21 percent of Tuscarora Creek have an urban land use. Figure 2 shows a digital orthophoto map of the watershed. Figure 3 shows the same watershed boundaries superimposed on a 7.5 minute USGS topographic quadrangle maps.

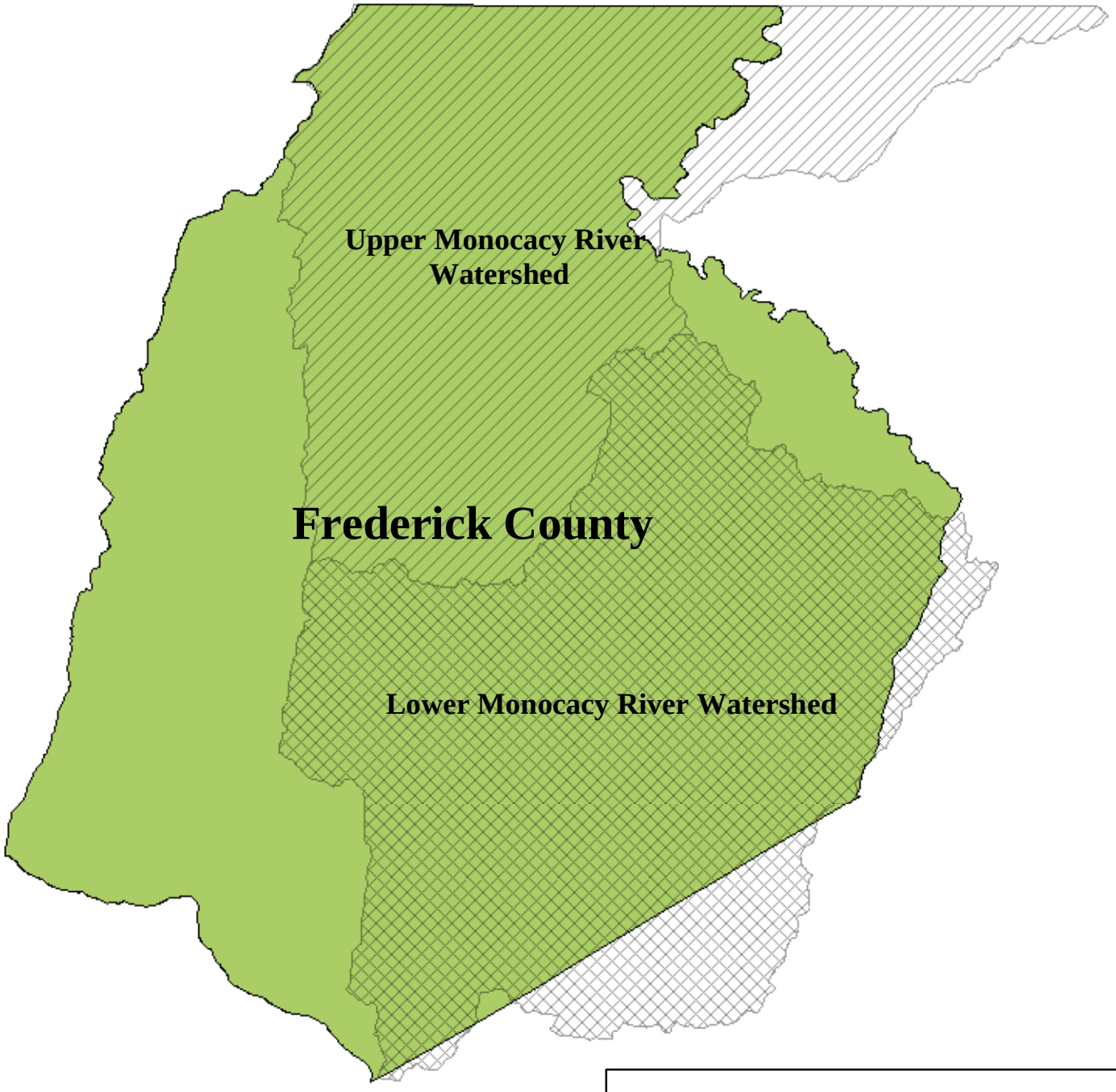
The first step in developing a Watershed Restoration Action Strategy for this watershed is to complete an overall assessment of the condition of the watershed and the streams it contains. This initial step was accomplished using three approaches. First, a watershed characterization was completed that compiles and analyzes existing water quality, land use, and living resource data about the watershed (Shanks, 2004). Secondly, a synoptic water quality survey, as well as surveys of the fish and macroinvertebrate communities, was conducted at selected stations throughout the Upper Monocacy watershed to provide information on the present condition of aquatic resources (Primrose, 2004). Lastly, a Stream Corridor Assessment (SCA) survey was completed for the watershed's stream network to provide specific information on the present location of potential environmental problems and restoration opportunities. This report details the results of the Upper Monocacy River Stream Corridor Assessment Survey and highlights potential restoration opportunities within the watershed based on the survey.

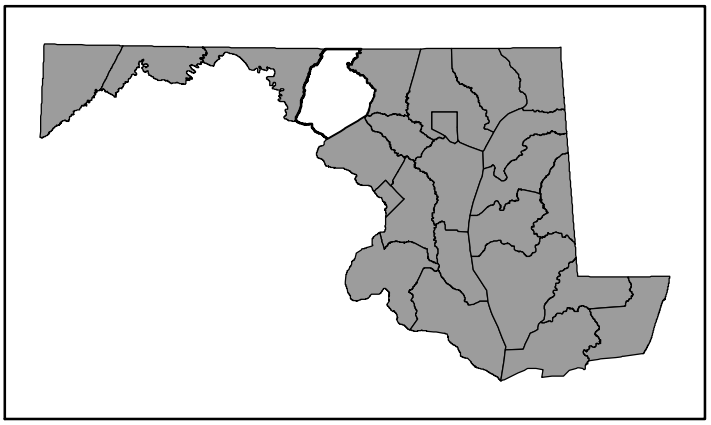
Survey teams walked over 130 miles of the Upper Monocacy River stream network from March to April 2004. At each site during the survey, field crews collected descriptive data, recorded the location on field maps, and took a photograph to document each potential environmental problem observed. As an aid 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.

To this end, the Maryland Department of Natural Resources is working with Frederick County to develop a Watershed Restoration Action Strategy (WRAS) of the Upper Monocacy 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 Upper Monocacy 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. All of the problems identified as part of the Upper Monocacy River Stream Corridor Assessment survey can be addressed through existing State or Local government programs.

Figure 1: Upper Monocacy River Watershed
Frederick County, Maryland





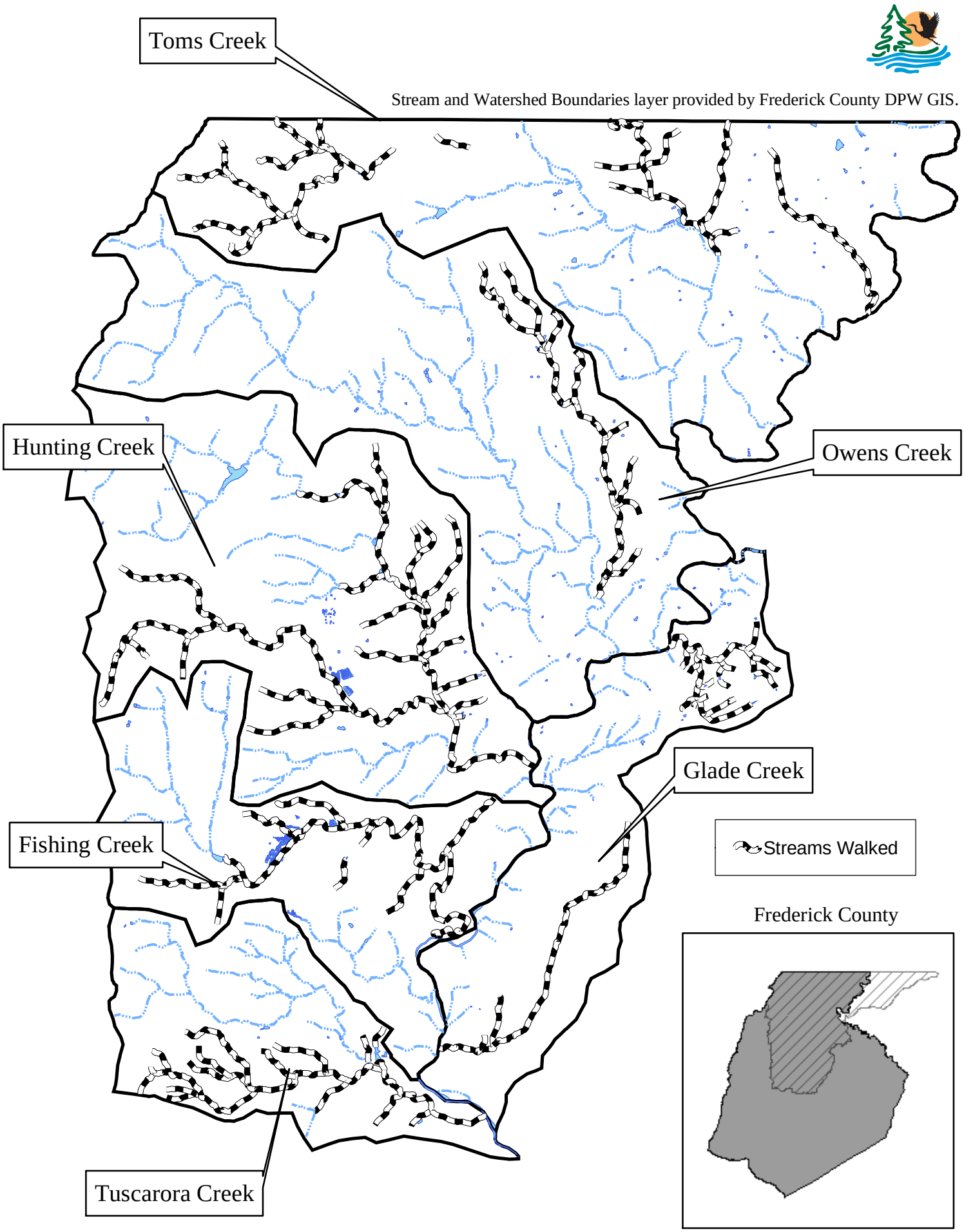
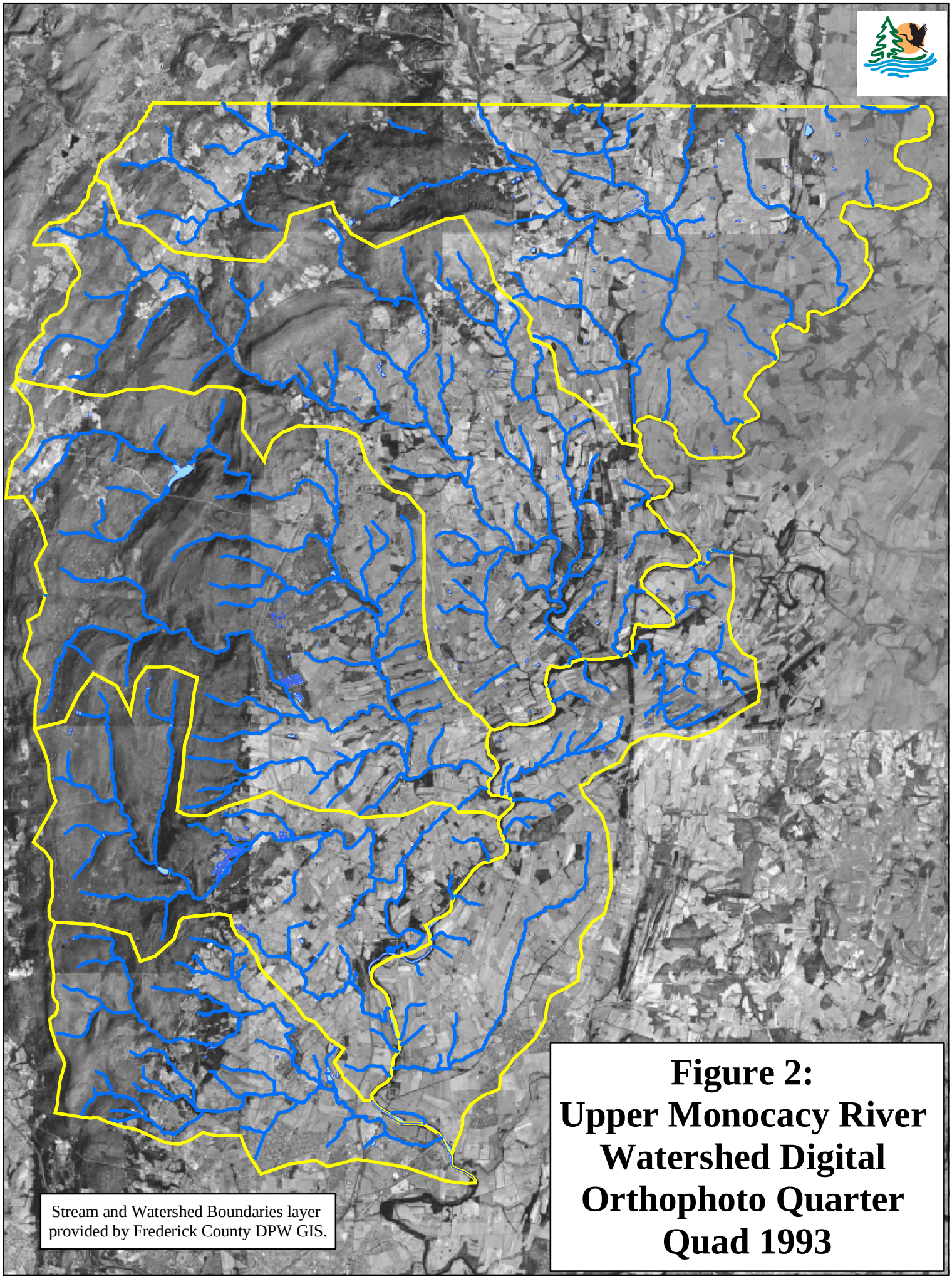


Figure 1a: Upper Monocacy River Subwatersheds



Stream and Watershed Boundaries layer provided by Frederick County DPW GIS.

Figure 2:
Upper Monocacy River Watershed Digital Orthophoto Quarter Quad 1993

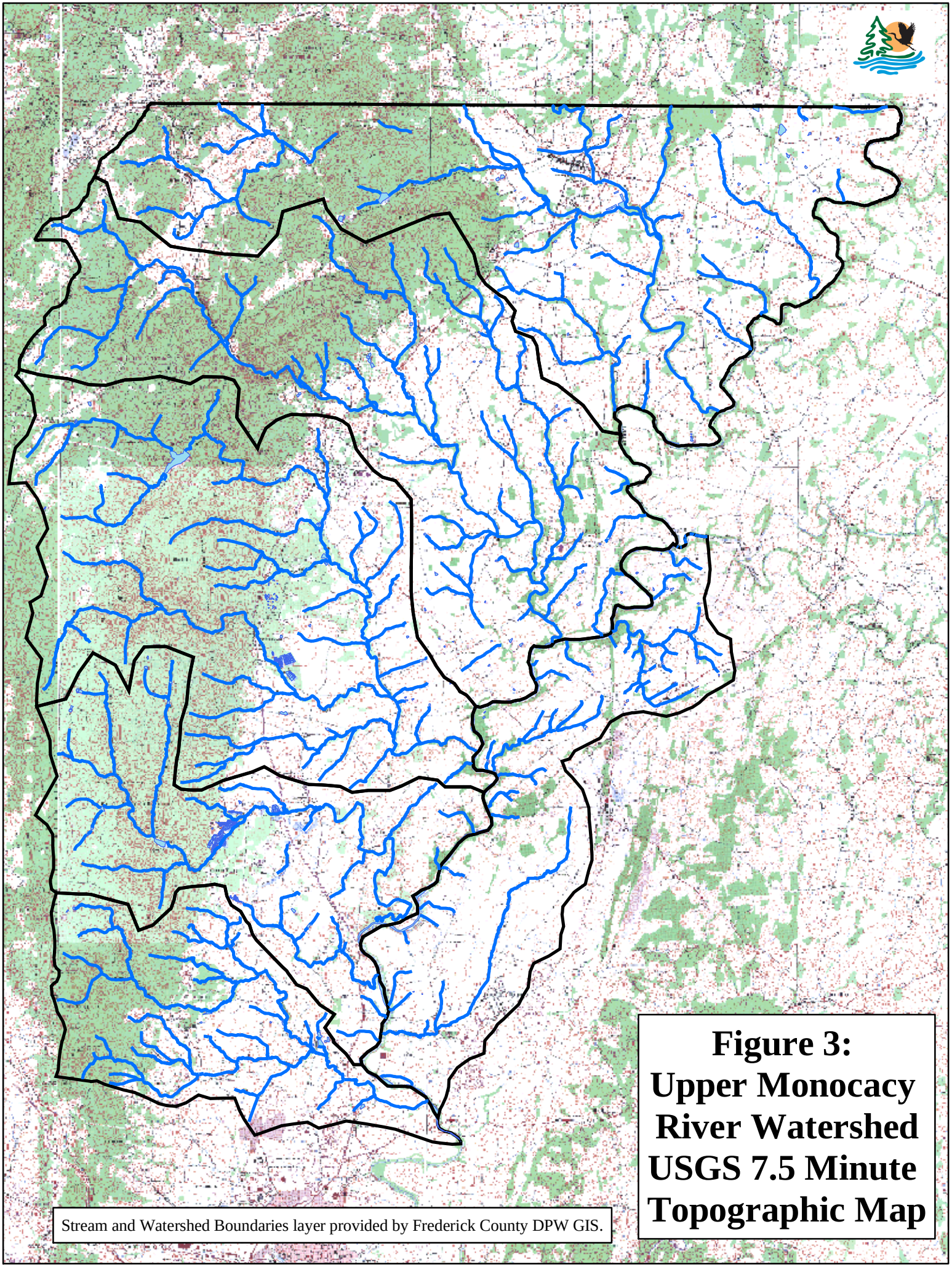


Figure 3: Upper Monocacy River Watershed USGS 7.5 Minute Topographic Map

Stream and Watershed Boundaries layer provided by Frederick County DPW GIS.

METHODS

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.

3. 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 passage, 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 National 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 at 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 National Civilian Community Corps (NCCC) has proven to be an ideal group to do this work in Maryland. The National Civilian Community Corps is part of the AmeriCorps Program, initiated to promote greater involvement of young volunteers in their communities and the environment. Volunteers with the NCCC are 17-25 years old and can have educational backgrounds ranging from high school to graduate degrees. With the proper training and supervision, NCCC 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 National Civilian Community Corps visit their website at http://www.americorps.org/nccc/index.html.

Prior to the start of the Upper Monocacy River SCA Survey, the members of the NCCC's Perry Point Crew 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 4-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 NCCC 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 is scheduled to be completed. Included with the letter is a postcard for the landowner to return giving permission for our crews

to enter their property. This letter also provided a phone number to call if individuals had any questions regarding the stream walk. In addition, survey crews were not to cross fence lines or enter any areas that were marked "No Trespassing" unless they had specific permission from the property owner, based on conditions set forth by the State Annotated Code.

The NCCC crew conducted field surveys of the Upper Monocacy River Watershed from March to April 2004. The survey teams walked a part of the watershed'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 passage 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 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 Protocols (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 others in the watershed 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 a pipe outfall 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 a 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 information from the field data sheets into a Microsoft Access database and verified the accuracy of the data. Field crews labeled and organized the 385 photographs taken during the survey by site number and placed them in folders in both print and digital form. Members of the Department of Natural Resources' Watershed Services Unit incorporated the map location, recorded data, and digitized photographs into the ArcGIS computer software. The GIS project is an electronic geodatabase 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 other digital geographic datasets available for features within the watershed. A final copy of the ArcView files are given to the Frederick County Division of Public Works for their use in developing a Watershed Restoration Action Strategy for the Upper Monocacy River watershed.

RESULTS

The Stream Corridor Assessment Survey identified 251 potential environmental problems within the Upper Monocacy River watershed (Table 1). At the time of the survey, the most frequently observed environmental problem in the watershed was inadequately forested stream buffers, reported at 102 sites. Other potential environmental problems recorded during the survey include: 49 erosion sites, 33 fish barriers, 24 pipe outfalls, 17 trash dumping sites, 11 channel alterations, 8 unusual conditions, 7 exposed pipes and no in- or near- stream construction sites. The survey teams also recorded representative data at 54 sites throughout the watershed. **Note:** Representative sites do not identify upstream/upland problem sources.

Table 1 presents a summary of survey results listed by identified problem, while Table 2 presents a summary by subwatershed. 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 Upper Monocacy River SCA Survey.

Identified Problems	Total Number of Sites	Total Estimated Length	Very Severe	Severe	Moderate	Low Severity	Minor	Unknown
Channel Alteration	11	N/A	0	0	0	5	6	0
Erosion Site	49	120,153 feet (22.74 miles)	1	9	16	12	11	0
Exposed Pipe	7	N/A	0	1	1	5	0	0
Fish Barrier	33	N/A	3	5	8	11	6	0
Inadequate Buffer	102	Left: 356,517 feet (67.51 miles) Right: 358,215 feet (67.81 miles) Total: 711,732 feet (178.98 miles)	7	18	33	31	13	0
Pipe Outfall	24	N/A	0	2	4	9	9	0
Trash Dumping	17	N/A	0	5	6	3	3	0
Unusual Condition	8	N/A	1	2	2	1	1	1
Total	**251**		**12**	**42**	**70**	**77**	**49**	**1**
Representative Sites	54							
Comments	8							

Table 2. Summary of results by major subwatershed.

Stream Name	Channel Alteration	Erosion Site	Exposed Pipe	Fish Barrier	In or Near Stream Construction	Inadequate Buffer	Pipe Outfall	Trash Dumping	Unusual Condition	TOTAL	Comment	Representative Site
Fishing Creek	6	13 sites (4.85 miles)	3	7	--	18 sites (left bank: 6.6 miles right bank: 7.4 miles)	5	3	4	59	--	11
Glade Creek	--	9 sites (3.9 miles)	1	5	--	15 sites (left bank: 14.92 miles right bank: 14.64 miles)	1	1	1	33	3	8
Hunting Creek	4	4 sites (0.84 miles)	--	4	--	16 sites (left bank: 10.64 miles right bank: 10.99 miles)	1	2	1	32	--	9
Owens Creek	--	7 sites (2.90 miles)	--	2	--	17 sites (left bank: 7.48 miles right bank: 7.01 miles)	2	3	1	32	1	8
Toms Creek	--	3 sites (2.16 miles)	1	8	--	20 sites (left bank: 15.03 miles right bank: 15.44 miles	13	4	--	49	--	12
Tuscarora Creek	1	13 sites (8.09 miles)	2	7	--	16 sites (left bank: 12.84 miles right bank: 12.33 miles)	2	4	1	46	4	6

Inadequate Buffers

Forests are the historically-occurring ecosystem around Maryland streams and are very important for maintaining stream health. 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 slows 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 can be 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 and benthic habitat. Maintaining healthy streams and forest buffers are important to reducing the nutrient and sediment loadings to the Chesapeake Bay. Because of the importance of forest stream buffers, the state of Maryland has set a goal of restoring 1,200 miles of forest stream buffers by the year 2010.

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.

Survey crews identified 102 inadequate buffer sites with a total left bank length of 356,517 feet (67.51 miles), right bank length of 358,215 feet (67.81 miles), and a total length of 711,732 feet (135.32 miles). Lengths of inadequate buffers are most often determined by land use. According to the Watershed Characterization for the Upper Monocacy (Shanks, 2004) the majority of the agricultural land is located in the eastern part of the watershed while the western part of the watershed is primarily forested with the developed land interspersed throughout.

Approximately 48.50% of all right banks and 48.29% of all left banks within the Upper Monocacy River watershed are inadequately buffered. Survey crews found inadequate buffers in all of the subwatersheds. However, the number of miles found in each watershed varied greatly with the greatest number of miles in Glade Creek and the least number of miles in Fishing Creek (Table 3). The severity and location of inadequate buffer sites are shown in Figures 4b-4g. The severity rankings ranged from very severe to minor and the frequency of these ratings is shown in Figure 4a.

As survey crews evaluate inadequate buffer sites, they are asked to consider wetland potential based on slope, bank height, and current conditions. The crews noted that 28 of the 102 inadequate buffer sites had the best wetland potential. They are also asked to determine if there is livestock access to the stream. Survey crews noted 15 sites in 4 subwatersheds: Fishing Creek (4), Glade Creek (6), Owens Creek (2), and Toms Creek (3) where livestock had stream access.

Wetland potential and livestock access are two important areas to consider for restoration as they both greatly affect the amount of nutrients reaching the stream. Wetlands help to slow the flow of water and act as a sponge, absorbing excess nutrients from the water, while livestock access can have many negative effects on the stream. Cattle and horses can cause additional erosion by compromising the stability of the banks at crossing points and thus increasing sediment levels. Nutrient and bacteria levels can also increase due to the increased possibility of animal feces entering the water. It is recommended that the Upper Monocacy WRAS committee investigate the possibility of restoring areas ideal for wetlands and work to fence livestock out of the stream.

Table 3: Inadequate buffer lengths and percent unbuffered for each subwatershed in the Upper Monocacy River Watershed

		Inadequate Buffer (miles)			Percent Inadequately Buffered	
Subwatershed	**Miles Walked**	**Right**	**Left**	**Total**	**Right**	**Left**
Fishing Creek	19.52	7.40	6.60	14.00	37.91	33.81
Glade Creek	18.02	14.64	14.92	29.56	81.24	82.80
Hunting Creek	37.16	10.99	10.64	21.63	29.57	28.63
Owens Creek	15.57	7.01	7.48	14.49	45.02	48.04
Toms Creek	28.50	15.44	15.03	30.47	54.18	52.74
Tuscarora Creek	21.04	12.33	12.84	25.17	58.60	61.03
Upper Monocacy Total	**139.81**	**67.81**	**67.51**	**135.32**	**48.50**	**48.29**

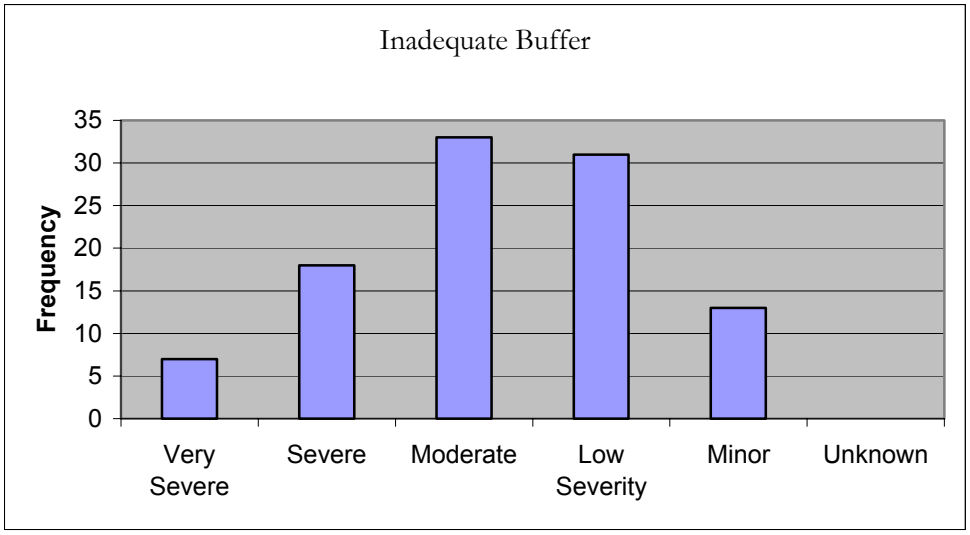


Figure 4a: Histograph showing the severity ratings given to inadequate buffers during the Upper Monocacy River SCA survey

Any inadequate buffer site would benefit from the restoration of trees and shrubs 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, streams running directly into the Monocacy River, or those that form gaps in existing forested buffer areas.

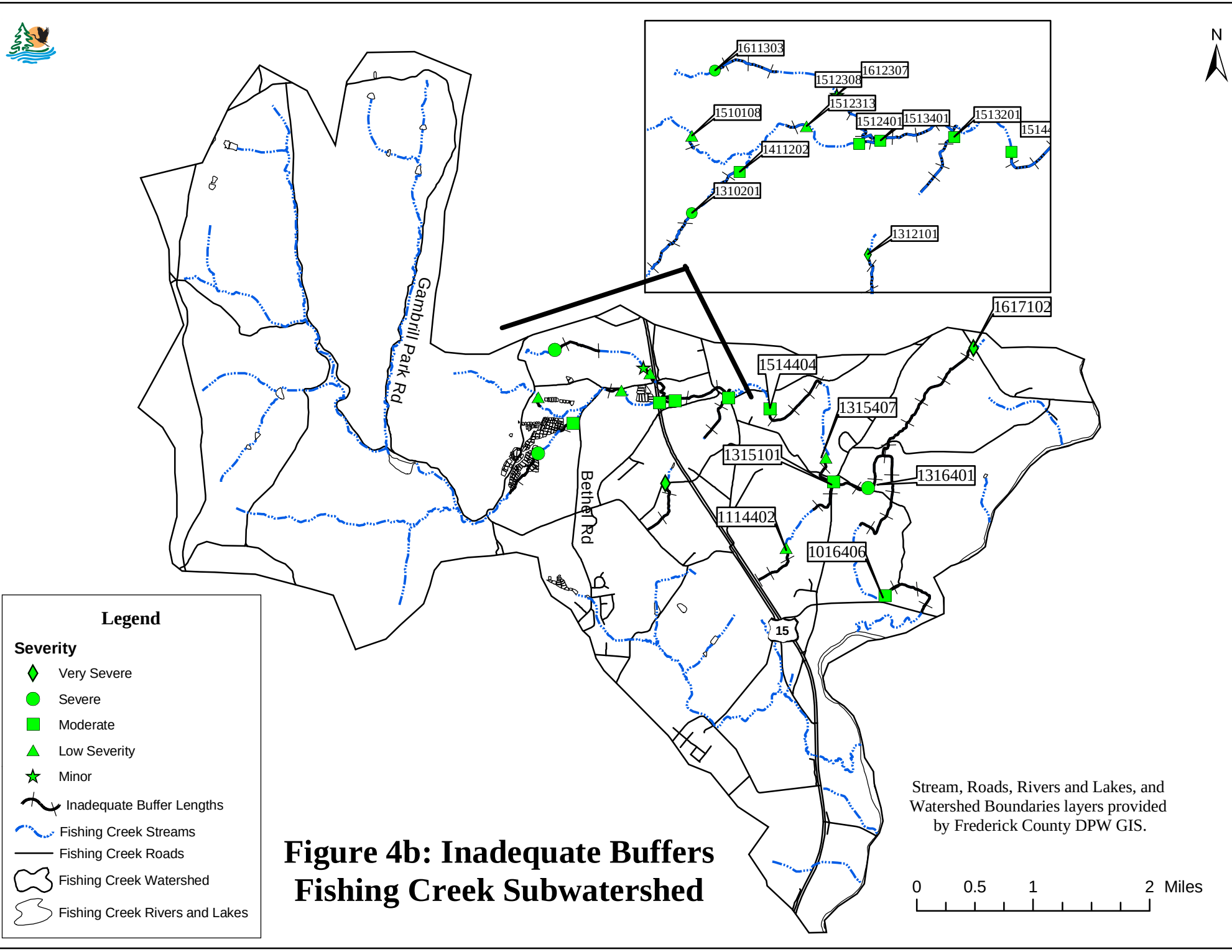
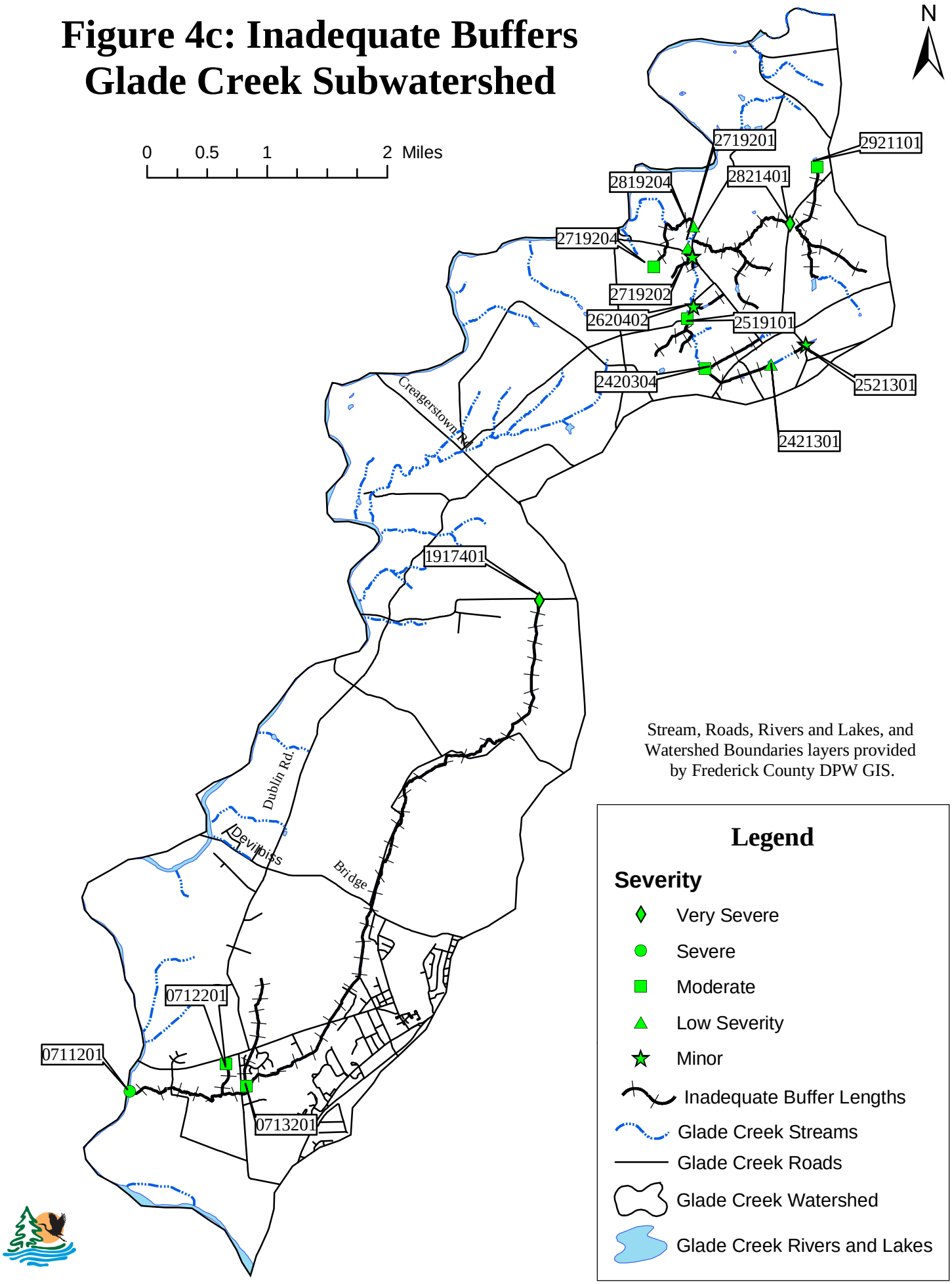


Figure 4b: Inadequate Buffers Fishing Creek Subwatershed

Figure 4c: Inadequate Buffers Glade Creek Subwatershed



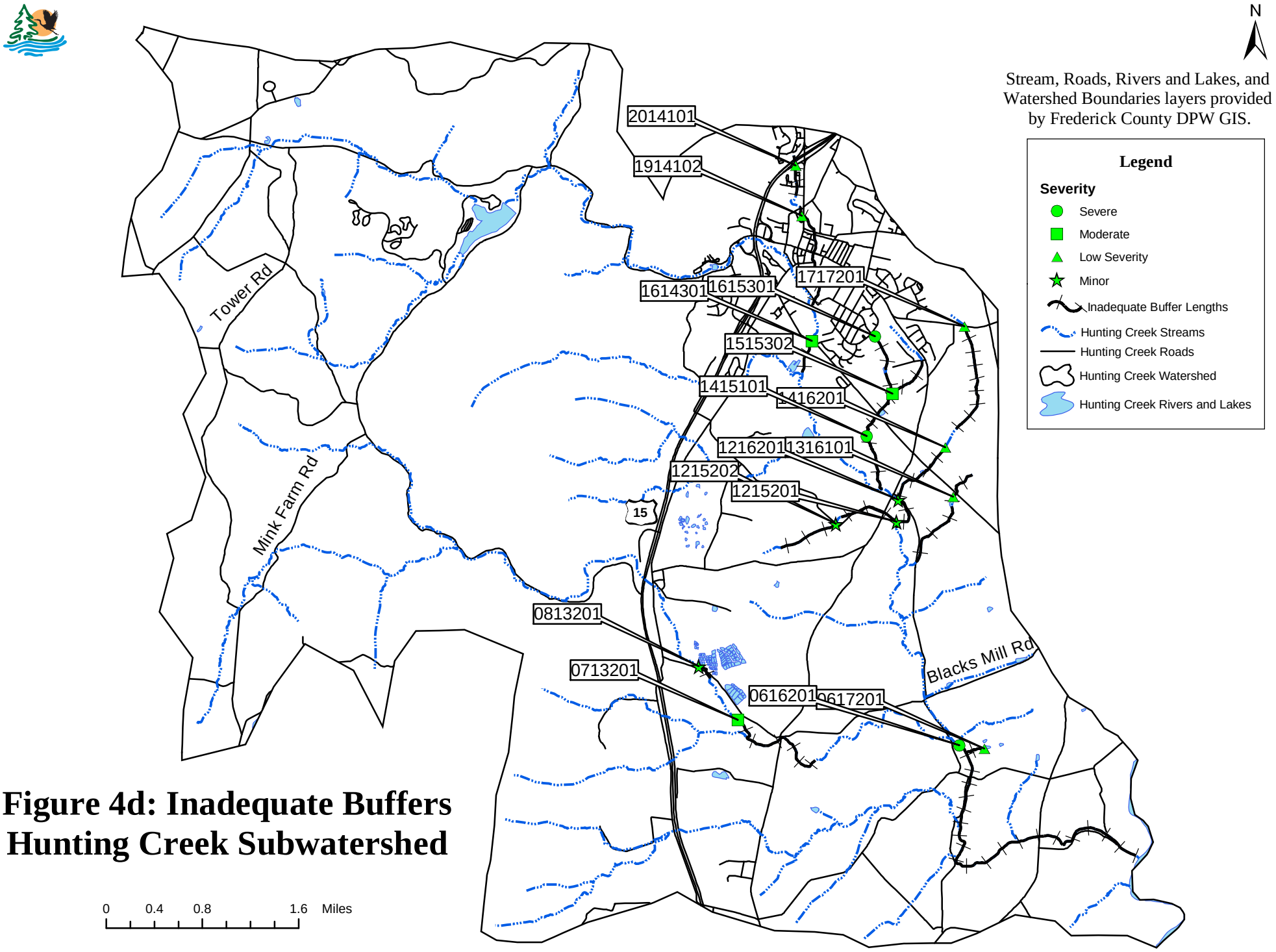


Figure 4d: Inadequate Buffers Hunting Creek Subwatershed

Figure 4e: Inadequate Buffers Owens Creek Subwatershed

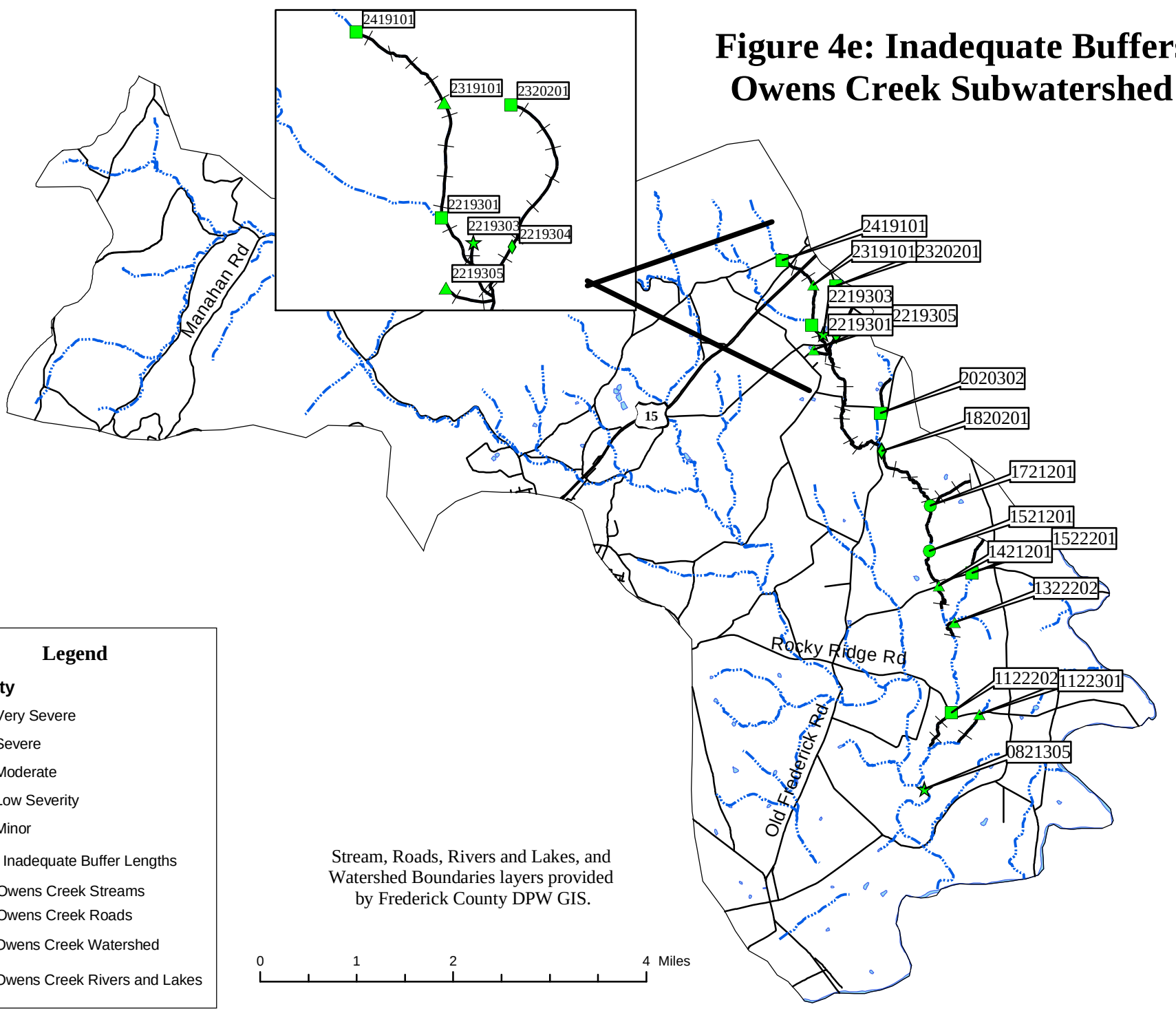
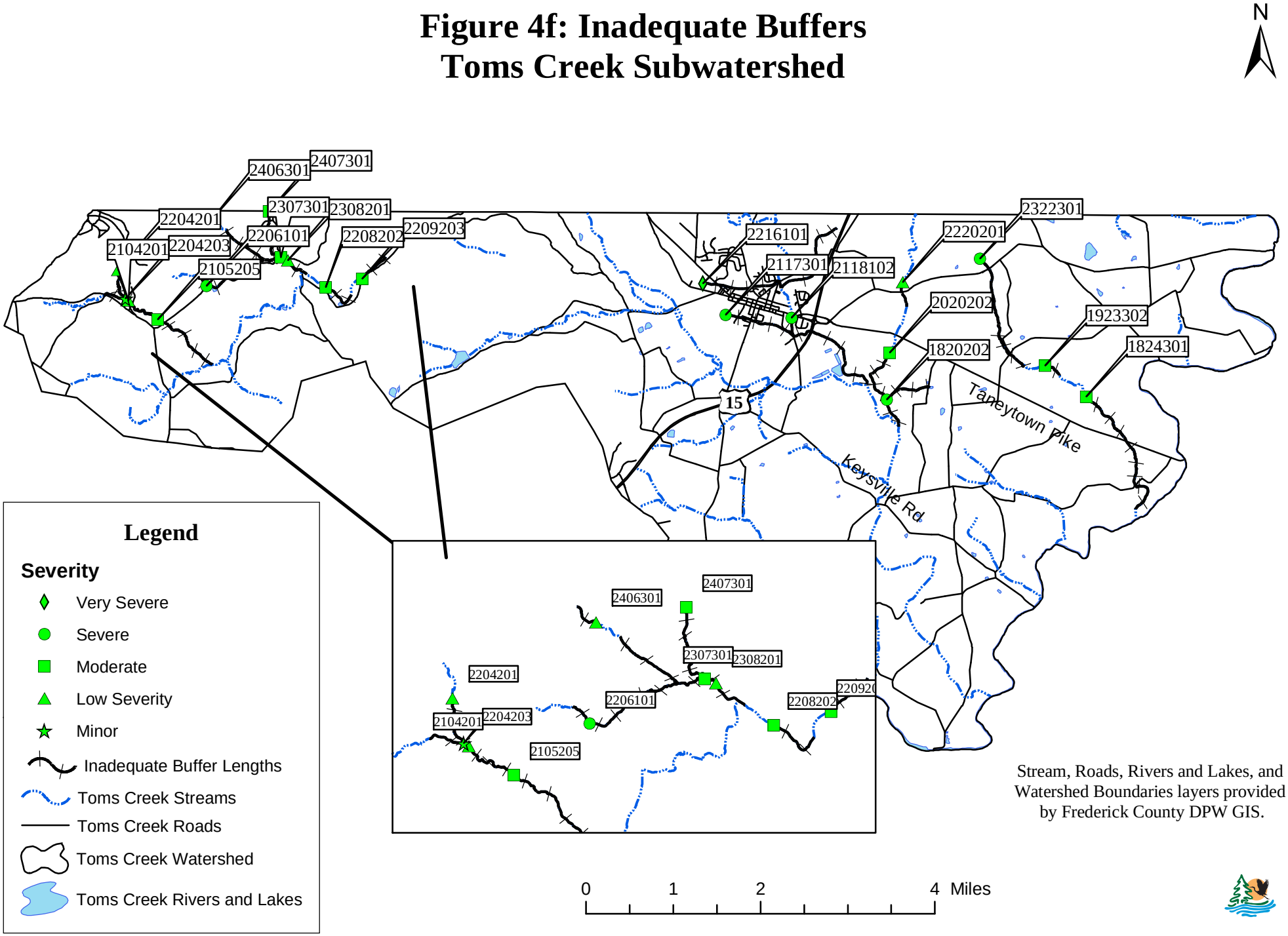


Figure 4f: Inadequate Buffers
Toms Creek Subwatershed



Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

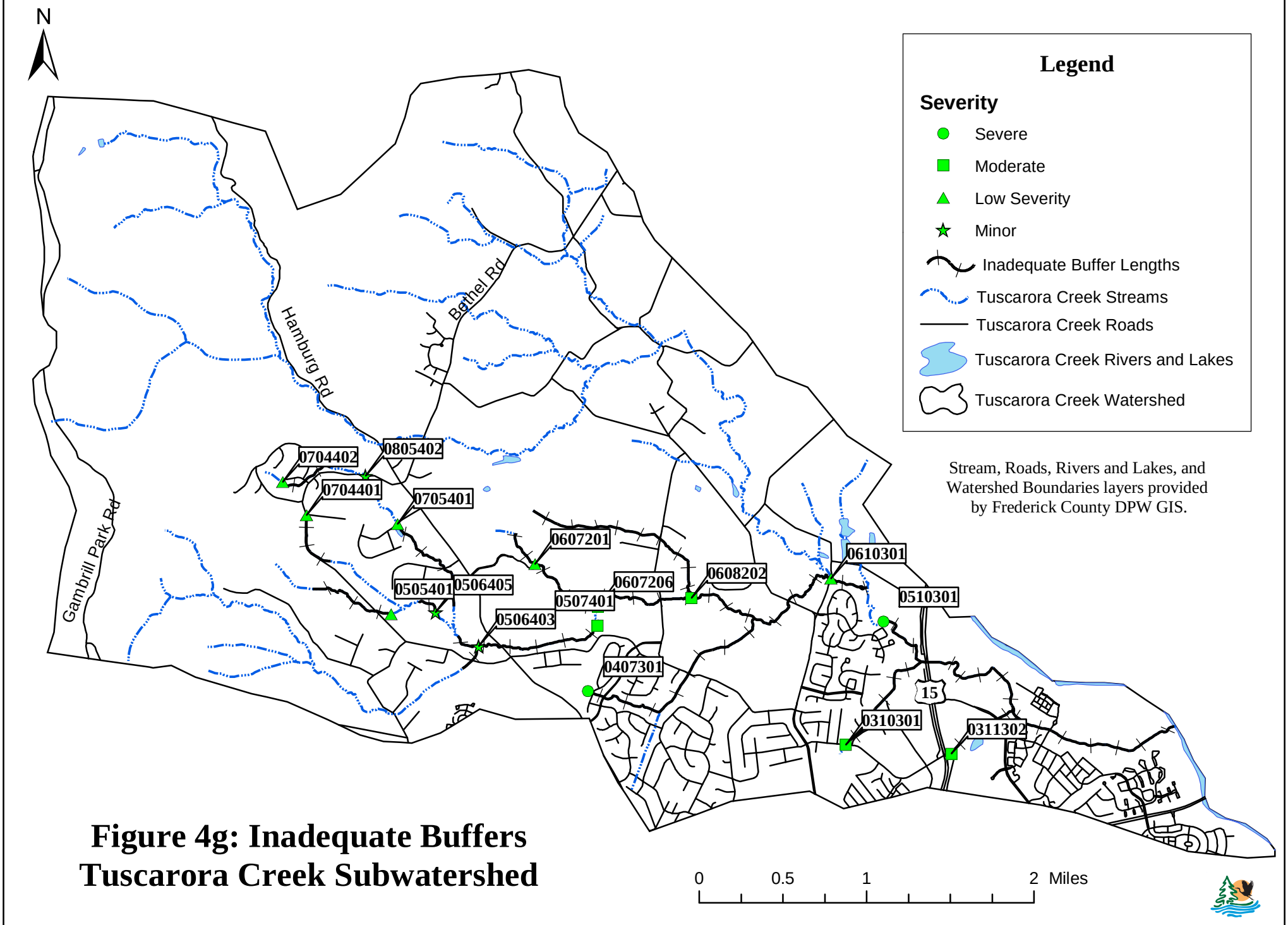


Figure 4g: Inadequate Buffers Tuscarora Creek Subwatershed

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 49 eroding stream banks over the length of 126,153 feet (22.74 miles). The survey crews cited erosion in all 6 subwatersheds. Based on the land use, soil type and gradient within the subwatershed, levels of erosion vary. Table 4 shows that 16.26 % of the Upper Monocacy River Watershed is eroded, with Tuscarora Creek having the highest percentage of erosion (38.45%) and Hunting Creek the lowest percentage (2.26%). The severity and location of erosion sites are shown in Figures 5b-5g. Severity rankings varied from minor to very severe. The frequency of the severity rankings is shown in Figure 8a. Only one site, located in Glade Creek (2719205), was ranked as being very severe.

In addition, survey crews are asked to evaluate whether there is a threat to infrastructure due to the erosion. Crews cited 13 instances where this was the case. Threatened infrastructures included: roads/parking lots (5), farmland encroachment (4), houses (2), and threats to area from flooding (1).

Table 4: Erosion lengths and percent eroded for each subwatershed in the Upper Monocacy River watershed

Subwatershed	Miles Walked	Erosion (miles)	Percent Eroded
Fishing Creek	19.52	4.85	24.85
Glade Creek	18.02	3.9	21.64
Hunting Creek	37.16	0.84	2.26
Owens Creek	15.57	2.9	18.63
Toms Creek	28.50	2.16	7.58
Tuscarora Creek	21.04	8.09	38.45
Upper Monocacy Total	**139.81**	**22.74**	**16.26**

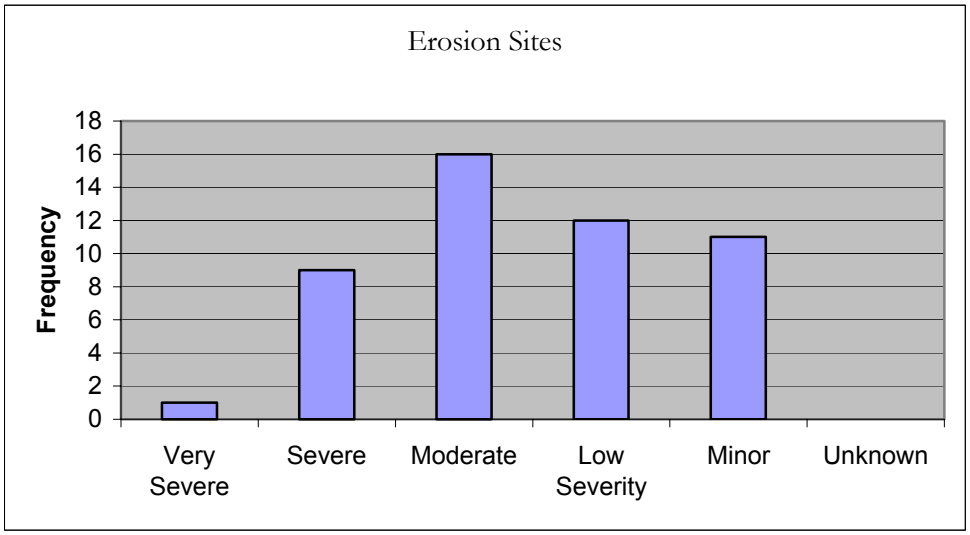


Figure 5a: Histograph showing the frequency of severity ratings given to erosion sites during the Upper Monocacy River SCA survey.

Figure 5b: Erosion Sites
Fishing Creek Subwatershed

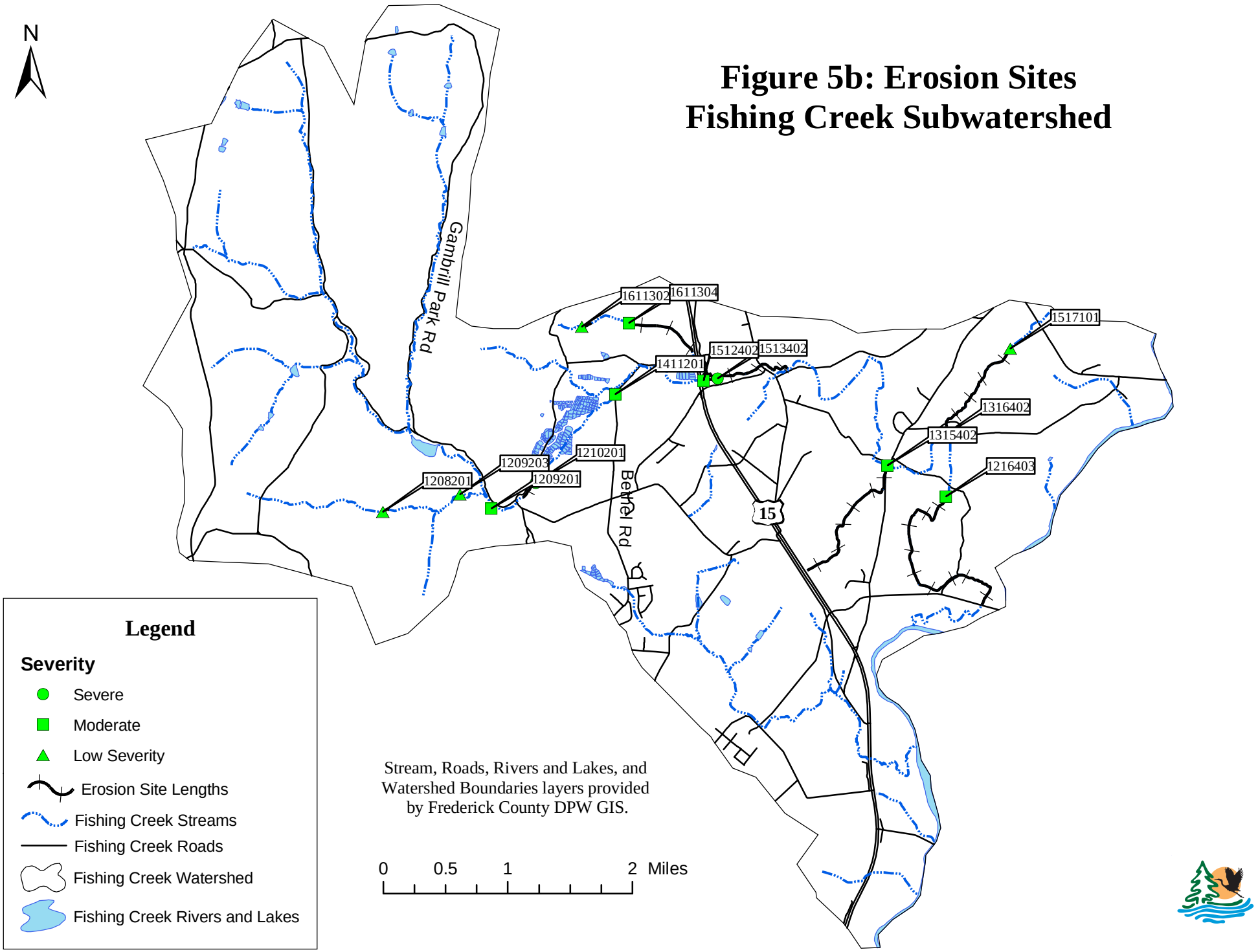
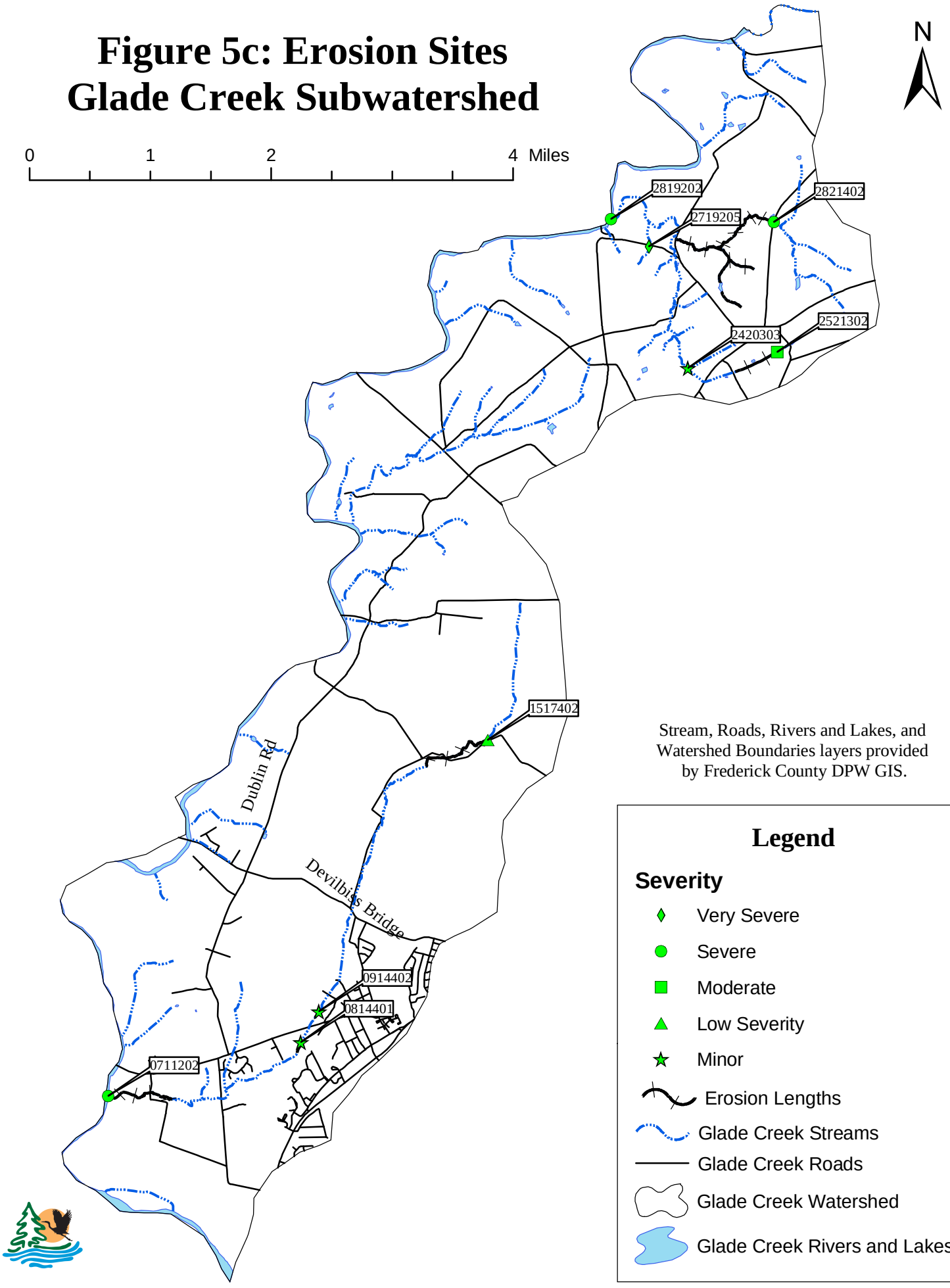


Figure 5c: Erosion Sites
Glade Creek Subwatershed



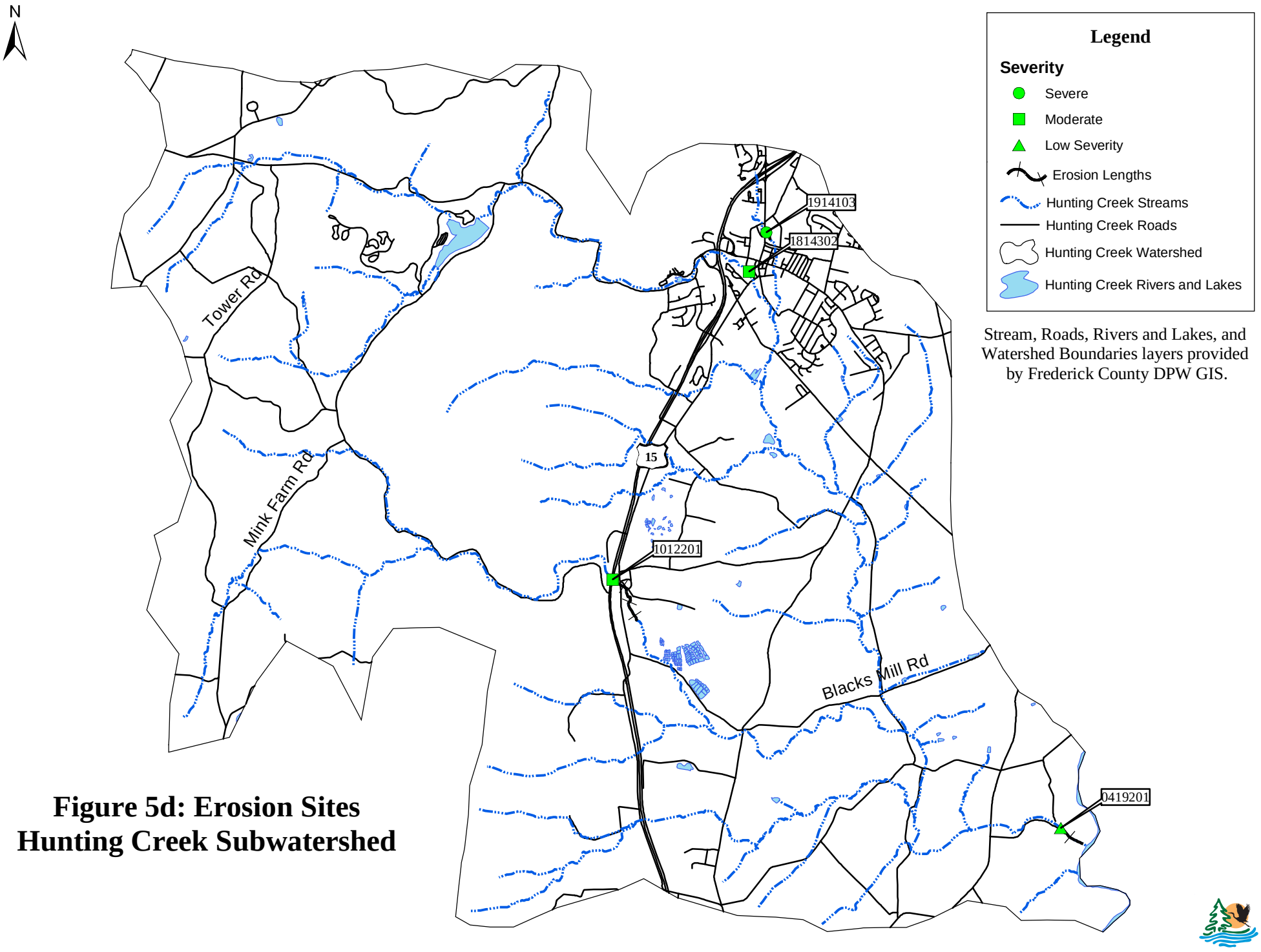


Figure 5d: Erosion Sites
Hunting Creek Subwatershed

Figure 5e: Erosion Sites
Owens Creek Subwatershed

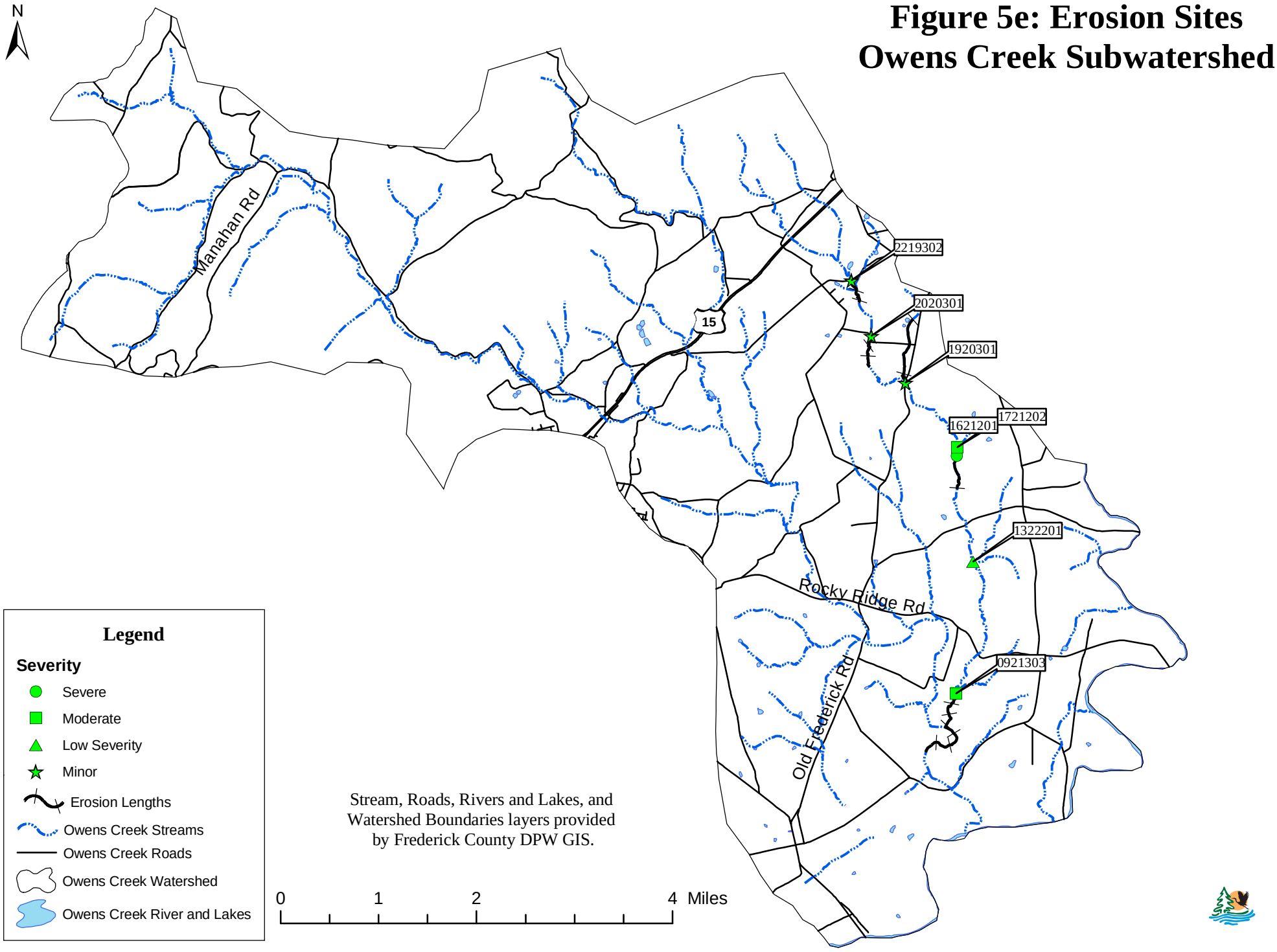
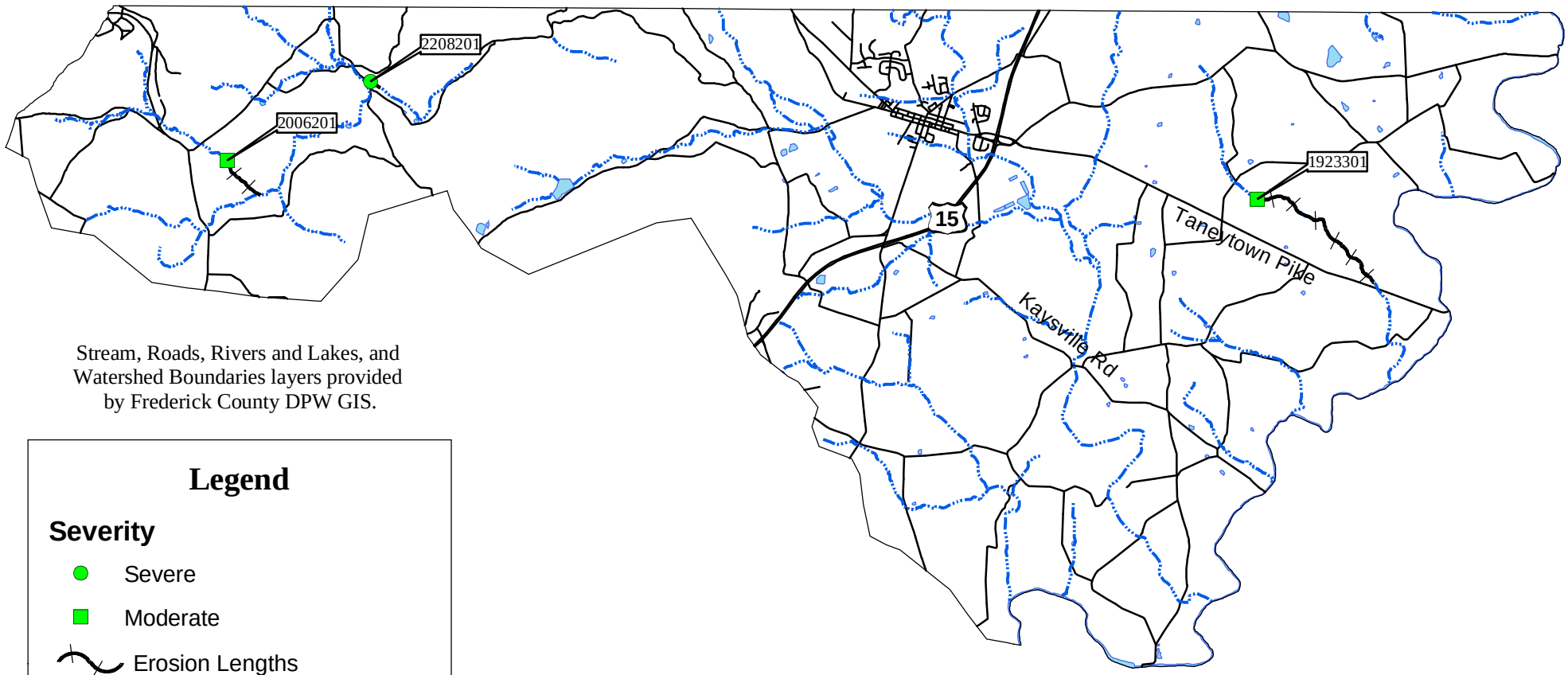


Figure 5f: Erosion Sites
Toms Creek Subwatershed



Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

Legend

Severity

- Severe
- Moderate
- Erosion Lengths
- Toms Creek Streams
- Toms Creek Roads
- Toms Creek Watershed
- Toms Creek Rivers and Lakes

0 1 2 4 Miles

N

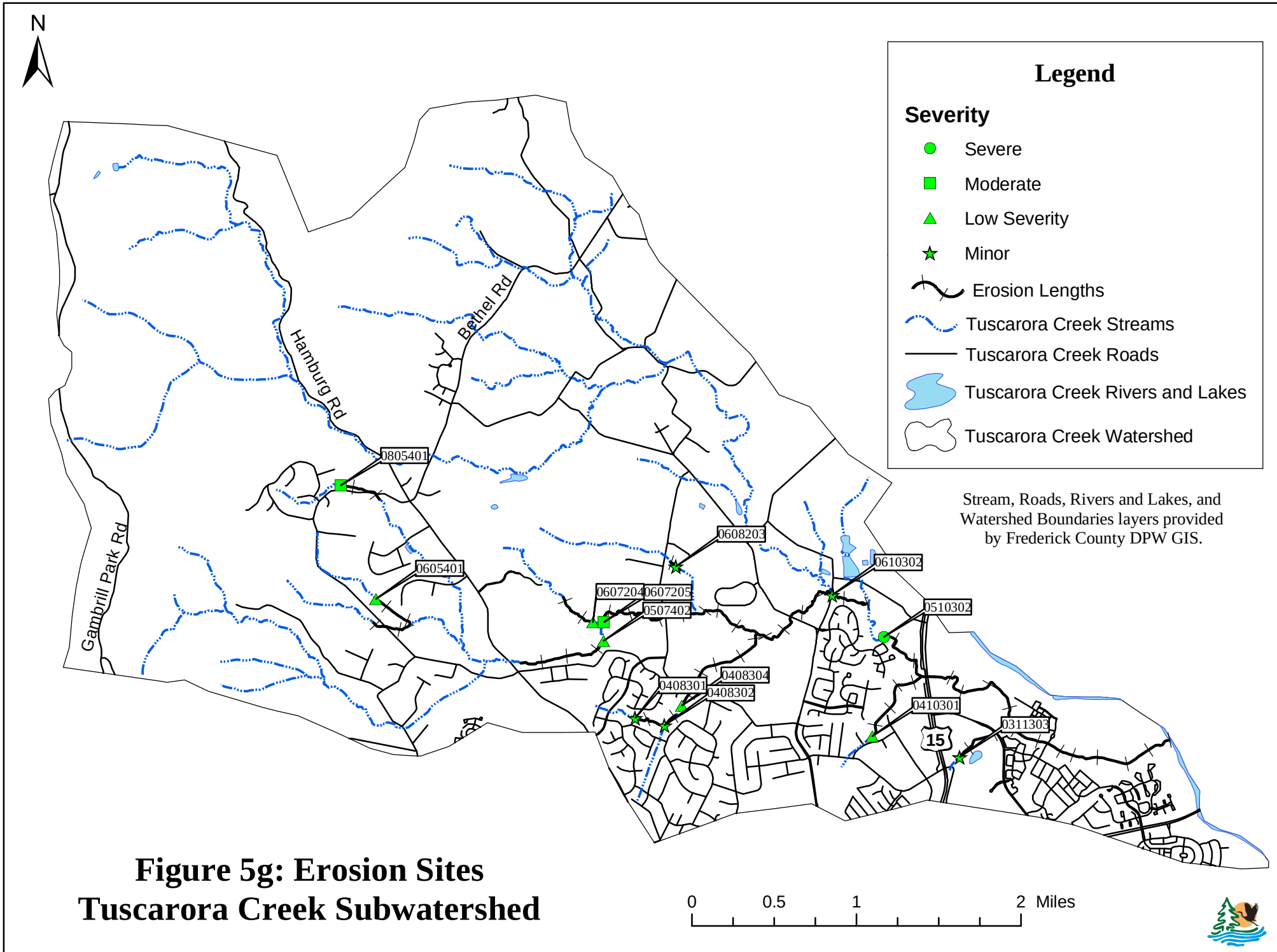


Figure 5g: Erosion Sites
Tuscarora Creek Subwatershed

Fish Passage Barriers

Fish passage barriers include anything in the stream that significantly interferes with the free, upstream movement of fish. Unobstructed upstream movement is important for resident fish species, many of which travel both up and down stream during different parts of their life cycles. 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. Ironically, barriers can also isolate species in a beneficial manner to prevent predation.

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 jump. A vertical drop as little as 6 inches may cause a fish passage problem for some resident fish species. 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 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 speed.

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 resident fish to migrate for spawning and to provide 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. However, in some cases, the optimal situation is to allow a barrier to remain because it is protecting upstream native species from downstream predators.

The Upper Monocacy River SCA survey found 33 fish passage barriers. Survey crews found fish barriers in all 6 subwatersheds. The locations of fish blockages are shown in Figures 6b-6g. Fish barriers in these subwatersheds are due to road crossings (12), dams (3), debris (7), channelized stream (5), a cement crossing (2), railroad crossing (1), natural falls (2), and unknown (1). Figure 6a shows that most sites were ranked as moderate to minor with three sites ranked severe. These sites were located in Fishing Creek (1512312), Hunting Creek (1813301), and Owens Creek (2419103). Two of these sites were cited as being too high while the other was cited as being too shallow during dry weather and too fast during wet weather. Total barriers blocking full movement of fish were observed at 22 sites. Partial barriers allowing some flow were found in 9 cases and 2 temporary sites were noted.

In all cases, areas should be assessed for viable fish habitat before restoration work begins, giving preference to sites with the most potential habitat area created.

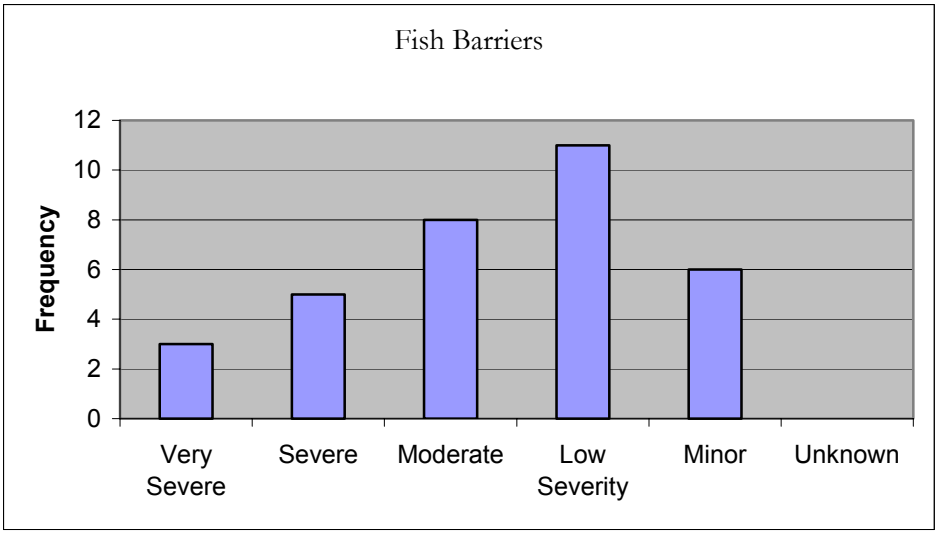


Figure 6a: Histograph showing frequency of severity rankings given to fish barriers seen during the Upper Monocacy SCA survey.

Figure 6b: Fish Passage Barriers
Fishing Creek Subwatershed

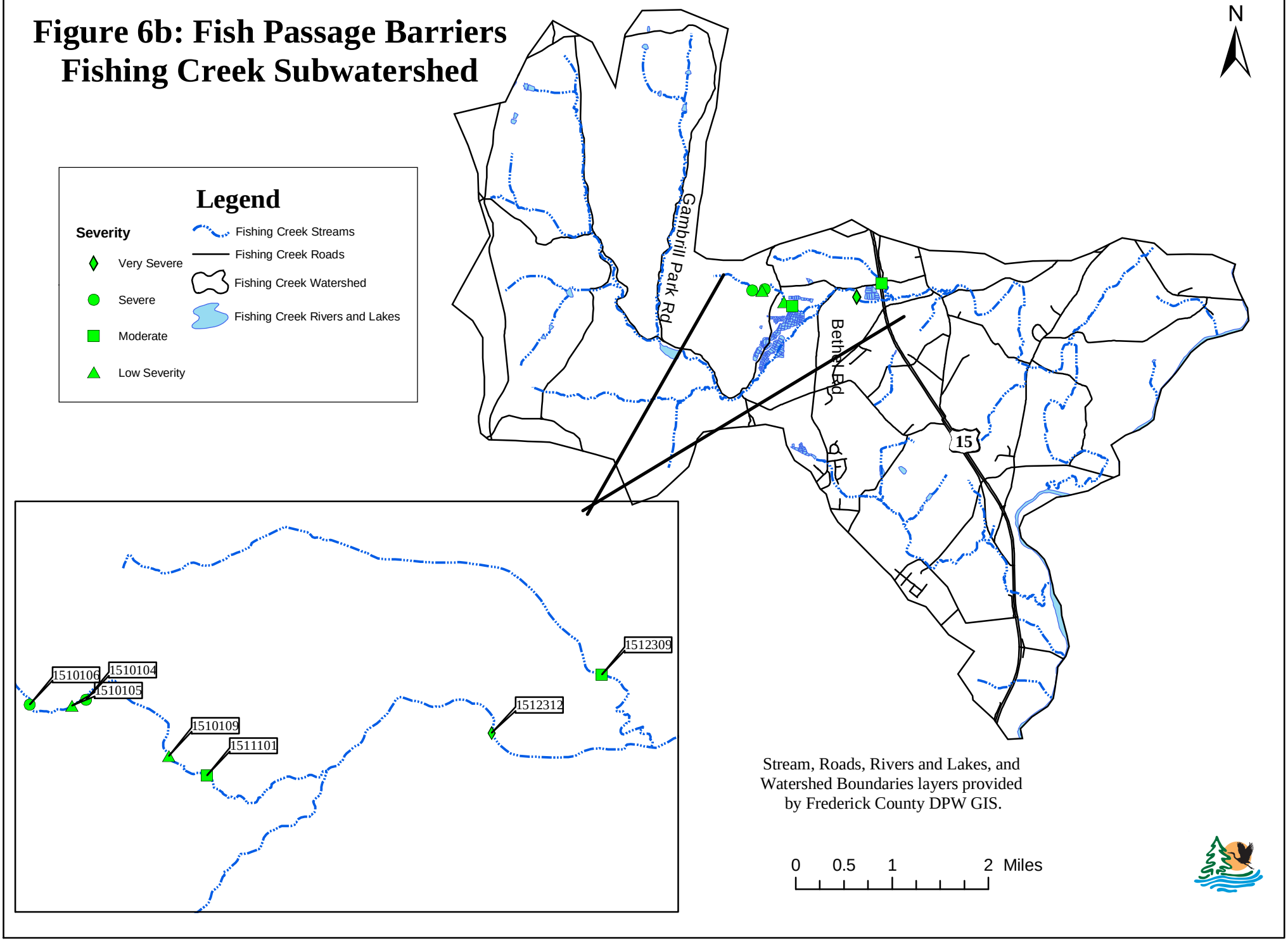
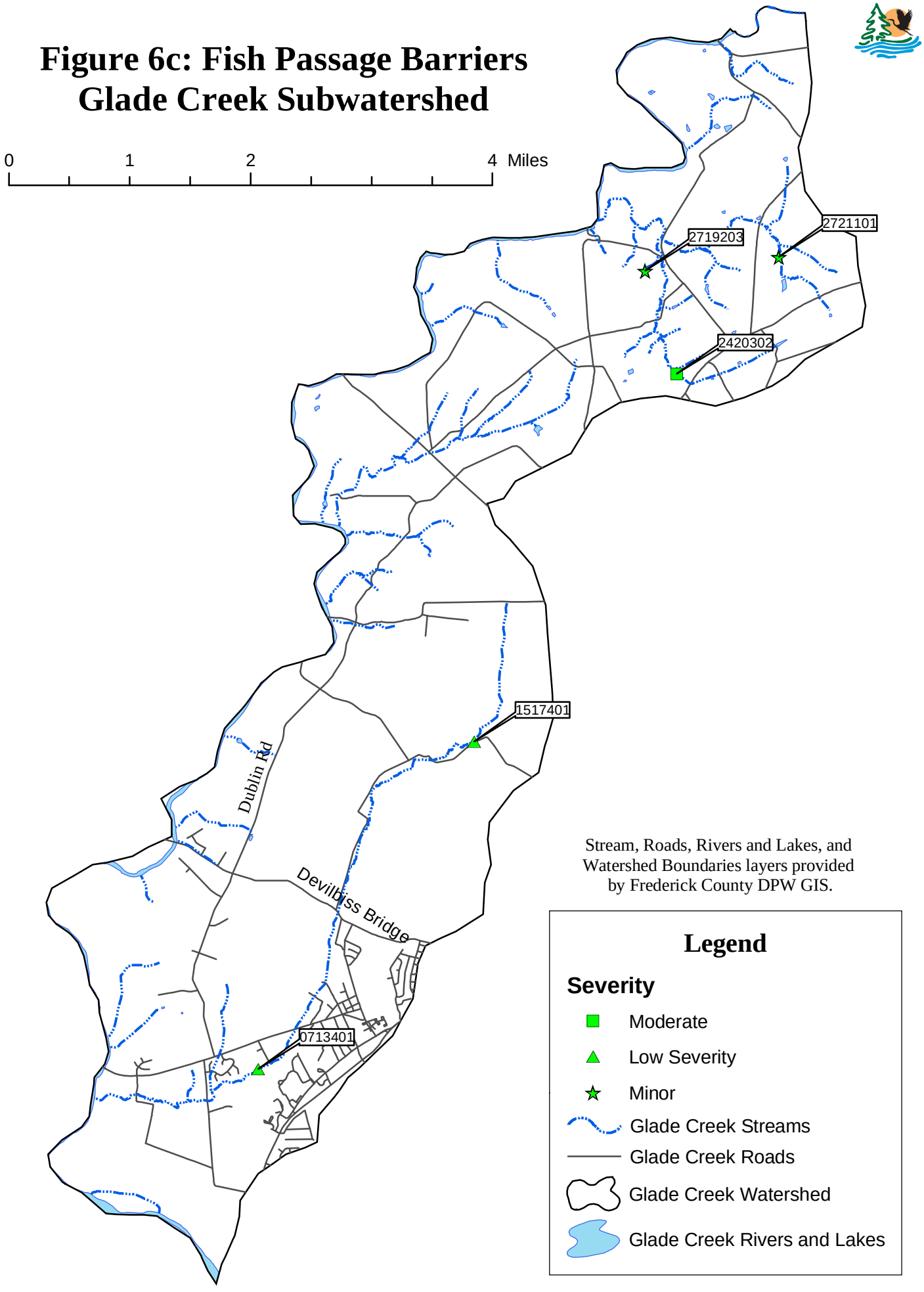


Figure 6c: Fish Passage Barriers
Glade Creek Subwatershed



Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

Legend

Severity

- Moderate
- Low Severity
- Minor
- Glade Creek Streams
- Glade Creek Roads
- Glade Creek Watershed
- Glade Creek Rivers and Lakes

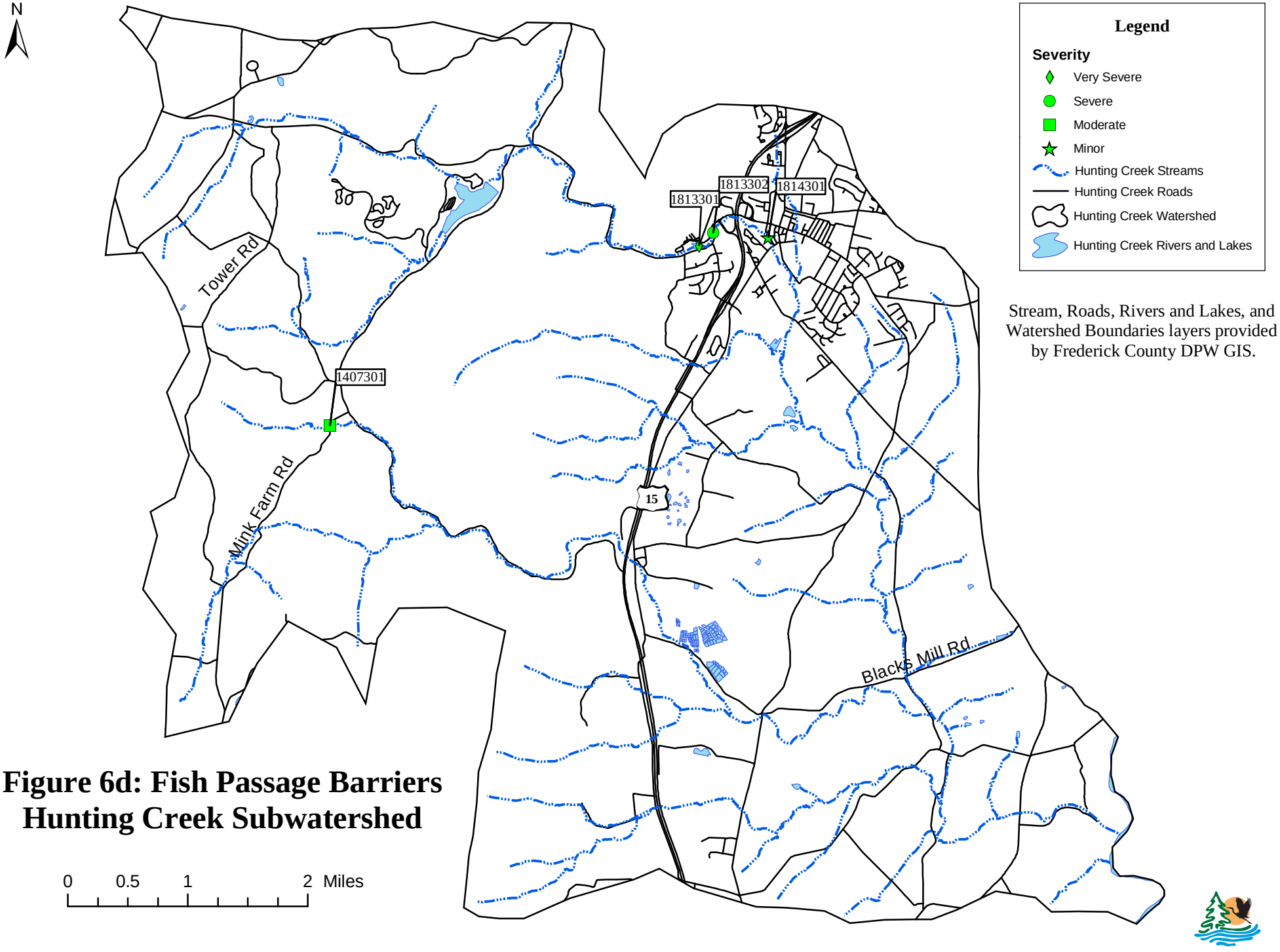


Figure 6d: Fish Passage Barriers Hunting Creek Subwatershed

Figure 6e: Fish Passage Barriers
Owens Creek Subwatershed

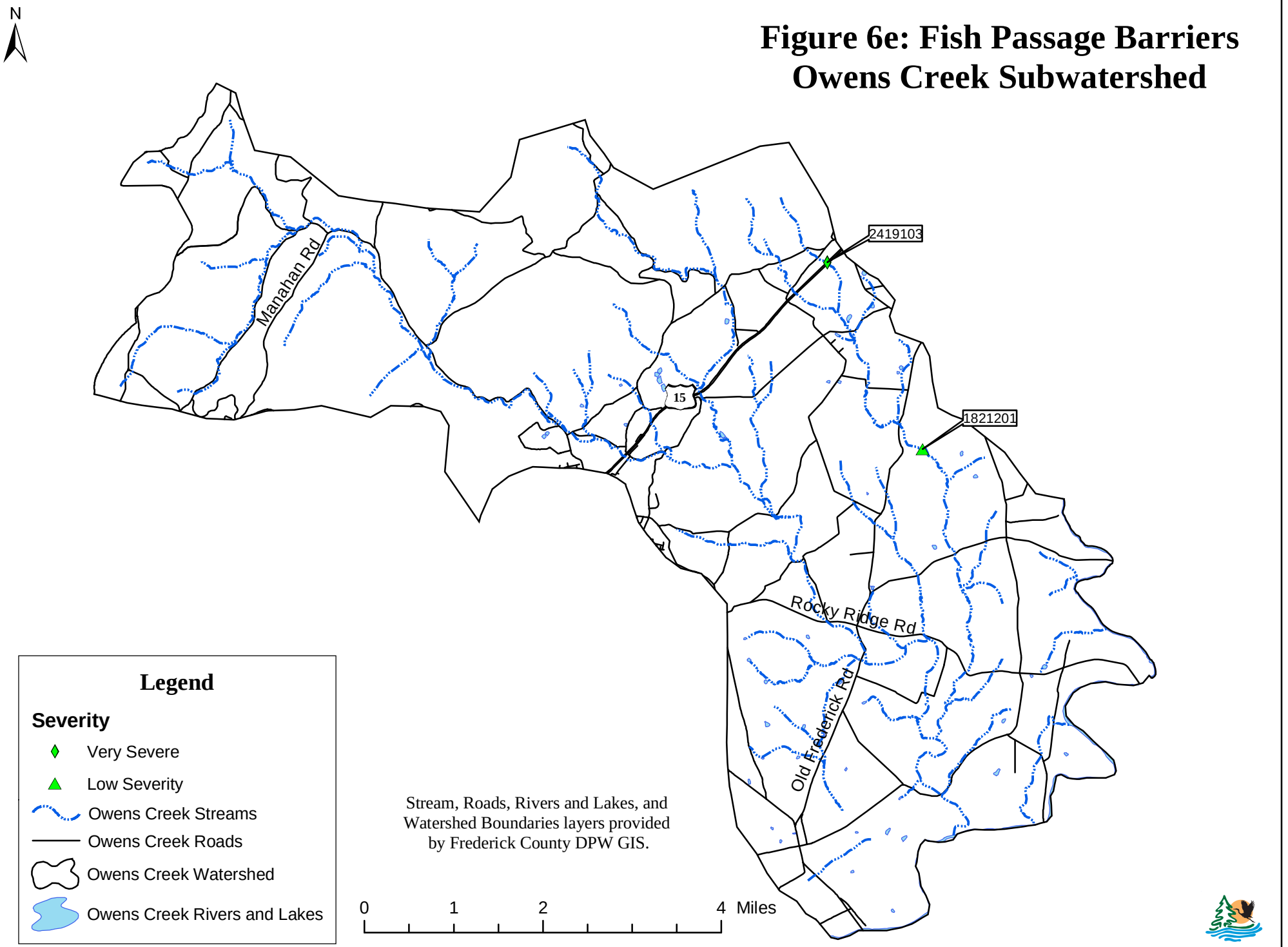
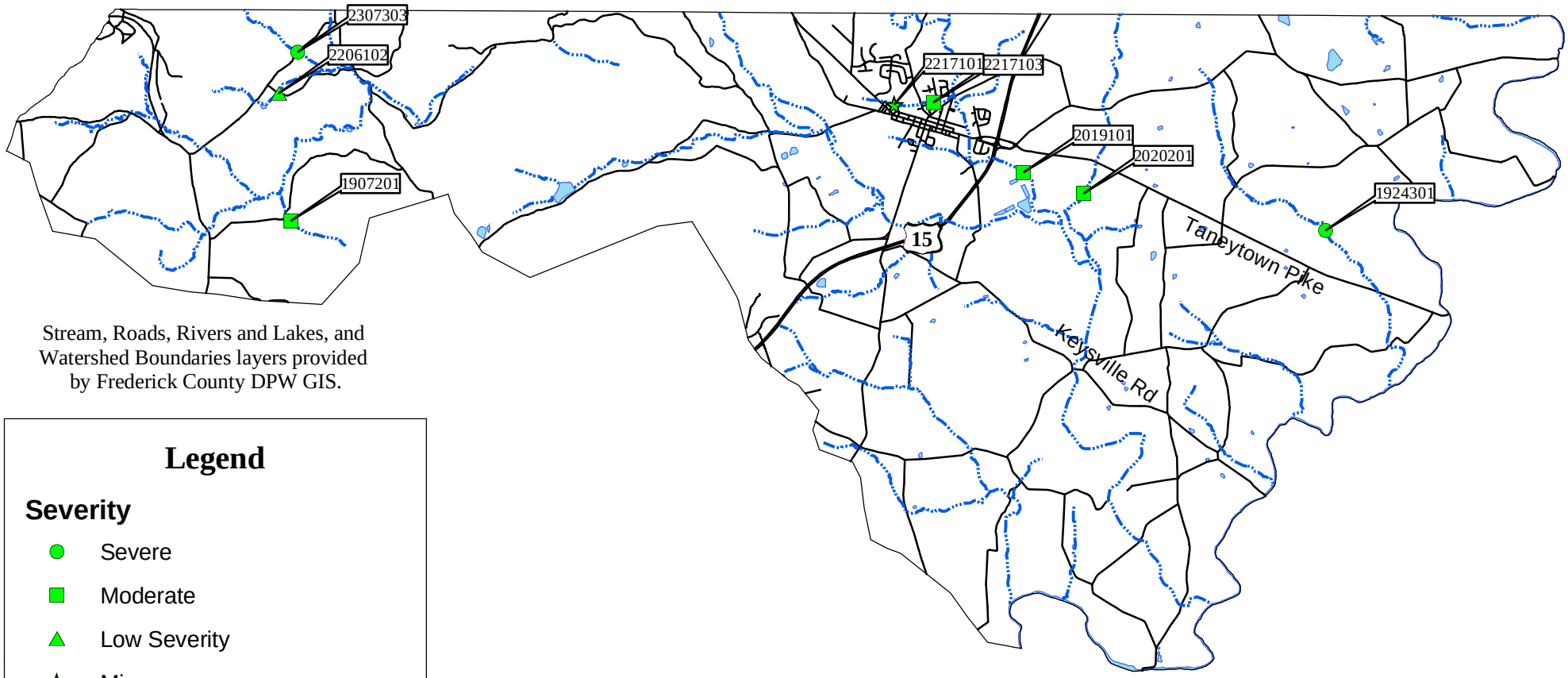


Figure 6f: Fish Passage Barriers
Toms Creek Subwatershed



Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

Legend

Severity

- Severe
- Moderate
- Low Severity
- Minor
- Toms Creek Streams
- Toms Creek Roads
- Toms Creek Watershed
- Toms Creek Rivers and Lakes

0 1 2 4 Miles

N

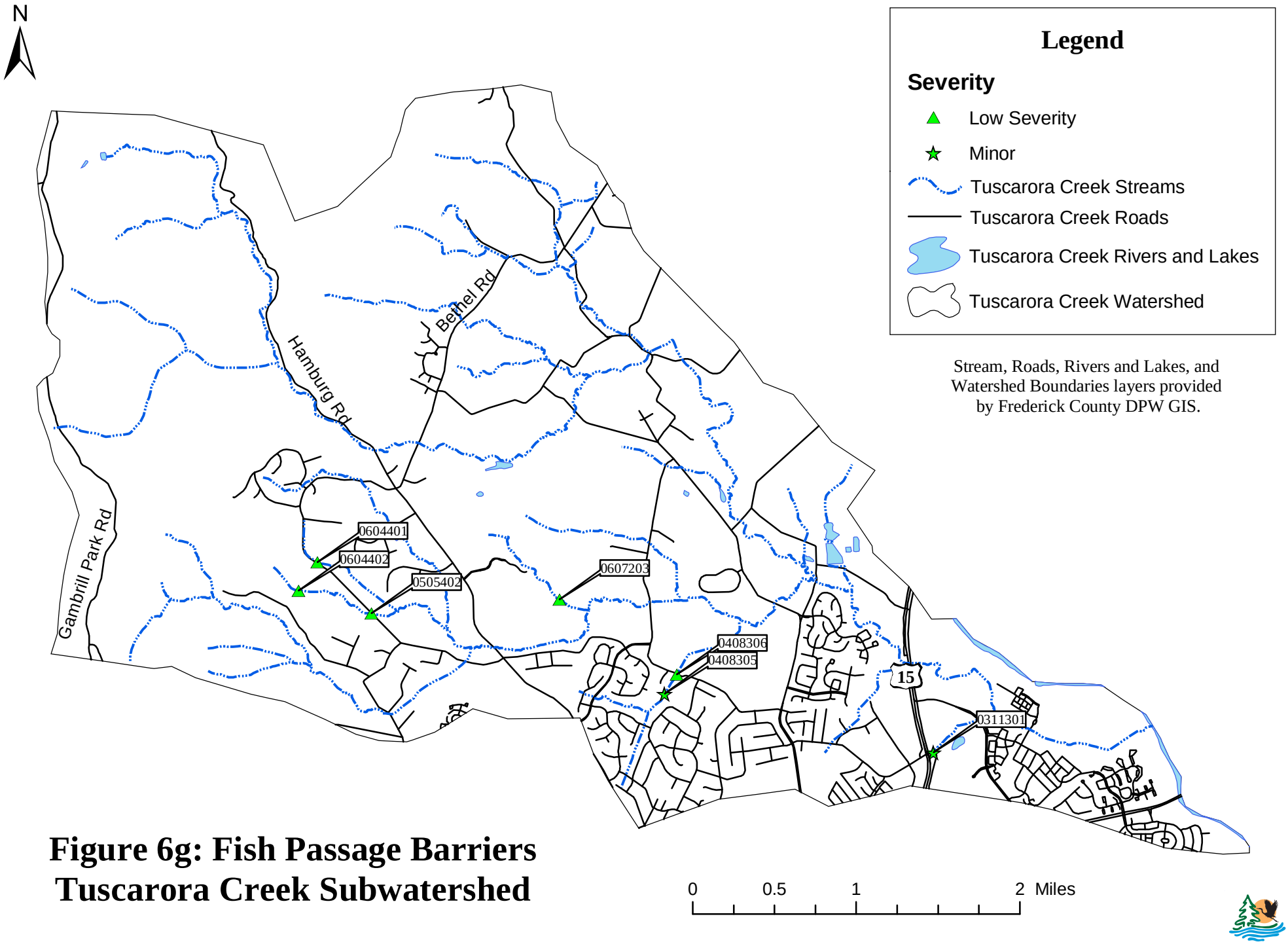


Figure 6g: Fish Passage Barriers
Tuscarora Creek Subwatershed

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 crews identified a total of 24 pipe outfalls, observed in all 6 subwatersheds. The severities and locations of pipe outfall sites are shown in Figures 7b-7g, and the distribution of severity ratings in Figure 7a.

Of the outfalls observed, 9 were dry when surveyed and 13 had a clear discharge with no associated odor. The remaining two pipe outfalls had a colored discharge. Site 1310203 was found on Fishing Creek with an oily discharge and site 2117302 was found on Toms Creek with a green/brown colored discharge. Those with dry weather discharge were given a more severe ranking of moderate to severe based on the type of discharge.

No immediate follow up actions were taken by the stream survey crews as part of this study to determine the source of the color coming from the pipe. In some cases, coloration from a storm drainpipe may be a sporadic occurrence. In addition, no estimates of the amount of fluid released from the pipes were made. It is recommended that the WRAS committee report these pipe outfalls to the Environmental Compliance Section for further investigation.

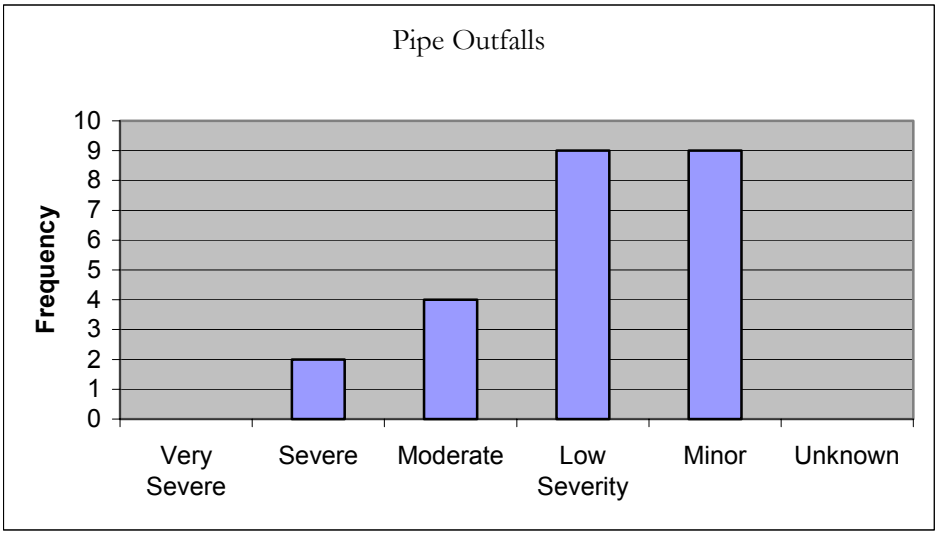
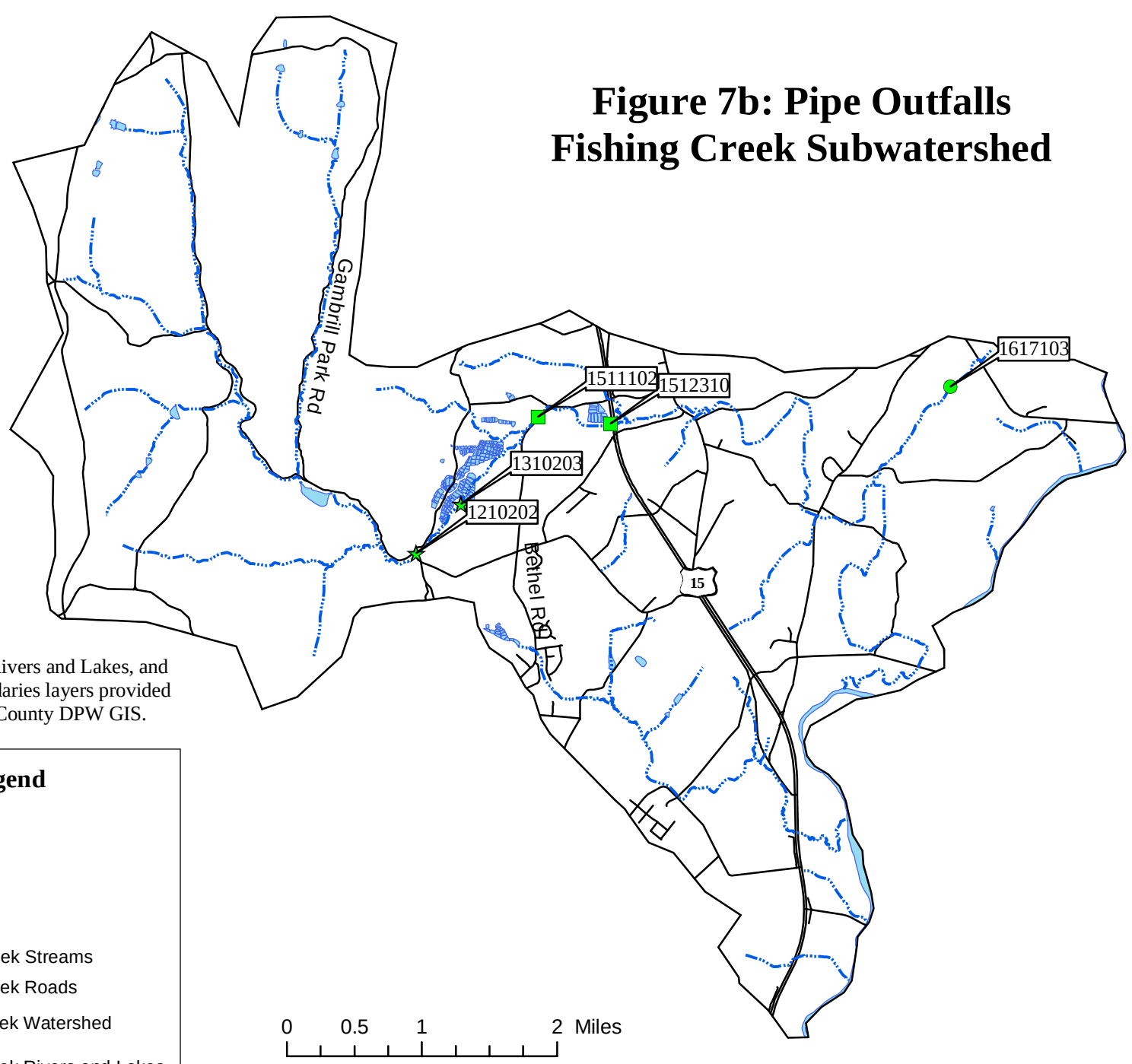


Figure 7a: Histograph showing the frequency of severity ratings given to pipe outfall sites during the Upper Monocacy River SCA survey.

Figure 7b: Pipe Outfalls
Fishing Creek Subwatershed



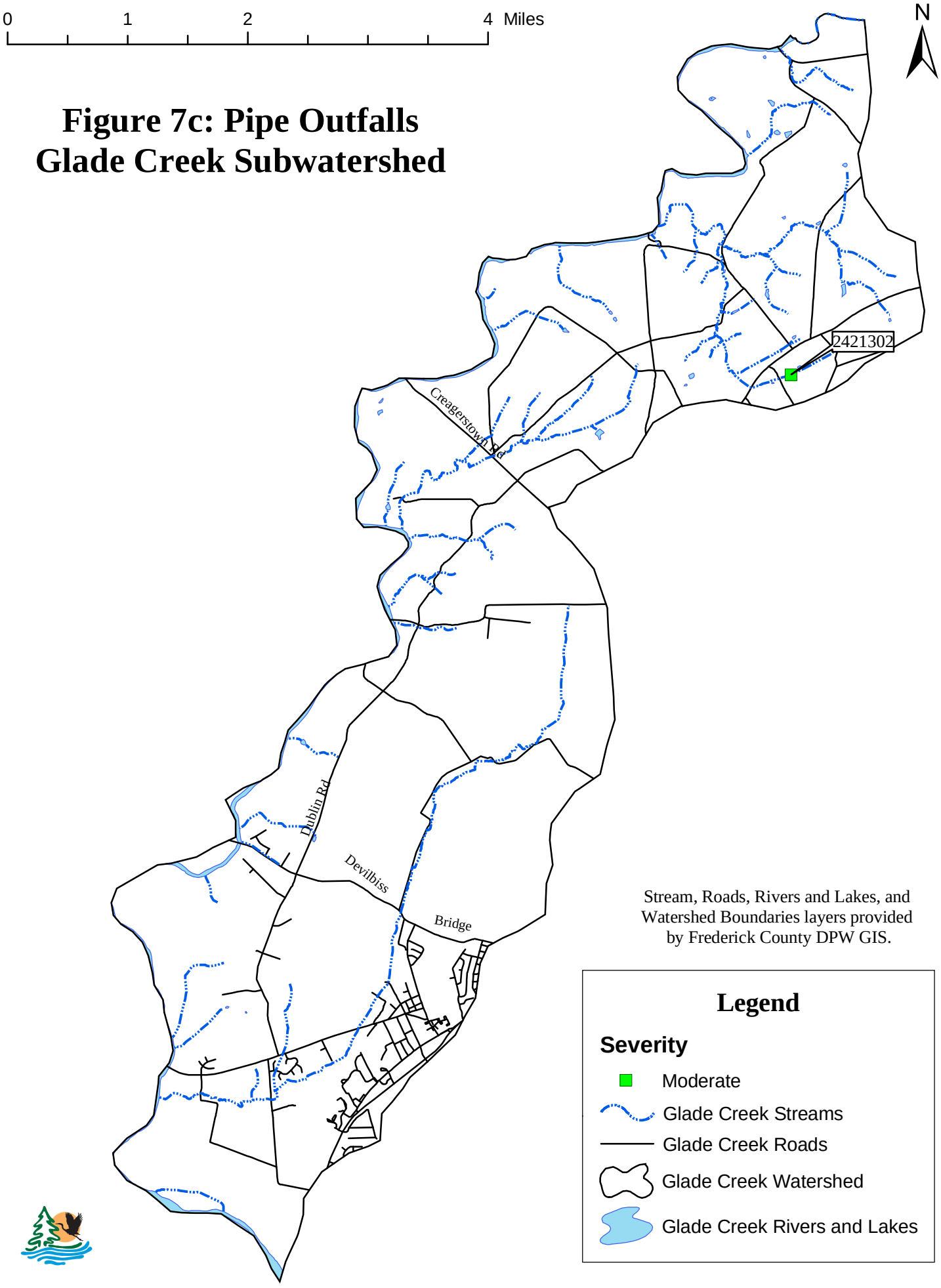
Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

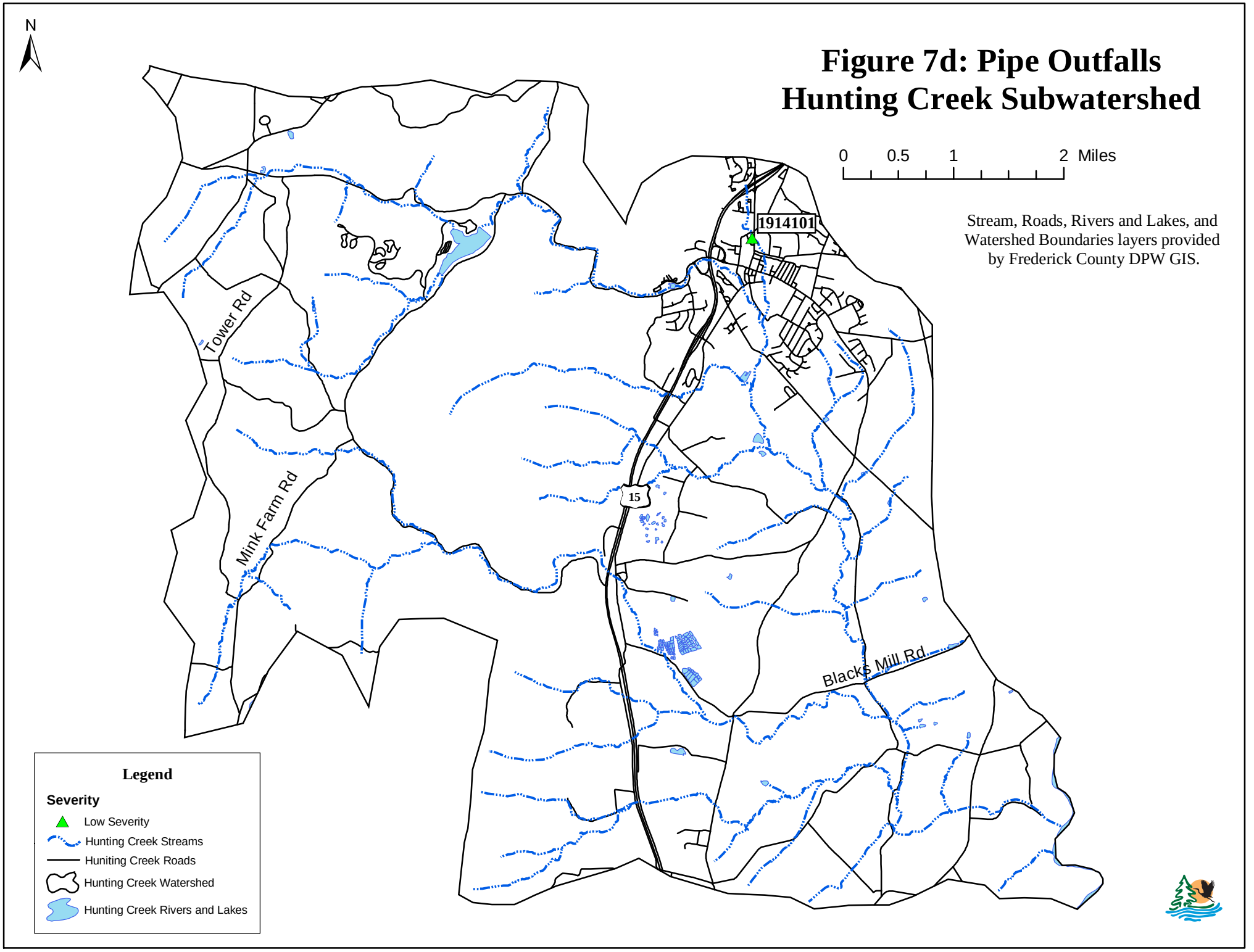
Legend

Severity

- Severe
- Moderate
- Minor
- Fishing Creek Streams
- Fishing Creek Roads
- Fishing Creek Watershed
- Fishing Creek Rivers and Lakes

Figure 7c: Pipe Outfalls
Glade Creek Subwatershed




N
Figure 7d: Pipe Outfalls
Hunting Creek Subwatershed
0 0.5 1 2 Miles
Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.
1914101
Tower Rd
Mink Farm Rd
15
Blacks Mill Rd
Legend
Severity
Low Severity
Hunting Creek Streams
Huniting Creek Roads
Hunting Creek Watershed
Hunting Creek Rivers and Lakes

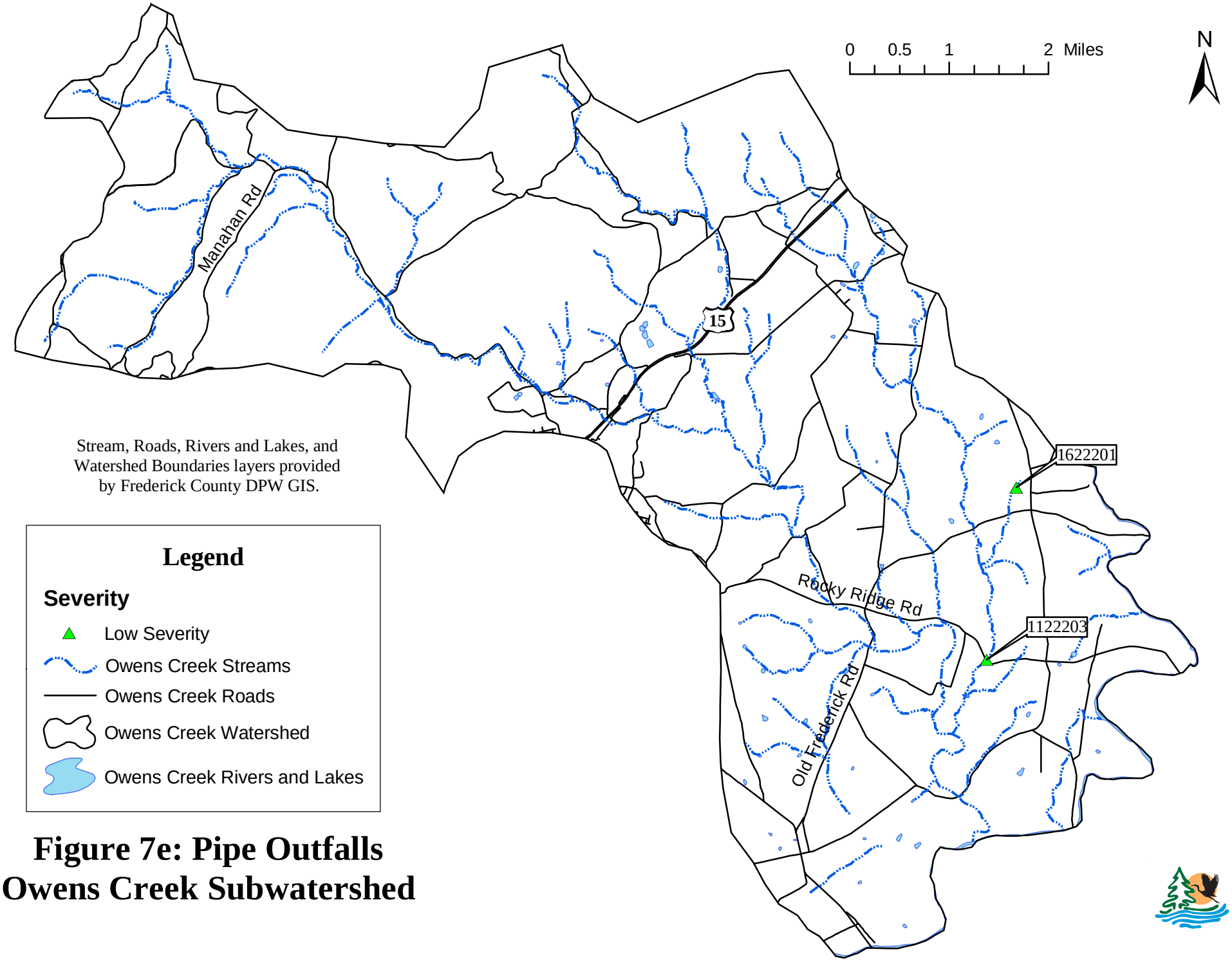
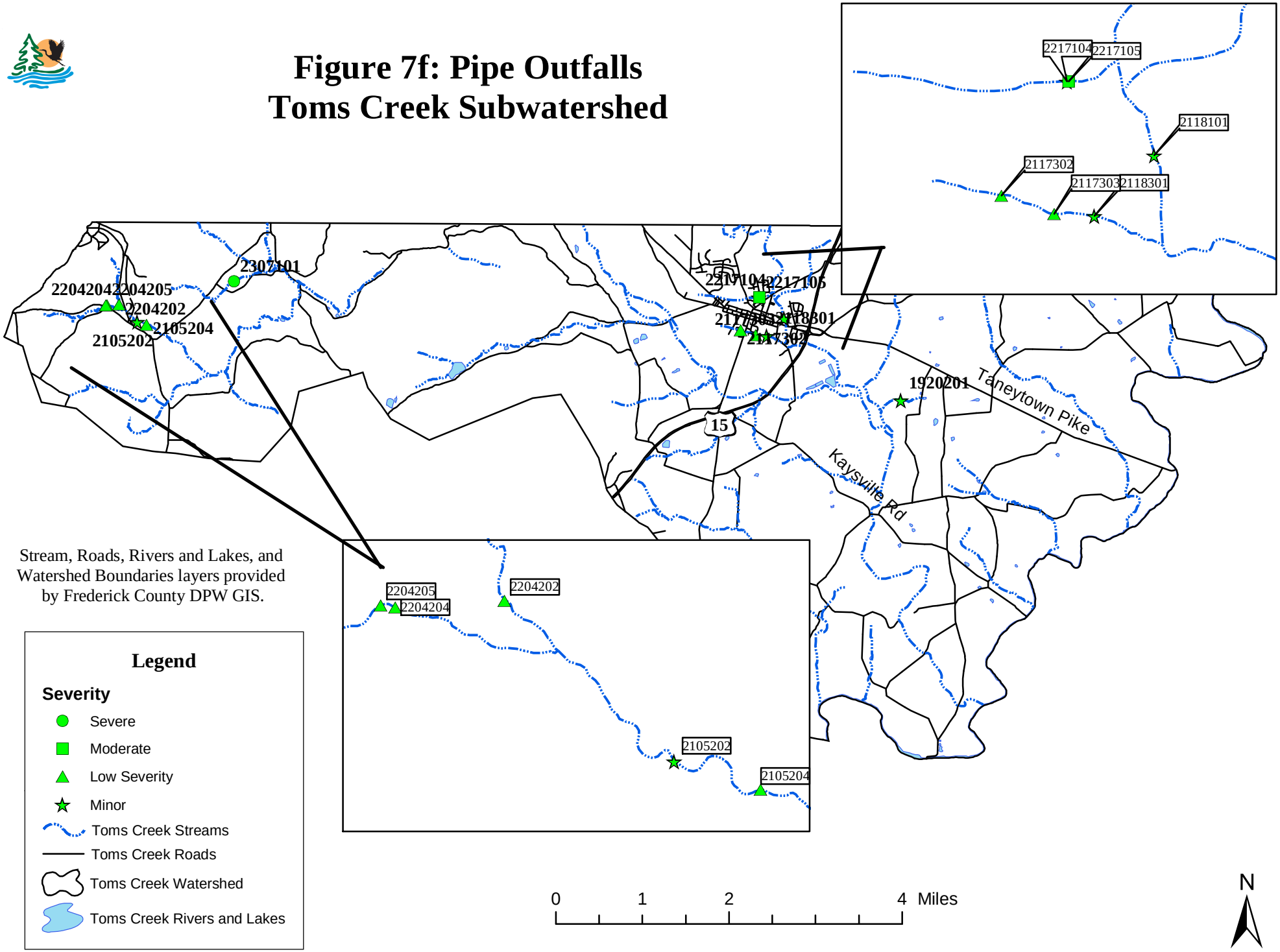


Figure 7e: Pipe Outfalls Owens Creek Subwatershed

Figure 7f: Pipe Outfalls
Toms Creek Subwatershed



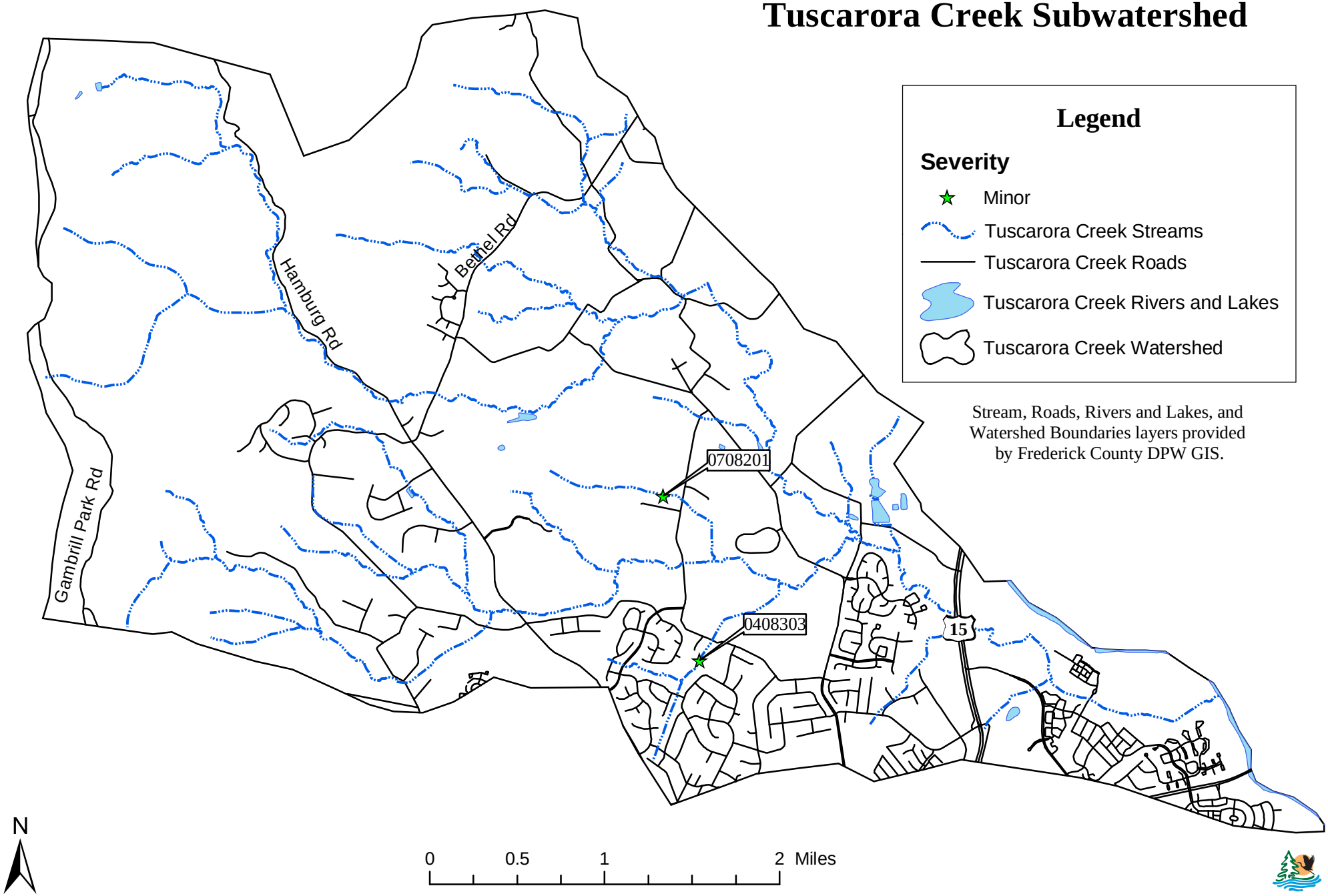
Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

Legend

Severity

- Severe
- Moderate
- Low Severity
- Minor
- Toms Creek Streams
- Toms Creek Roads
- Toms Creek Watershed
- Toms Creek Rivers and Lakes

Figure 7g: Pipe Outfalls
Tuscarora Creek Subwatershed



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 a total of 17 trash dumping sites dispersed throughout all 6 subwatersheds (Figures 8b-8g). This is a low number of sites compared to other watersheds previously surveyed throughout Maryland. In terms of severity, the six sites are ranked as severe (5), moderate (6), low severity (3), and minor (3), as shown in Figure 10a. The sites contained residential waste (11), tires/construction (1), construction (1), residential/tires (1), industrial (2), and residential/farm equipment (1). All sites were found on private land with 6 of the sites not suitable as a volunteer clean up project.

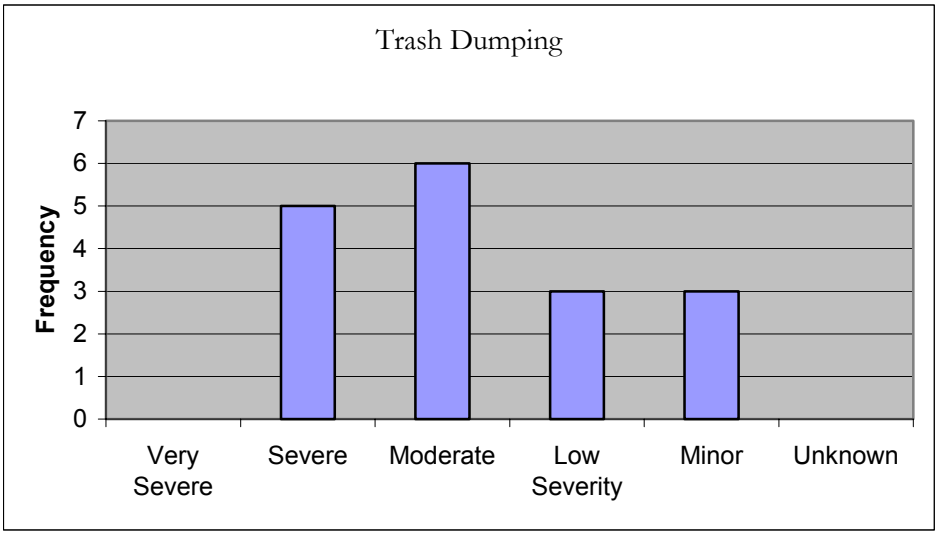


Figure 8a. Histograph showing frequency of severity ratings given to trash dumping sites in the Upper Monocacy River SCA survey.

Figure 8b: Trash Dumping
Fishing Creek Subwatershed

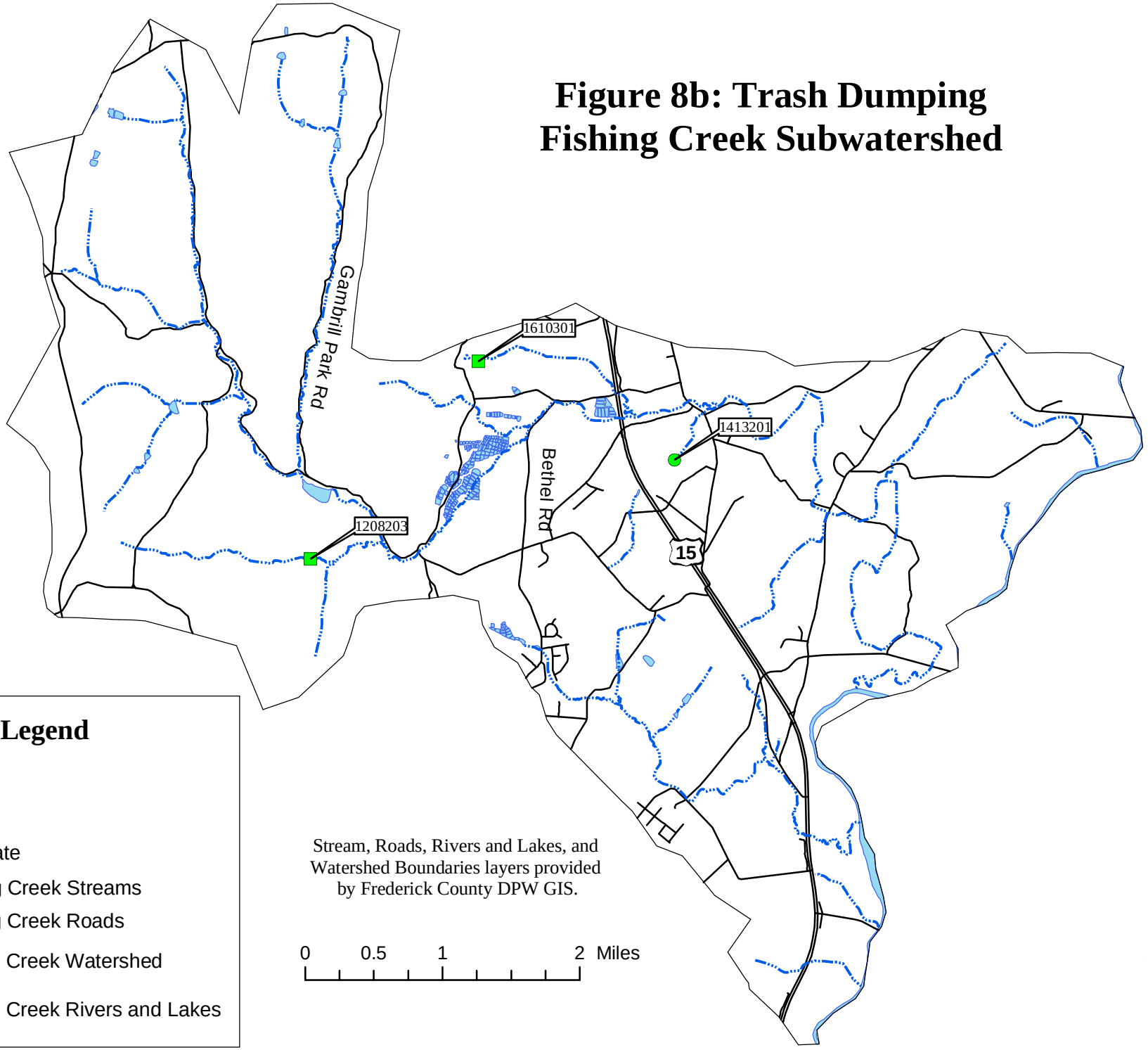
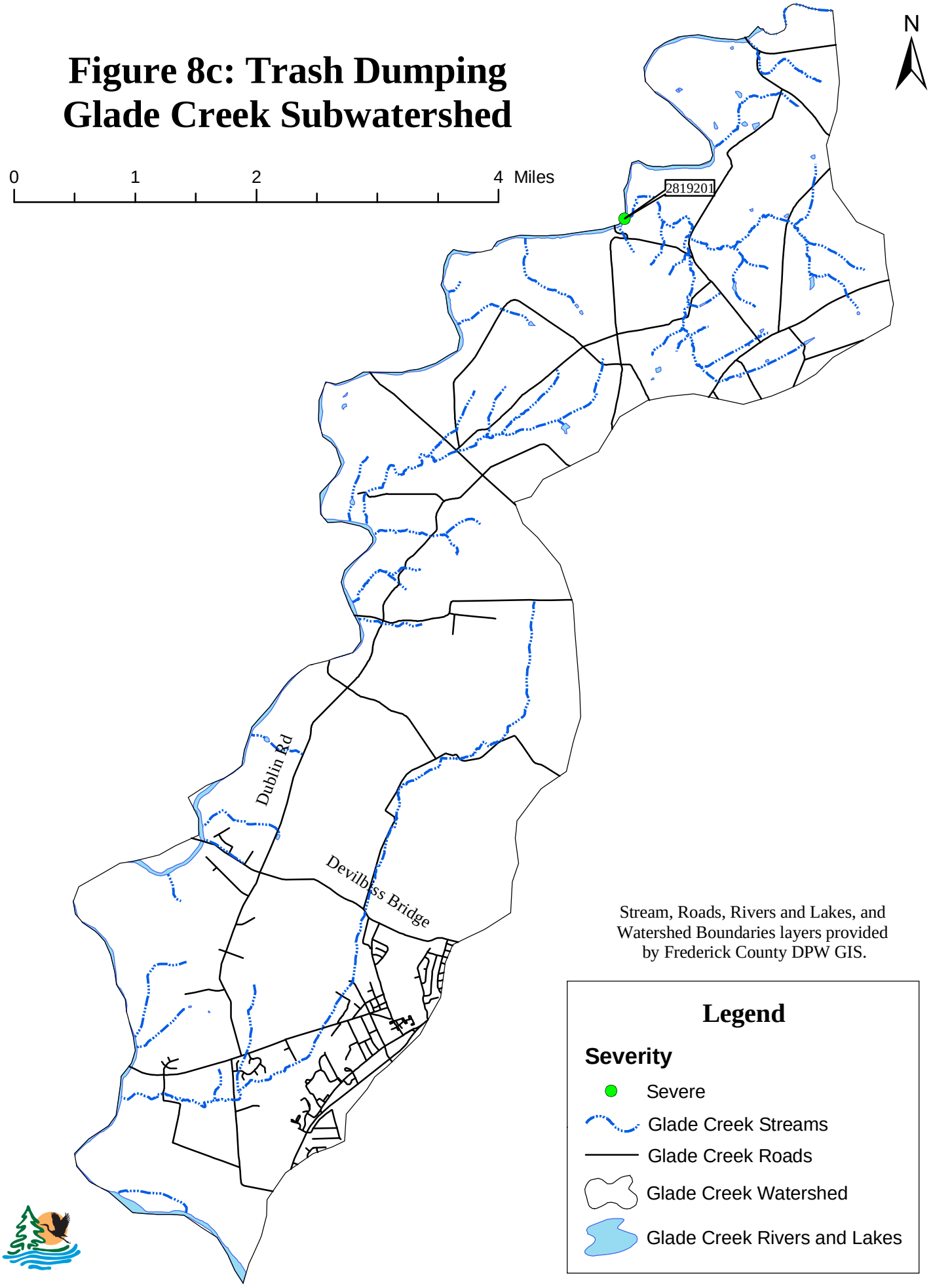


Figure 8c: Trash Dumping
Glade Creek Subwatershed



Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

Legend

Severity

- Severe
- Glade Creek Streams
- Glade Creek Roads
- Glade Creek Watershed
- Glade Creek Rivers and Lakes

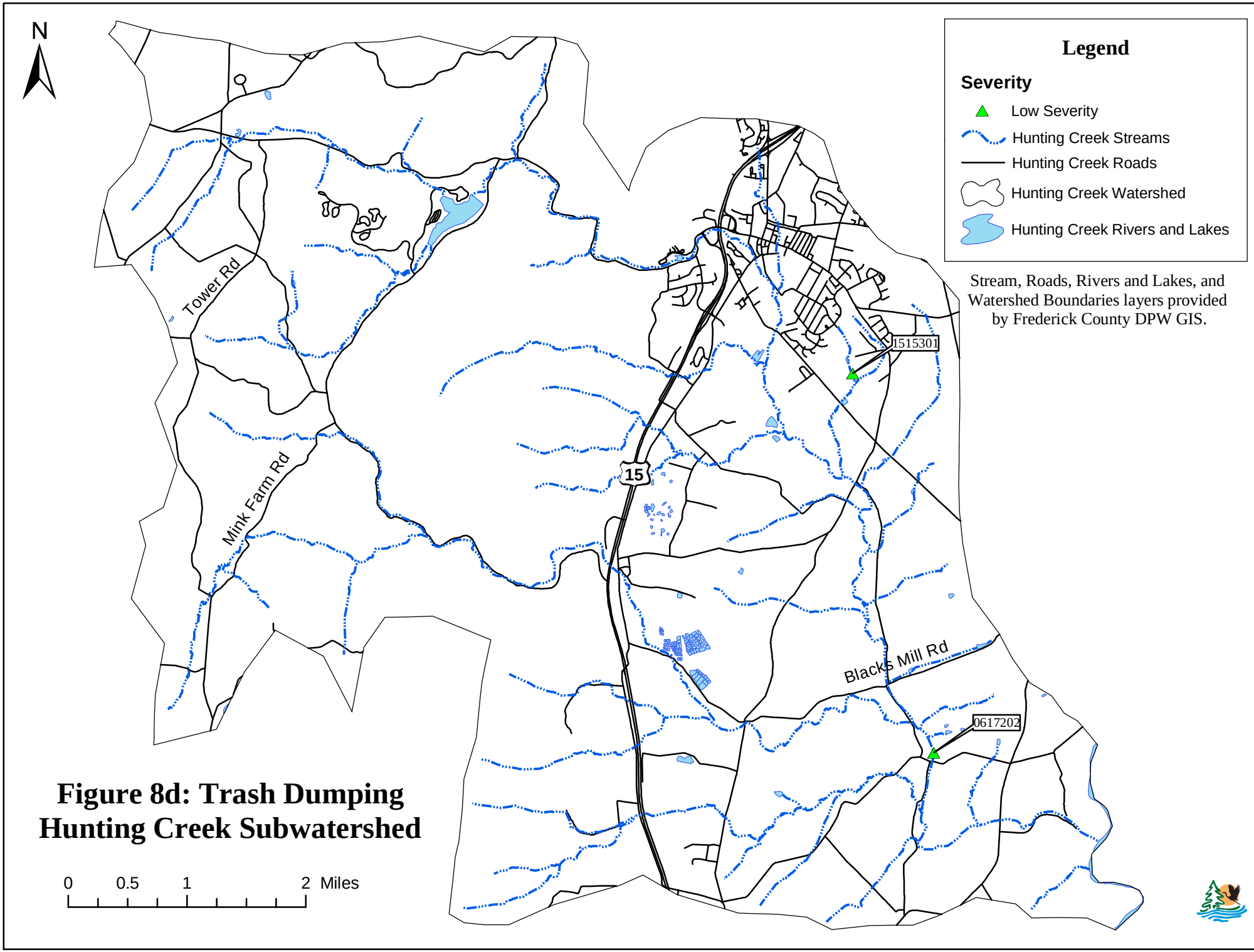


Figure 8d: Trash Dumping Hunting Creek Subwatershed

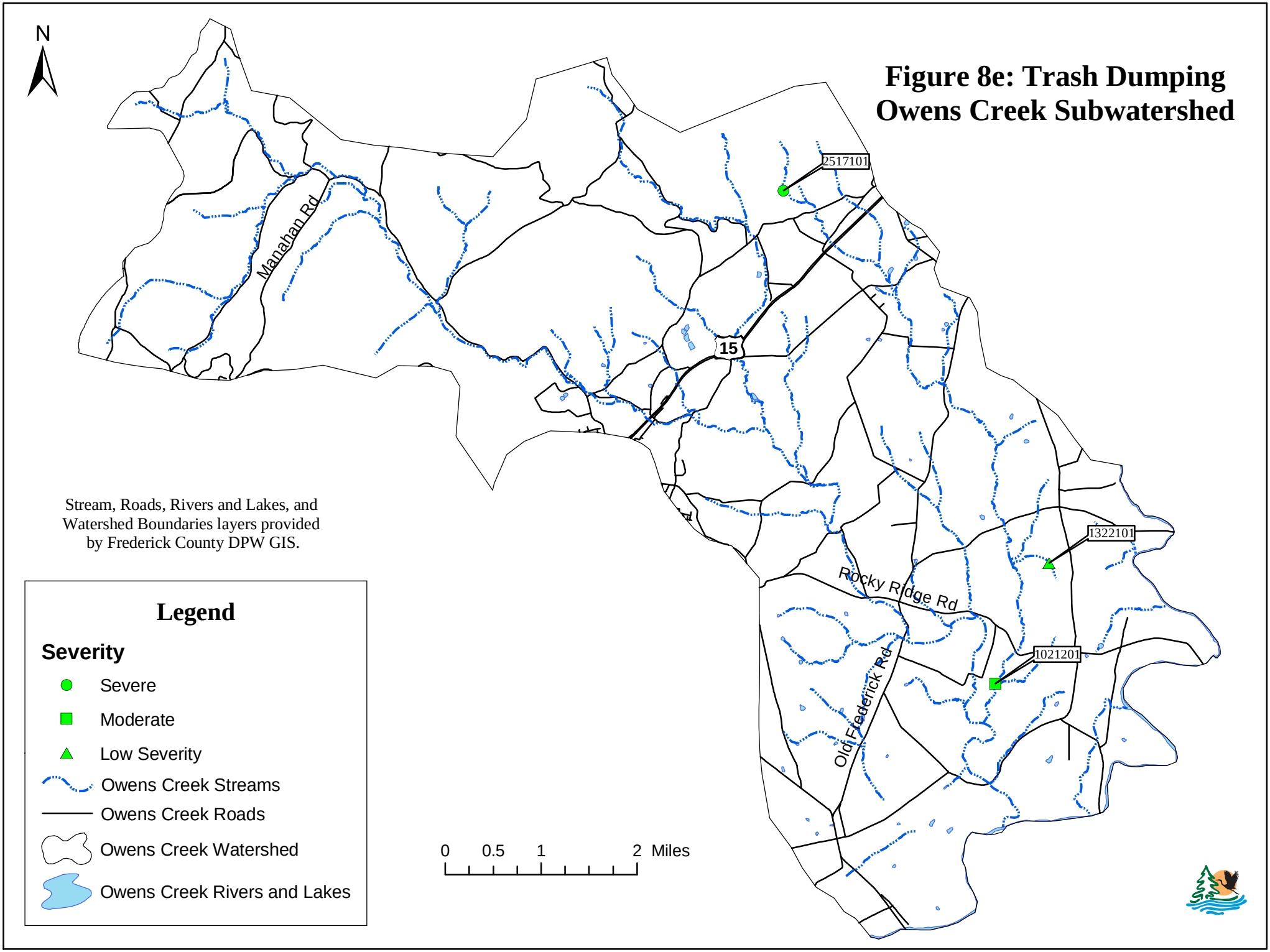
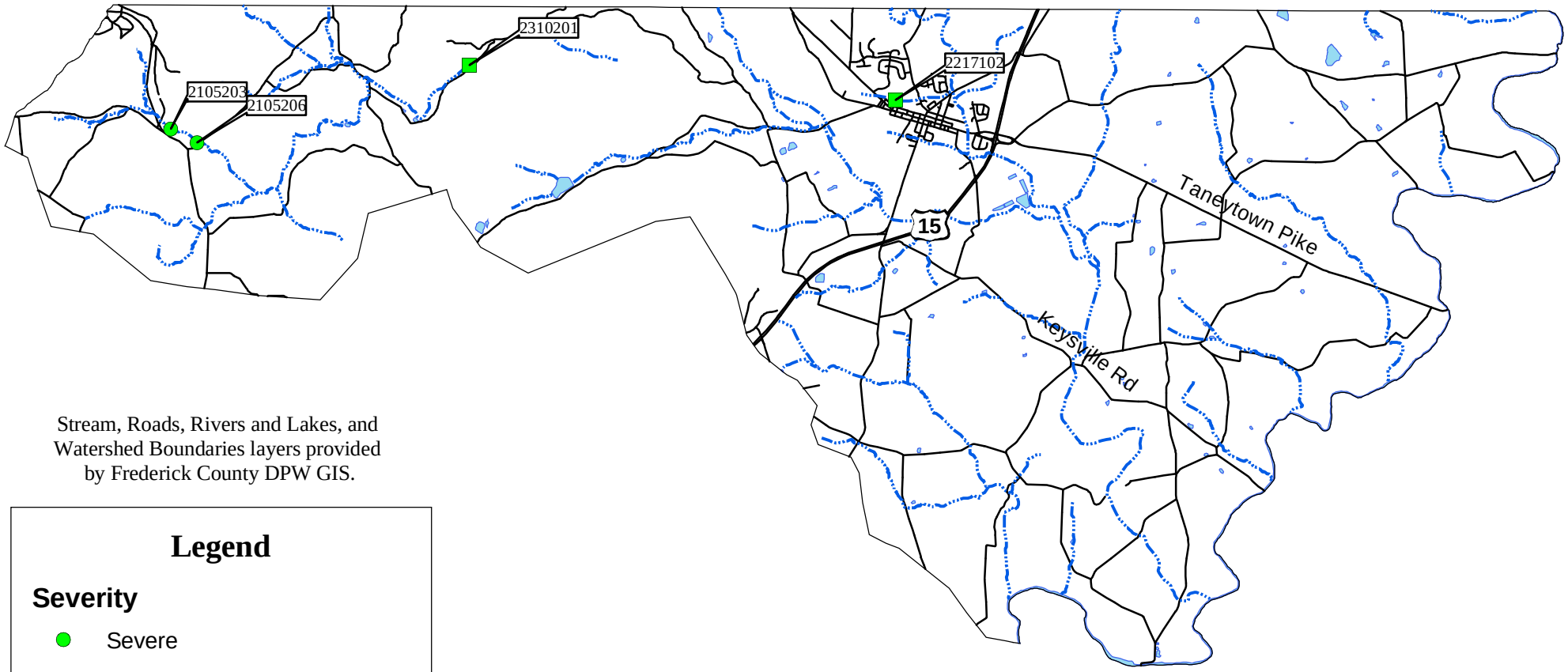

N
Figure 8e: Trash Dumping
Owens Creek Subwatershed
2517101
Manahan Rd
15
1322101
Rocky Ridge Rd
1021201
Old Frederick Rd
Stream, Roads, Rivers and Lakes, and
Watershed Boundaries layers provided
by Frederick County DPW GIS.
Legend
Severity
Severe
Moderate
Low Severity
Owens Creek Streams
Owens Creek Roads
Owens Creek Watershed
Owens Creek Rivers and Lakes
0 0.5 1 2 Miles

Figure 8f: Trash Dumping
Toms Creek Subwatershed



Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

Legend

Severity

- Severe
- Moderate
- Toms Creek Streams
- Toms Creek Roads
- Toms Creek Watershed
- Toms Creek Rivers and Lakes

0 1 2 4 Miles

N

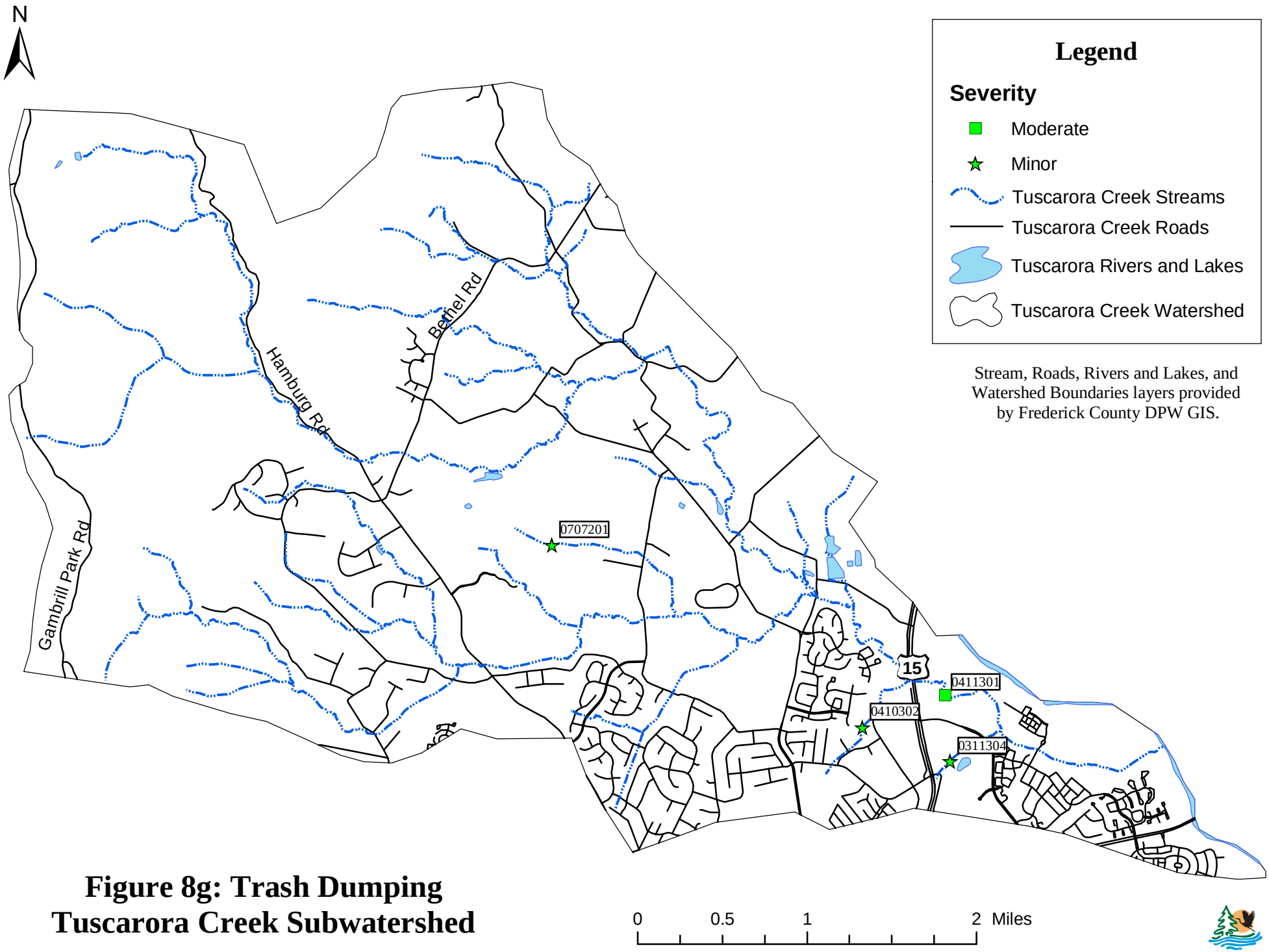


Figure 8g: Trash Dumping
Tuscarora Creek Subwatershed

Channel Alterations

Channel alterations sites are stream sections where the stream's banks and channel have been significantly altered from a natural condition. This includes areas where the stream may have been straightened and/or where the stream banks have been hardened using rock, gabion baskets or concrete over a significant length. It does not include road crossings unless a significant portion of the stream above and below the road has also been channelized. In addition, places where a small section of only one side of the stream's banks may have been stabilized to reduce erosion were not reported as channel alterations. However, if human alterations to the channel were performed in an effort to protect the channel, this may indicate a stormwater problem upstream/upland from the site. It is recommended that the WRAS committee investigate such situations. For the purposes of this survey, channel alteration also does not include tributaries where storm drains were placed in the stream channel, and the entire tributary is now piped underground. While these streams sections have been significantly altered, it is not possible to tell by walking the stream corridor precisely where this was done.

In the six subwatersheds of the Upper Monocacy River watershed, survey crews found 11 areas where the stream channel had been recognizably altered in three of the subwatersheds. Locations of channel alteration sites are shown in Figure 9b, 9c, and 9d. Channel alterations were found in the Hunting Creek, Fishing Creek, and Tuscarora Creek watersheds equaling approximately 2,712 feet in total length. Six sites were concrete, 2 were earth channels, and 3 were rip-rap. All severity rankings were low to minor (Figure 9a) and all but one were reported to have perennial flow.

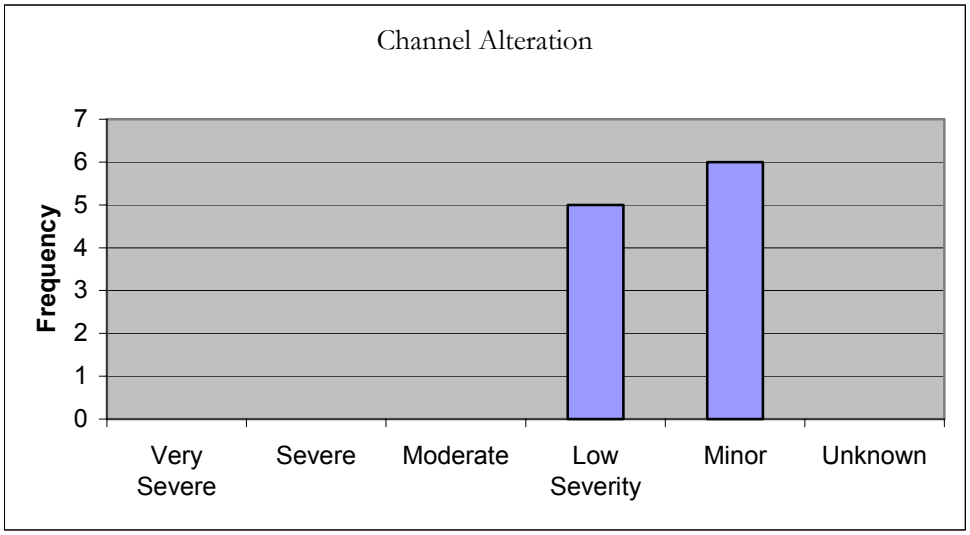


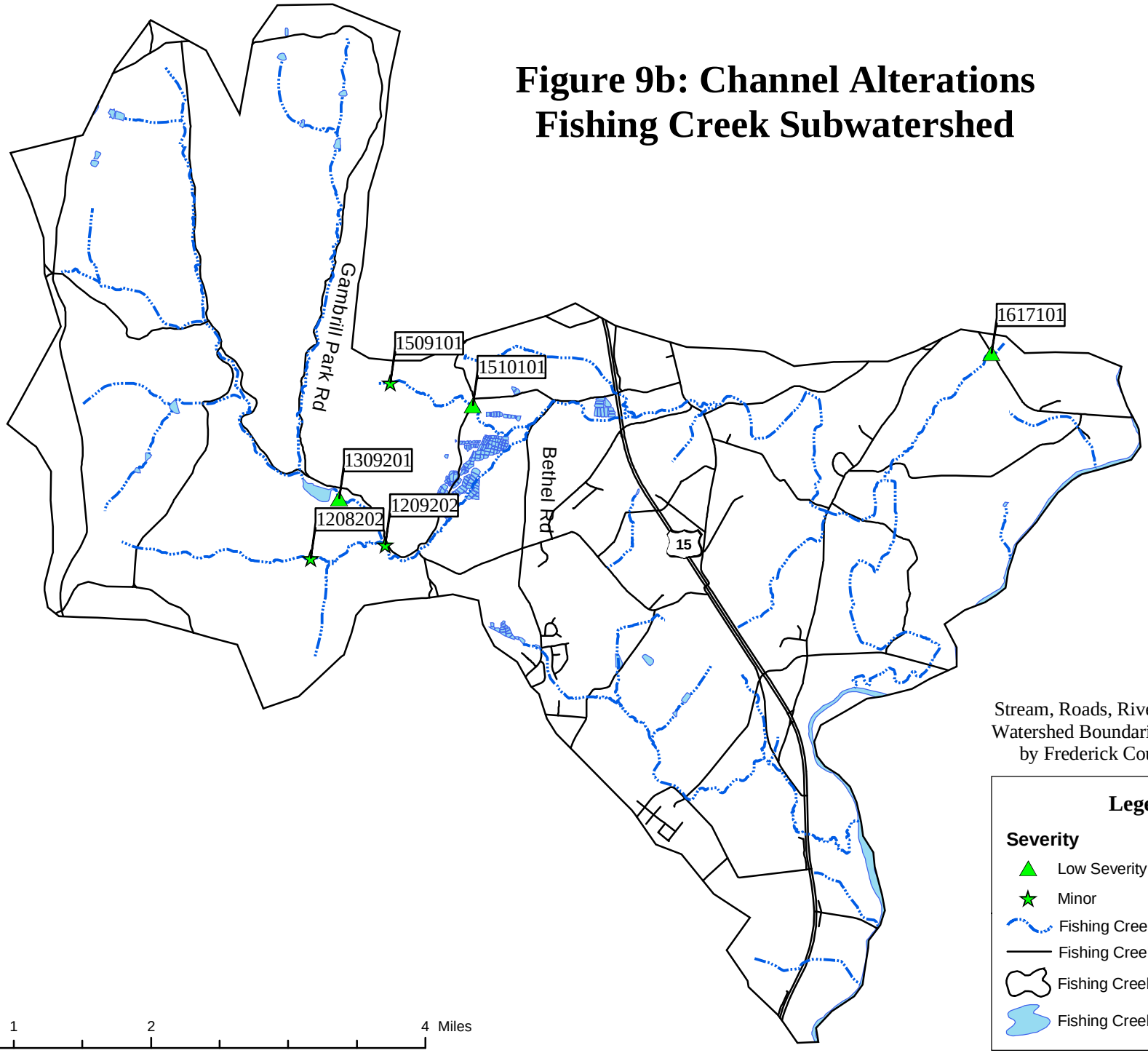
Figure 9a: Histograph showing the frequency of severity ratings given to channel alteration sites during the Upper Monocacy SCA survey

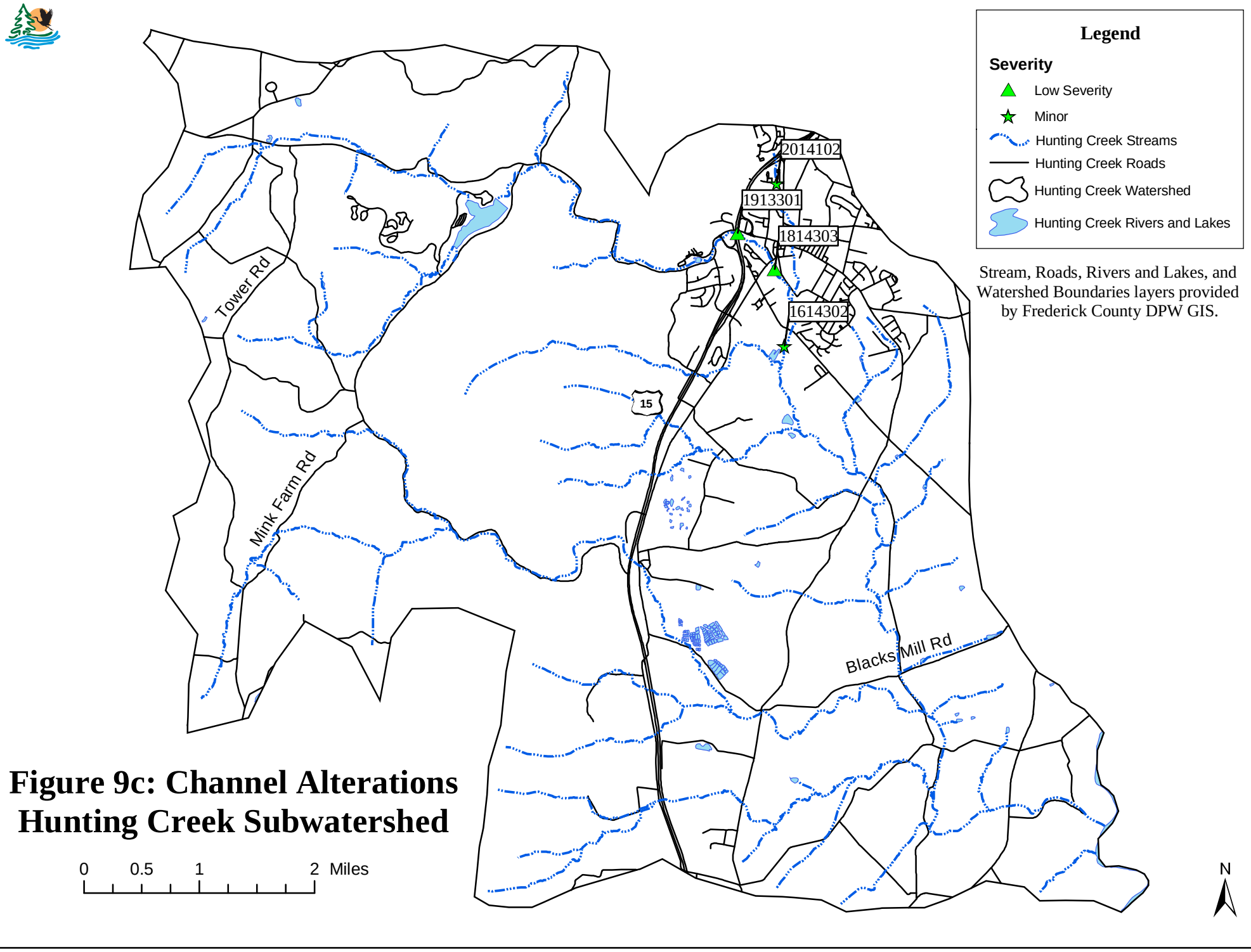
The severity of channel alterations is based on both the channel type and the length of the site. The presence of hardened stream banks using concrete or rock for a total length of over a thousand feet increases the severity of a site. This is due to the greater habitat potential of earth channels, which can easily develop and support vegetation, stream sinuosity, and refuge areas for wildlife within the channel bed than areas with a hardened stream channel.

In addition to channel type and site length, the potential fish and wildlife habitat available within the channel was a factor in evaluating severity. Sites that showed signs of forming bends, having natural banks, or supporting forest or wetland vegetation over a considerable length of the total site rank as less severe than those sites without these characteristics. The presence of vegetation and sediment in the channel are two factors recorded in the survey that may indicate a higher habitat potential for the earth channel. Six of the eleven channel alteration sites supported both vegetation and sediment in the channel.

Restoring channel alteration sites can increase fish and wildlife habitat and may allow for additional 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 9b: Channel Alterations
Fishing Creek Subwatershed





Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

Figure 9c: Channel Alterations Hunting Creek Subwatershed

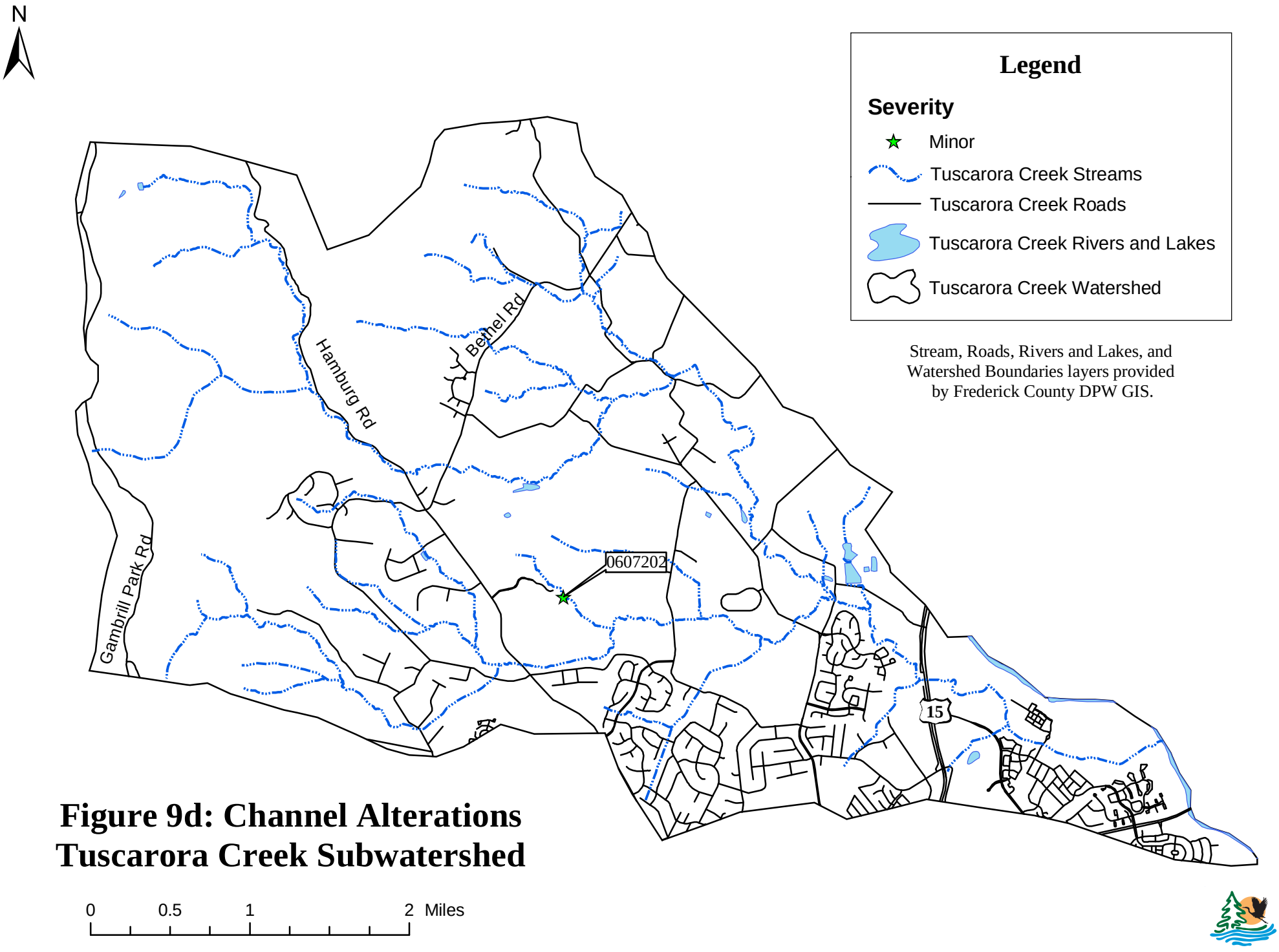


Figure 9d: Channel Alterations Tuscarora Creek Subwatershed

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 crews identified 8 unusual conditions and 8 comments throughout the Upper Monocacy River watershed. The conditions and comments noted vary from a dry stream to wetland potential to livestock access and others. It is recommended that unusual conditions be further investigated to determine cause and potential correctibility. Unusual conditions were found in 5 of the six subwatersheds while comments were made in 3 of the 6 subwatersheds (Figures 10b-10f).

Only sites marked as unusual conditions are given a severity ranking. The severity of the sites ranged from very severe to unknown. The frequency of these ranking can be seen in Figure 10a.

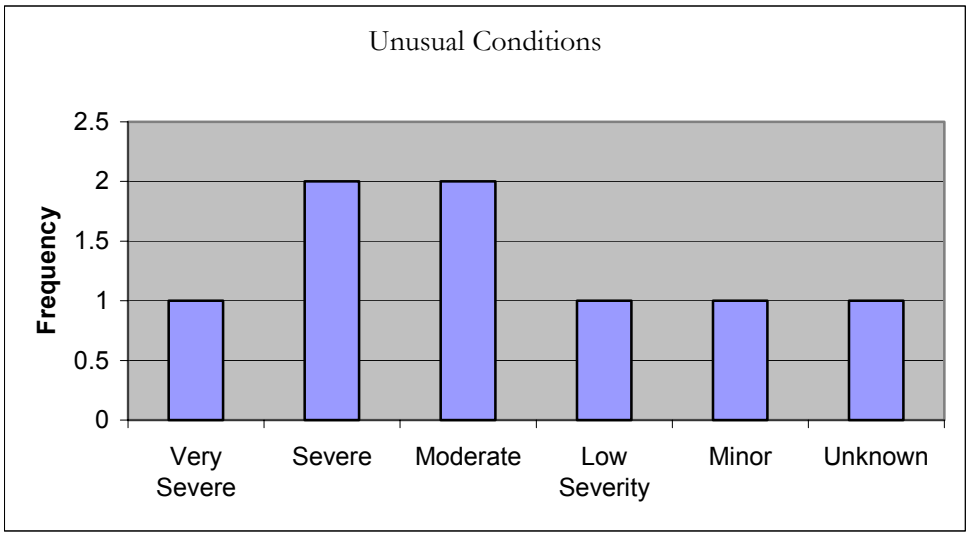


Figure 10a: Histograph of the frequency of severity ratings given to unusual condition sites in the Upper Monocacy River SCA survey.

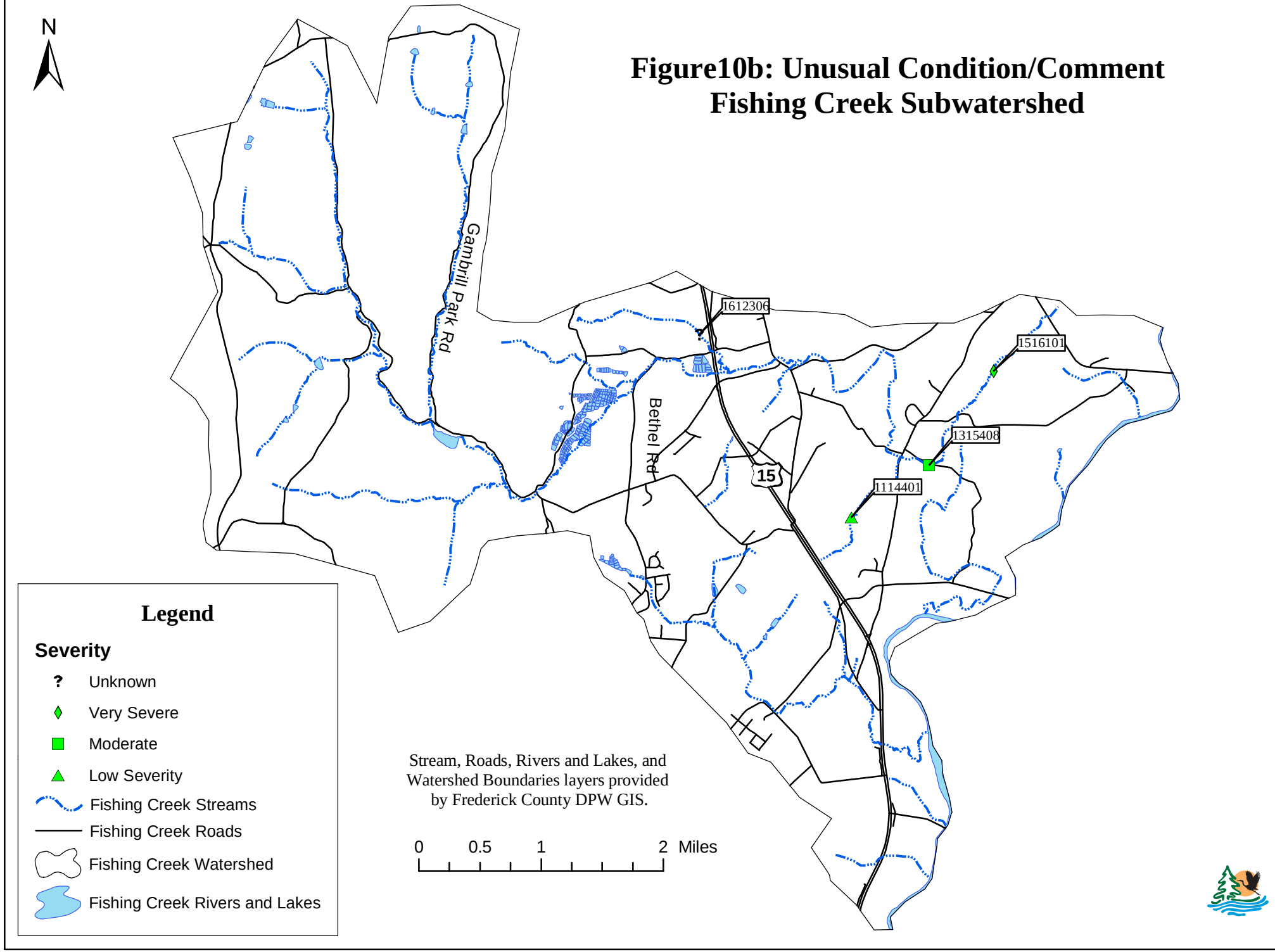
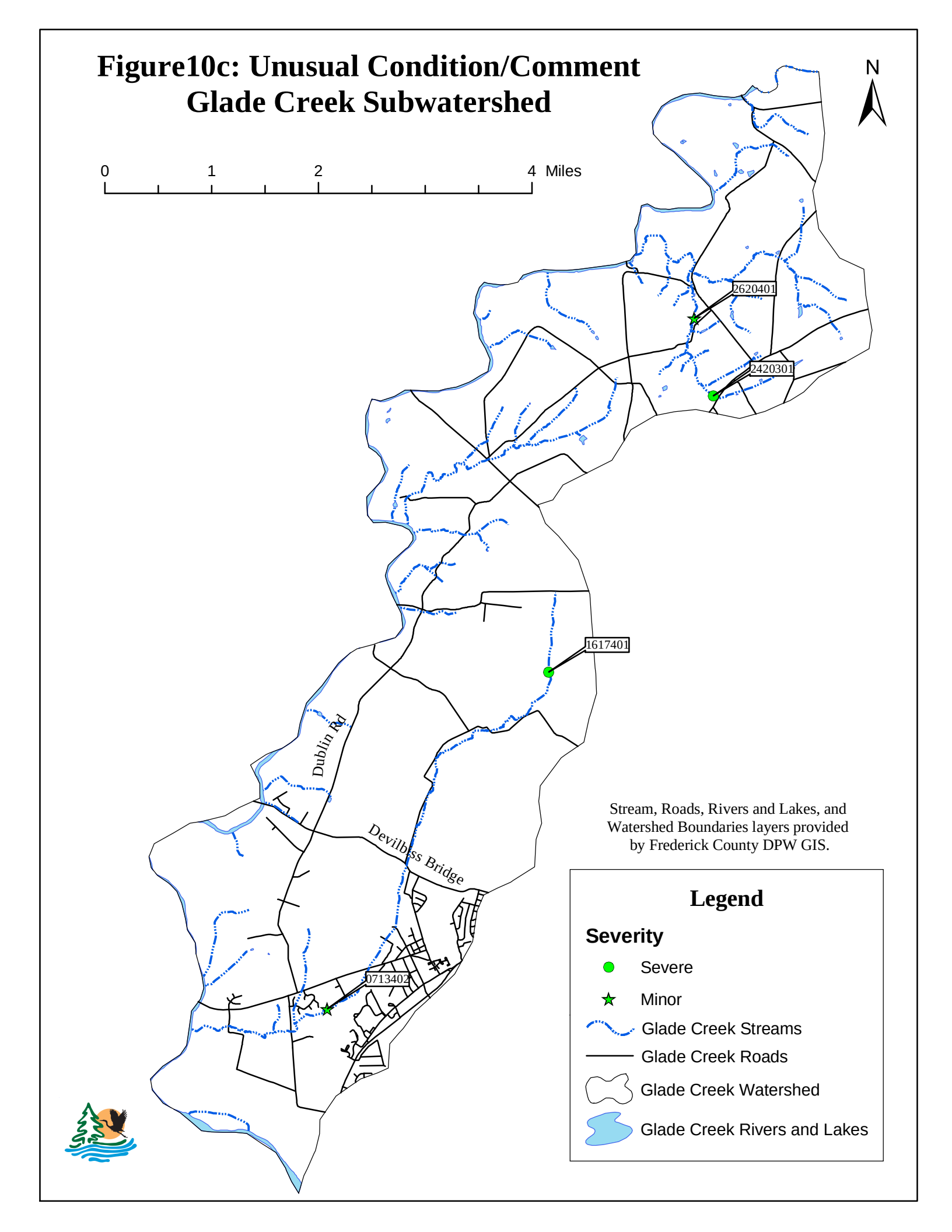

N
Figure10b: Unusual Condition/Comment
Fishing Creek Subwatershed
Gambrill Park Rd
Bethel Rd
15
1612306
1516101
1315408
1114401
Legend
Severity
? Unknown
Very Severe
Moderate
Low Severity
Fishing Creek Streams
Fishing Creek Roads
Fishing Creek Watershed
Fishing Creek Rivers and Lakes
Stream, Roads, Rivers and Lakes, and
Watershed Boundaries layers provided
by Frederick County DPW GIS.
0 0.5 1 2 Miles

Figure10c: Unusual Condition/Comment
Glade Creek Subwatershed



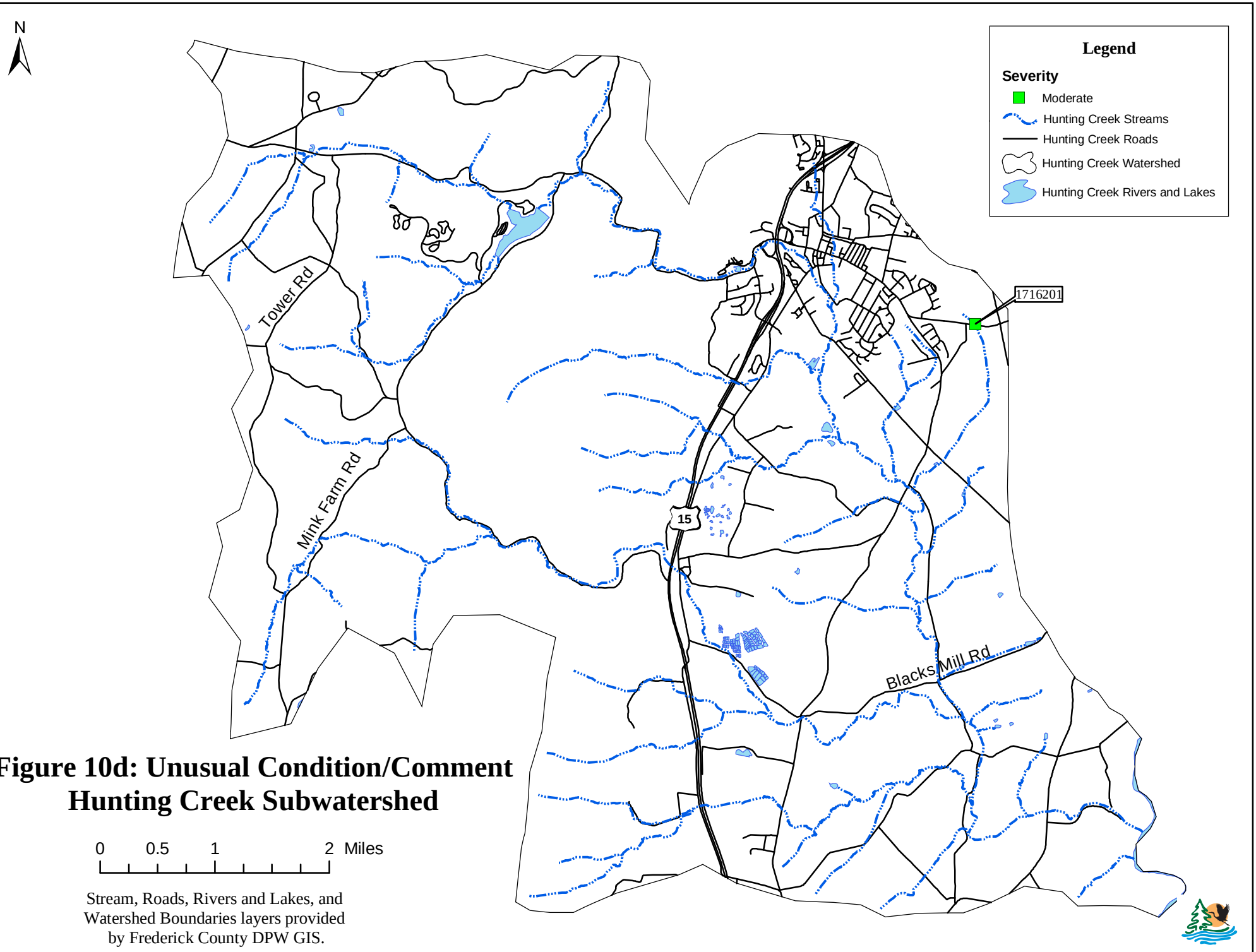


Figure 10d: Unusual Condition/Comment Hunting Creek Subwatershed

Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

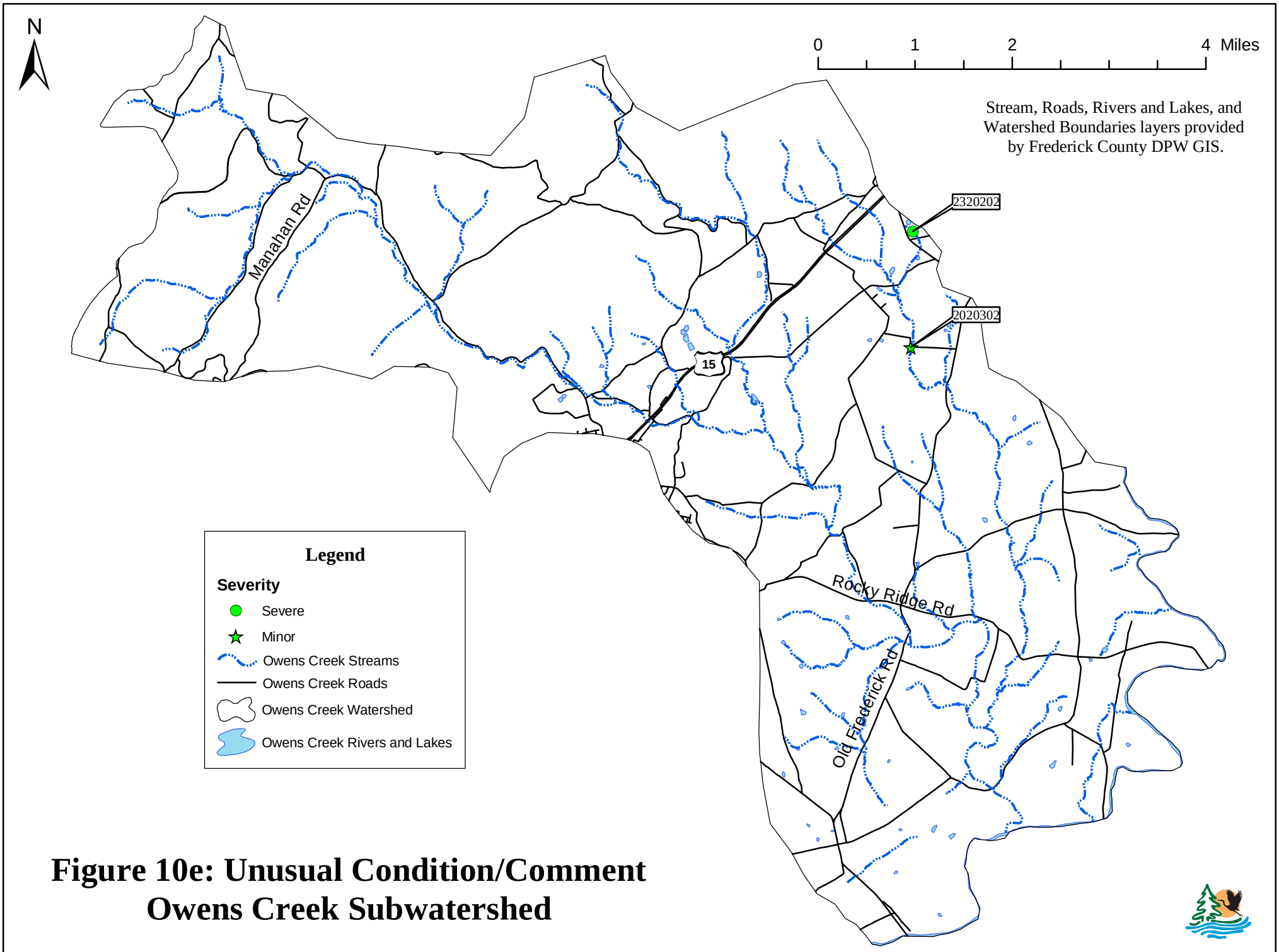


Figure 10e: Unusual Condition/Comment Owens Creek Subwatershed

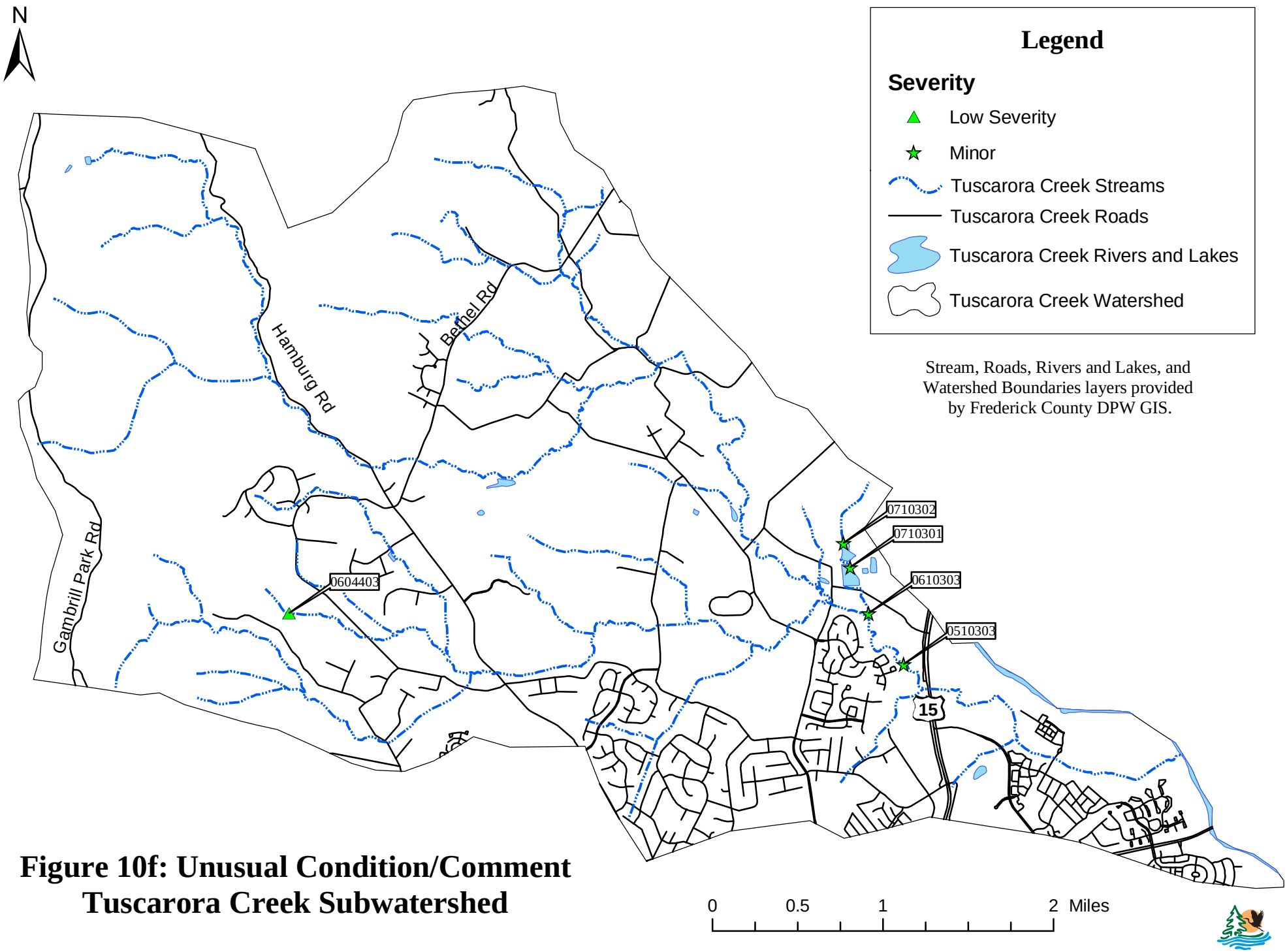


Figure 10f: Unusual Condition/Comment
Tuscarora Creek Subwatershed

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 stream bed.

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 seven exposed pipes during the survey, rated between severe and low severity (Figure 11a). Exposed pipes were cited in 4 of the 6 subwatersheds (Figures 11b-11e). Four of the pipes were exposed above the stream while the other three were exposed across the bottom of the stream. Only one of the pipes had a clear and odorless discharge at the time of the survey and as a result was given a severe ranking (1510102). Five of the pipes were noted as having a diameter less than ten inches. The other two pipes, 0711203 found in Glade Creek and 0506401 found in Tuscarora Creek had diameters greater than ten inches. Six of the pipes were made of smooth metal with the final pipe made of concrete. In all cases, survey crews were unable to determine the purpose of the pipe.

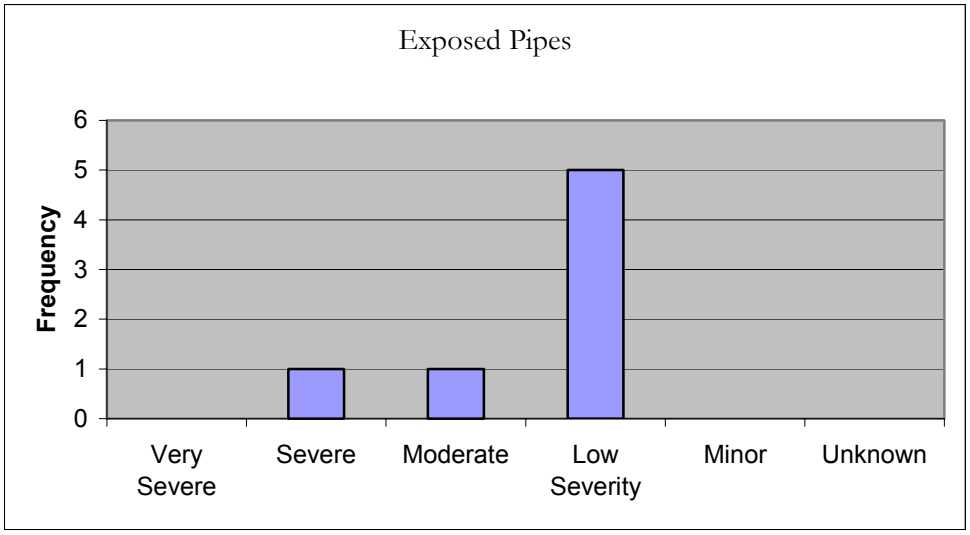


Figure 11a. Histograph showing the severity rating given to exposed pipe site during the Upper Monocacy River SCA survey.

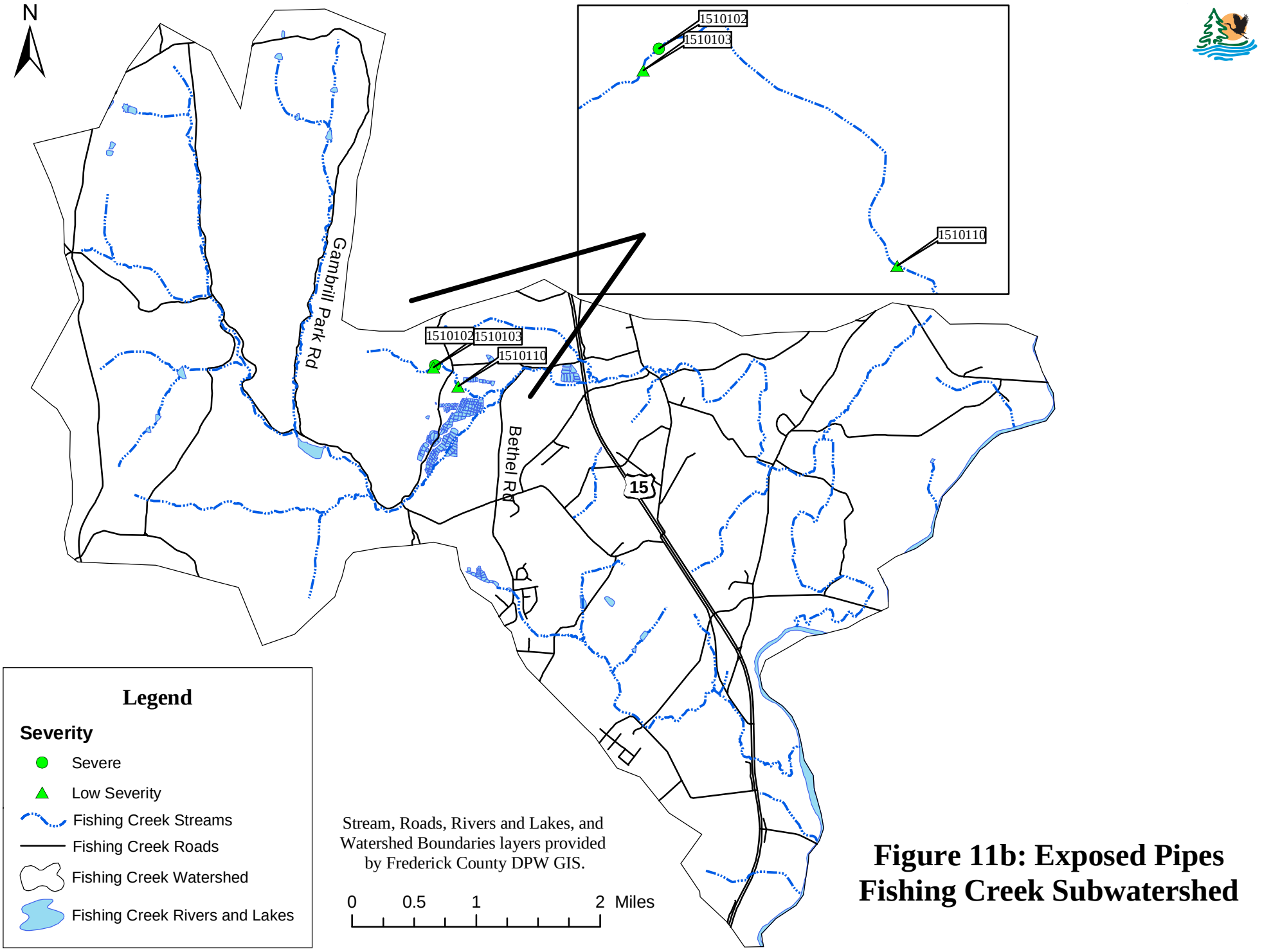
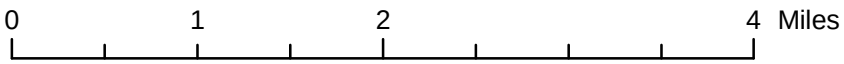


Figure 11b: Exposed Pipes Fishing Creek Subwatershed

Figure 11c: Exposed Pipes
Glade Creek Subwatershed



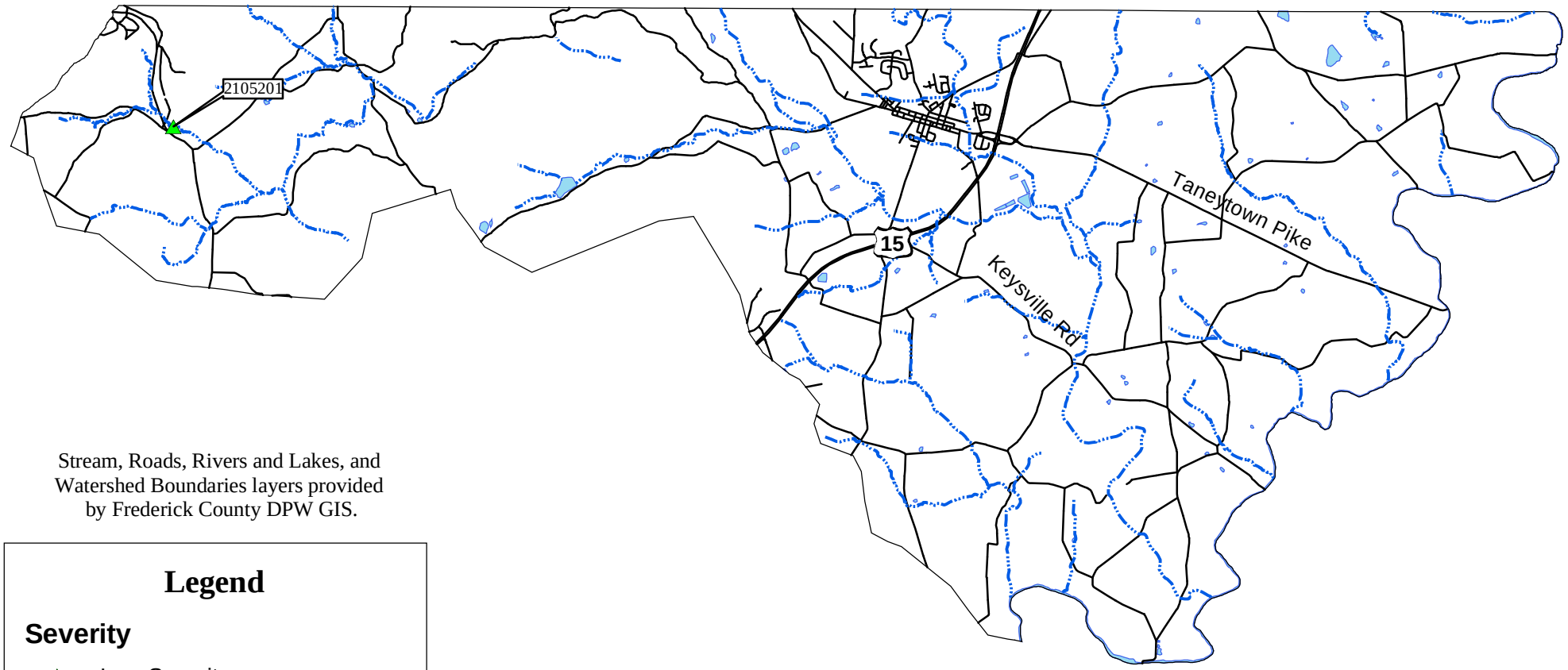
Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

Legend

Severity

- Moderate
- Glade Creek Streams
- Glade Creek Roads
- Glade Creek Watershed
- Glade Creek Rivers and Lakes

Figure 11d: Exposed Pipes
Toms Creek Subwatershed



N

Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

Legend

Severity

- Low Severity
- Toms Creek Streams
- Toms Creek Roads
- Toms Creek Watershed
- Toms Creek Rivers and Lakes

0 1 2 4 Miles

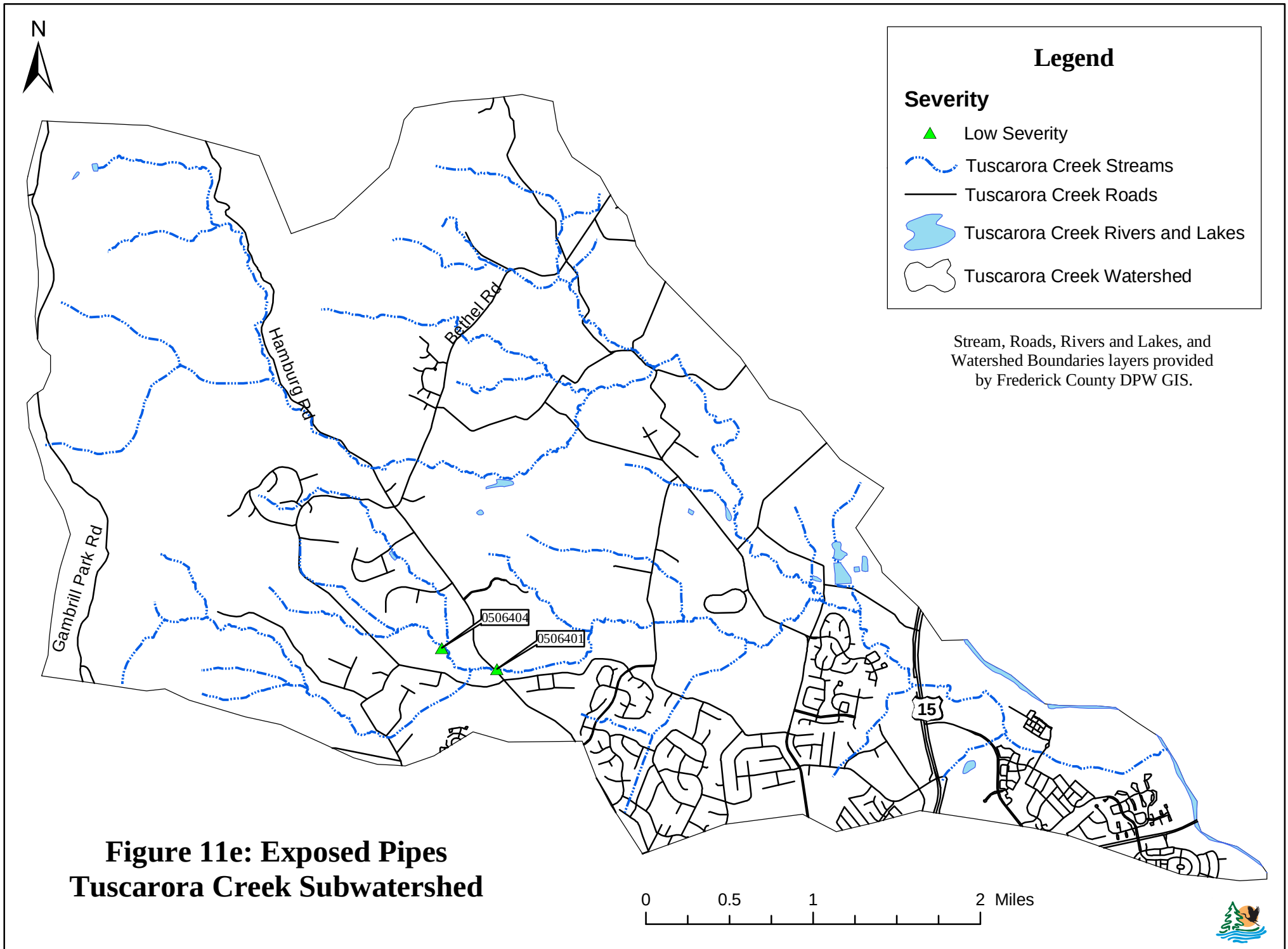


Figure 11e: Exposed Pipes
Tuscarora Creek Subwatershed

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:

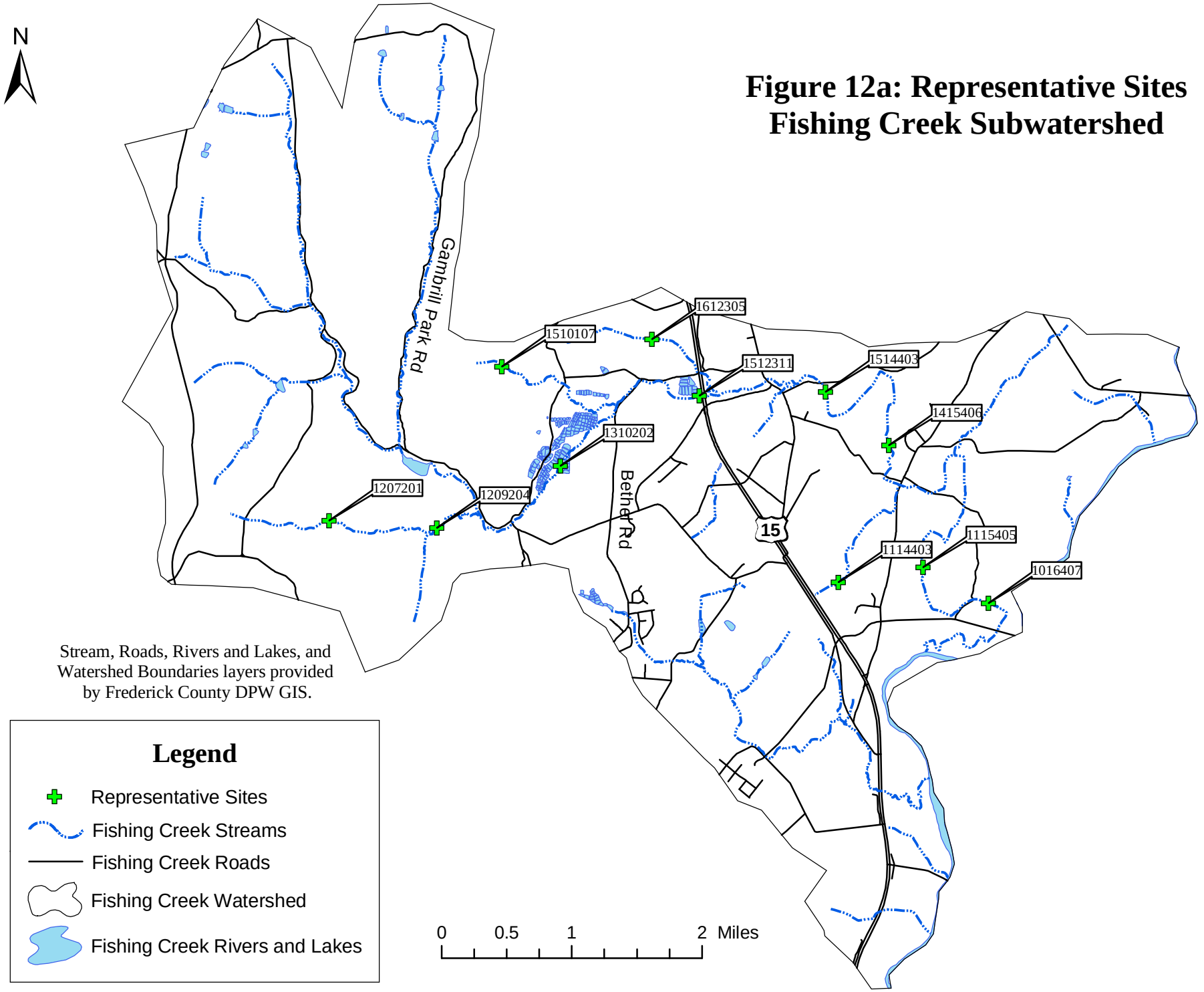
- Attachment Sites for Macroinvertebrates
- Embeddedness
- Shelter for Fish
- Channel Alteration
- Sediment Deposition
- Velocity and Depth Regime
- Channel Flow Status
- Bank Vegetation Protection
- Condition of Banks
- Riparian Vegetative Zone Width

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 54 representative sites in the Upper Monocacy River watershed. Locations of representative sites are shown in Figures 12a-12f, and data collected for all categories are listed in Appendix B.

Since representative sites provide an overall assessment of the in-stream and riparian corridor habitat, they can be used to target areas for restoration. The WRAS committee can suggest further investigation of areas given marginal to poor ratings such as sites 1617402 in Glade Creek and 1617202 in Hunting Creek. If there are areas that the WRAS committee has already identified for targeted restoration, the representative sites can be used to give additional information on the condition of the stream corridor as well. In addition, these sites can be used to identify areas of the stream corridor where the in-stream and riparian corridors are pristine and should thus be targeted with preservation. Sites were observed within three of the subwatersheds having optimal conditions across the board. These sites are 1207201 (Fishing Creek), 1112301 (Hunting Creek), and 2320201 (Toms Creek). Other sites having a combination of optimal and suboptimal conditions occurred more frequently and can be found in all subwatersheds. These areas could possibly be targeted for preservation with minimal amounts of restoration. It is recommended that the WRAS committee utilize the representative sites in Appendices A and B to assist in restoration and preservation targeting.

Figure 12a: Representative Sites Fishing Creek Subwatershed

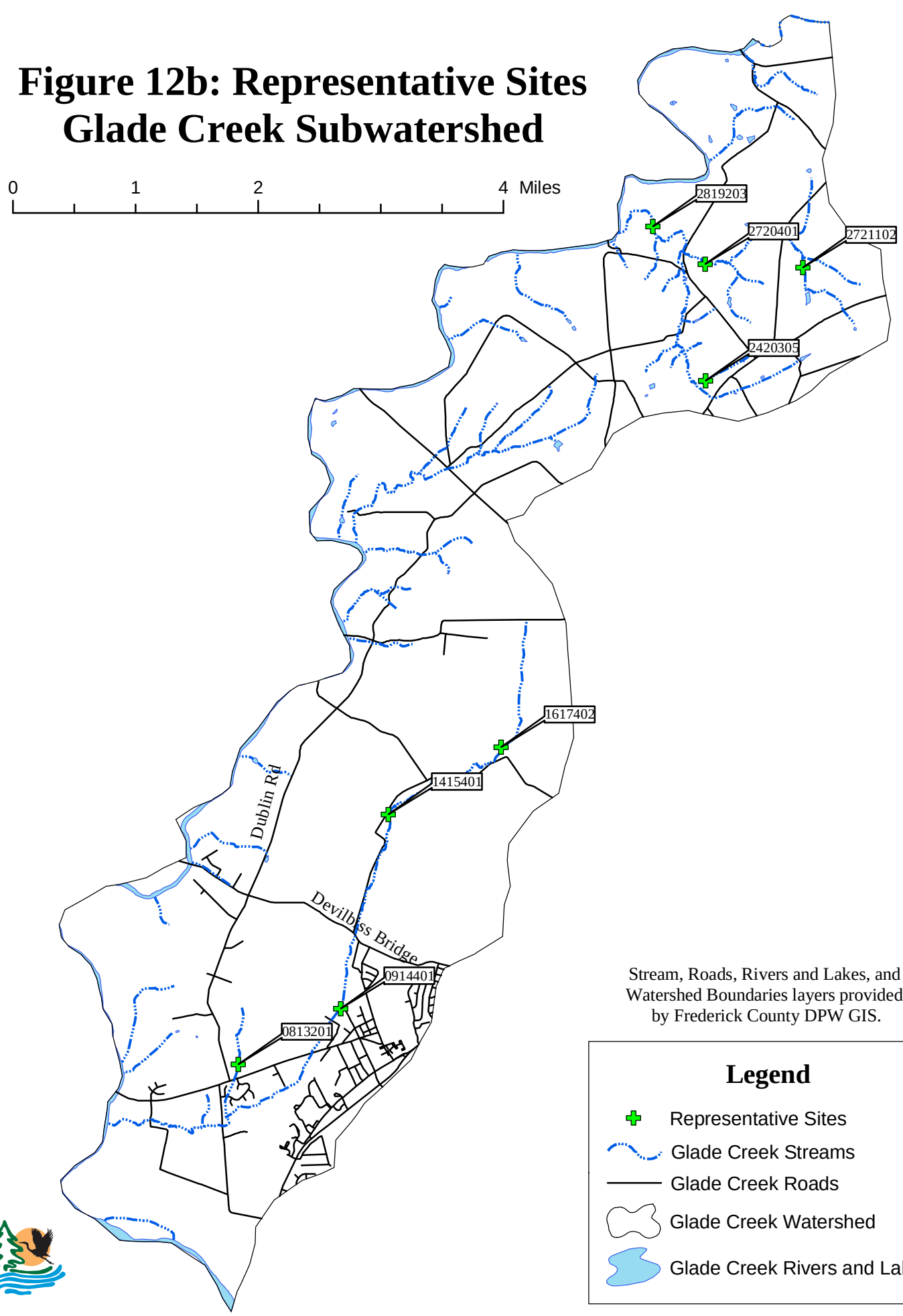


Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

Legend

- Representative Sites
- Fishing Creek Streams
- Fishing Creek Roads
- Fishing Creek Watershed
- Fishing Creek Rivers and Lakes

Figure 12b: Representative Sites Glade Creek Subwatershed



Stream, Roads, Rivers and Lakes, and Watershed Boundaries layers provided by Frederick County DPW GIS.

Legend

- Representative Sites
- Glade Creek Streams
- Glade Creek Roads
- Glade Creek Watershed
- Glade Creek Rivers and Lakes

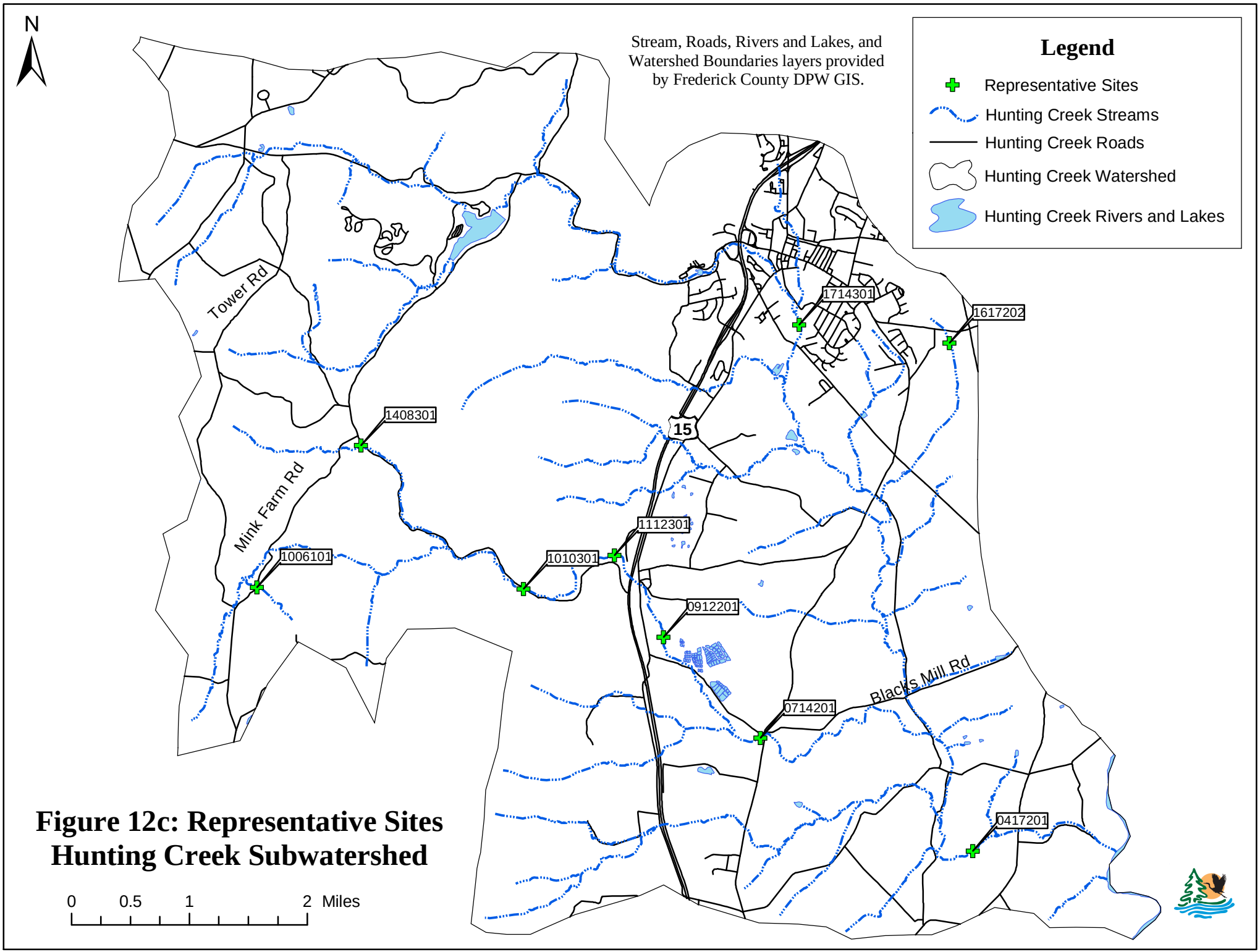


Figure 12c: Representative Sites Hunting Creek Subwatershed

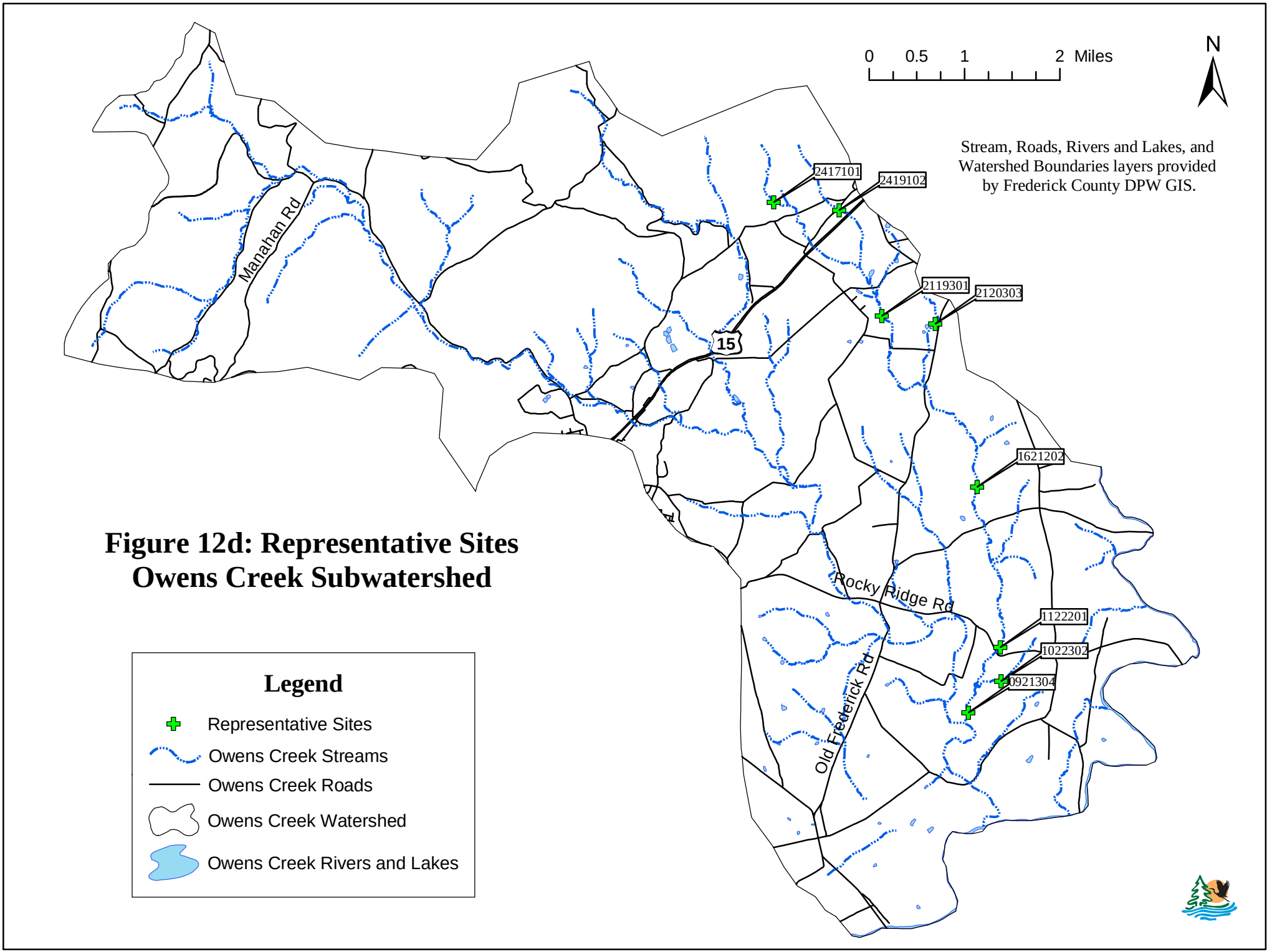
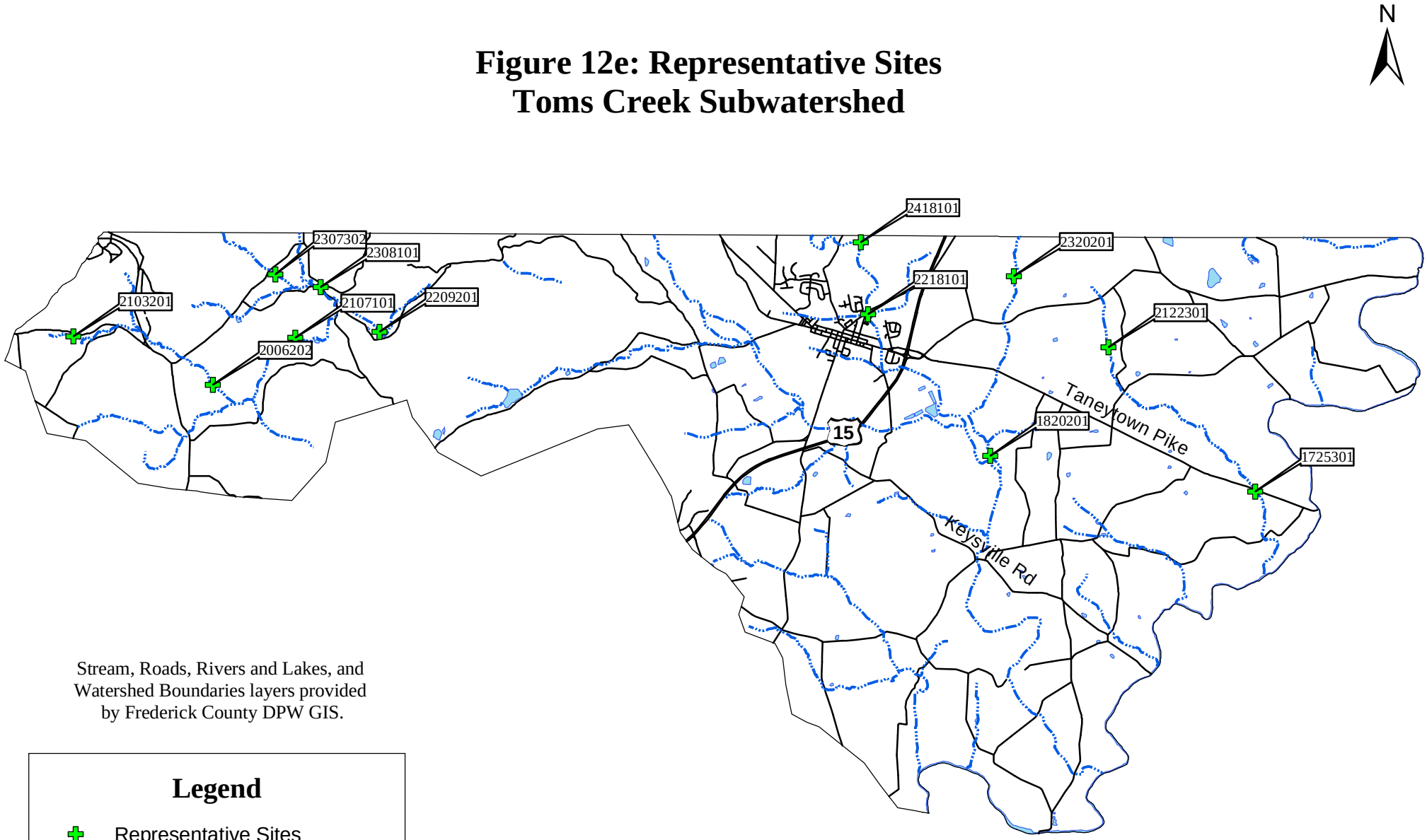


Figure 12d: Representative Sites Owens Creek Subwatershed

Figure 12e: Representative Sites
Toms Creek Subwatershed



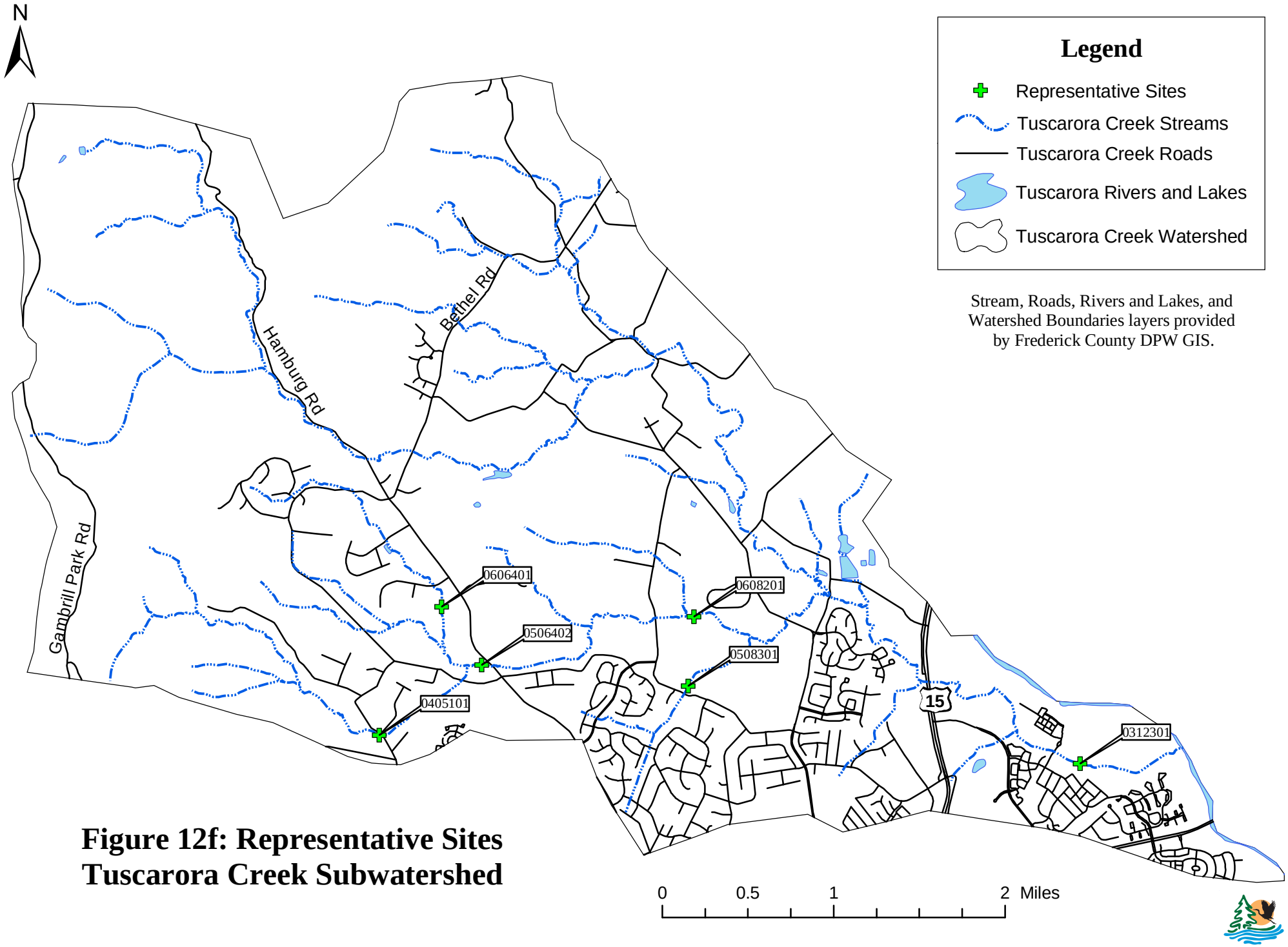


Figure 12f: Representative Sites
Tuscarora Creek Subwatershed

DISCUSSION

The results of the Upper Monocacy 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 survey 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 watershed's 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.

During the SCA survey, the most frequently observed potential problem sites were inadequately forested buffers, reported at 102 sites (or 67.51 miles of stream on the left bank and 67.81 miles of stream on the right bank), and erosion sites, reported at 49 sites (or 22.74 miles of stream). Other potential environmental problems recorded during the survey included: 33 fish barriers, 24 pipe outfalls, 17 trash dumping sites, 11 channel alterations, 8 unusual conditions, 7 exposed pipe, and no in- or near-stream construction sites (Table 1). Additionally, crews recorded descriptive habitat condition data at 54 representative sites.

Inadequate buffers were the most common observed problem within the Upper Monocacy River watershed. Erosion sites were the second most common observed problem within the Upper Monocacy. This is not surprising considering the almost 50% of the land in the Upper Monocacy watershed is agricultural. In most cases, erosion sites were found either in conjunction with or just downstream from inadequate buffer sites. The occurrence is most likely due to increased flow rates of water and scour from stream banks and the stream bed through the stream channel. However, the degree of soil erodibility and the change in gradient from the headwaters to the confluence with the Monocacy River play important roles as well.

For example, the stream survey crews walked 18.02 miles within the Glade Creek subwatershed and found that approximately 80% of the stream banks were inadequately buffered but only 21% of the banks were eroded. While in the Tuscarora Creek subwatershed, the crews noted almost 60% of the banks as inadequately buffered and 40% of the banks as eroded. Though Glade Creek is almost completely inadequately buffered and is mostly agricultural in land use, it is a very flat watershed. There is little elevation change from the headwaters to the confluence. Additionally, the soil in this subwatershed is not considered highly erodible.

In contrast, Tuscarora Creek's headwaters are located in Gambrill State Park and the Frederick City Watershed, in the Catoctin Mountains and soils are considered highly erodible. As waters flow downstream, gradient decreases, agriculture increases, and development increases, all continuing to add to the flow rates of water leaving the landscape.

The GIS and attribute data for the sites described in the SCA survey can be combined with other existing GIS datasets to 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, 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 Natural Resources has formed a partnership with Frederick County to develop a Watershed Restoration Action Strategy (WRAS) for the Upper Monocacy 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 Upper Monocacy River Watershed WRAS Steering Committee, which is developing a Watershed Restoration Action Strategy for the Upper Monocacy River. Information on the Upper Monocacy River Watershed Action Strategy can be found on the Department of Natural Resources' website (www.dnr.maryland.gov/wras).

REFERENCES

Annual Report, National Pollutant Discharge Elimination System, Municipal Separate Storm Sewer System Discharge Permit Number MD0068357. Section 7.6. Prepared by Versar, Inc. for Frederick County Division of Public Works, Maryland. March 11, 2003.

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. Web address is http://misdata/cwap/index.html.

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.

National 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.

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.

Appendix A

Listing of sites by site number

Location	Problem	Severity	Correctability	Acccess	X Coordinate	Y Coordinate	Stream
2521301	Inadequate Buffer	5	1	1	375567.52443	210986.68887	Glade Creek
0310301	Inadequate Buffer	3	4	4	364659.60284	198815.43945	Tuscarora Creek
0311301	Fish Barrier	5	2	1	365671.00931	198729.72382	Tuscarora Creek
0311302	Inadequate Buffer	3	4	4	365672.01919	198729.84527	Tuscarora Creek
0311303	Erosion Site	5	3	3	365757.25897	198824.59099	Tuscarora Creek
0311304	Trash Dumping	5	3	3	365782.36447	198851.51853	Tuscarora Creek
0312301	Representative Site				366865.75741	198842.23893	Tuscarora Creek
0405101	Representative Site				360287.68317	199111.34724	Tuscarora Creek
0407301	Inadequate Buffer	2	4	1	362179.27246	199331.24496	Tuscarora Creek
0408301	Erosion Site	5	1	1	362584.19153	199207.37042	Tuscarora Creek
0408302	Erosion Site	5	1	1	362871.98023	199135.36729	Tuscarora Creek
0408303	Pipe Outfall	5	2	2	363032.12395	199318.28254	Tuscarora Creek
0408304	Erosion Site	4	3	2	363036.68143	199326.74636	Tuscarora Creek
0408305	Fish Barrier	5	3	2	363026.32420	199309.69862	Tuscarora Creek
0408306	Fish Barrier	4	2	1	363145.79901	199498.77041	Tuscarora Creek
0410301	Erosion Site	4	1	1	364903.14163	199029.33371	Tuscarora Creek
0410302	Trash Dumping	5	3	3	364950.68060	199172.82457	Tuscarora Creek
0411301	Trash Dumping	3	4	3	365737.12644	199479.05126	Tuscarora Creek
0417201	Representative Site				367269.26067	209175.92820	Hunting Creek
0419201	Erosion Site	4	4	3	368865.58825	209422.21874	Hunting Creek
0505401	Inadequate Buffer	4	2	1	360285.99135	200069.61126	Tuscarora Creek
0505402	Fish Barrier	4	4	1	360138.04967	200098.46436	Tuscarora Creek
0506401	Exposed Pipe	4	4	3	361369.91615	199764.86314	Tuscarora Creek
0506402	Representative Site				361249.28139	199771.35857	Tuscarora Creek
0506403	Inadequate Buffer	5	2	2	361129.72934	199763.40787	Tuscarora Creek
0506404	Exposed Pipe	4	3	5	360836.33933	199969.01427	Tuscarora Creek
0506405	Inadequate Buffer	5	4	3	360716.19553	200091.12231	Tuscarora Creek
0507401	Inadequate Buffer	3	4	2	362271.62108	199960.80235	Tuscarora Creek
0507402	Erosion Site	4	2	1	362271.91929	199960.94904	Tuscarora Creek
0508301	Representative Site				363185.23729	199571.84723	Tuscarora Creek
0510301	Inadequate Buffer	2	4	4	365017.12463	200000.22311	Tuscarora Creek
0510302	Erosion Site	2	4	4	365017.24608	200000.41063	Tuscarora Creek
0510303	Unusual Condition/Comment	5	1	2	365195.42997	199844.89966	Tuscarora Creek
0604401	Fish Barrier	4	2	1	359607.95270	200601.88249	Tuscarora Creek
0604402	Fish Barrier	4	3	3	359423.52071	200322.33463	Tuscarora Creek
0604403	Unusual Condition/Comment	4	3	3	359399.16177	200326.27875	Tuscarora Creek
0605401	Erosion Site	4	4	4	360047.64698	200371.00863	Tuscarora Creek
0606401	Representative Site				360872.29777	200317.69483	Tuscarora Creek
0607201	Inadequate Buffer	4	3	2	361669.93365	200550.57254	Tuscarora Creek
0607202	Channel Alteration	5	2	2	361772.41867	200447.14564	Tuscarora Creek
0607203	Fish Barrier	4	4	3	361988.16930	200236.49836	Tuscarora Creek
0607204	Erosion Site	4	5	4	362169.73979	200143.84603	Tuscarora Creek
0607205	Erosion Site	3	3	4	362277.50434	200143.34768	Tuscarora Creek
0607206	Inadequate Buffer	3	2	3	362277.38490	200143.26119	Tuscarora Creek
0608201	Representative Site				363240.91488	200222.57896	Tuscarora Creek
0608202	Inadequate Buffer	3	3	4	363172.60364	200225.54865	Tuscarora Creek
0608203	Erosion Site	5	3	3	362980.97299	200688.50358	Tuscarora Creek
0610301	Inadequate Buffer	4	2	2	364513.41215	200410.81513	Tuscarora Creek
0610302	Erosion Site	5	2	2	364513.42574	200410.98224	Tuscarora Creek
0610303	Unusual Condition/Comment	5	1	1	364863.68438	200326.27875	Tuscarora Creek

Location	Problem	Severity	Correctability	Acccess	X Coordinate	Y Coordinate	Stream
0616201	Inadequate Buffer	2	4	3	366817.23829	210675.55310	Hunting Creek
0617201	Inadequate Buffer	4	2	3	367155.34163	210629.42500	Hunting Creek
0617202	Trash Dumping	4	1	4	366991.04358	210369.23580	Hunting Creek
0704401	Inadequate Buffer	4	2	1	359475.77141	201023.41321	Tuscarora Creek
0704402	Inadequate Buffer	4	2	1	359247.12437	201338.64943	Tuscarora Creek
0705401	Inadequate Buffer	4	2	1	360350.79115	200937.29714	Tuscarora Creek
0707201	Trash Dumping	5	4	4	362003.24864	200903.46939	Tuscarora Creek
0708201	Pipe Outfall	5	2	3	362696.89851	200828.53693	Tuscarora Creek
0710301	Unusual Condition/Comment	5	1	1	364693.17179	200760.09990	Tuscarora Creek
0710302	Unusual Condition/Comment	5	1	1	364630.53451	200990.92988	Tuscarora Creek
0711201	Inadequate Buffer	2	4	4	366486.91888	200966.87075	Glade Creek
0711202	Erosion Site	2	4	4	366486.62116	200967.26549	Glade Creek
0711203	Exposed Pipe	3	5	4	366921.50786	200959.10266	Glade Creek
0712201	Inadequate Buffer	3	4	4	367779.52991	201337.05404	Glade Creek
0713201	Inadequate Buffer	3	4	4	368051.91298	201037.01774	Glade Creek
0713201	Inadequate Buffer	3	3	2	363854.98750	211013.93393	Hunting Creek
0713401	Fish Barrier	4	2	1	368669.50827	201354.68495	Glade Creek
0713402	Unusual Condition/Comment	5	1	3	368536.52049	201275.79390	Glade Creek
0714201	Representative Site				364370.78588	210717.88871	Hunting Creek
0805401	Erosion Site	3	2	3	359703.64030	201479.99617	Tuscarora Creek
0805402	Inadequate Buffer	5	2	1	360042.69531	201397.75340	Tuscarora Creek
0813201	Inadequate Buffer	5	5	3	363331.91669	211733.20815	Hunting Creek
0813201	Representative Site				368201.79700	201739.11559	Glade Creek
0814401	Erosion Site	5	2	1	369051.80379	201685.38889	Glade Creek
0821305	Inadequate Buffer	5	1	5	371209.97934	214012.79368	Owens Creek/Beaver Branch
0912201	Representative Site				363048.11446	212095.29136	Hunting Creek
0914401	Representative Site				369546.32601	202472.80241	Glade Creek
0914402	Erosion Site	5	2	1	369295.19558	202093.96890	Glade Creek
0921303	Erosion Site	3	4	5	371277.25314	214625.98087	Owens Creek/Beaver Branch
0921304	Representative Site				371173.49185	214247.42319	Owens Creek/Beaver Branch
1006101	Representative Site				357503.15658	212776.01105	Hunting Creek
1010301	Representative Site				361137.08230	212754.34661	Hunting Creek
1012201	Erosion Site	3	4	4	362612.54507	212891.53885	Hunting Creek
1016406	Inadequate Buffer	3	3	1	366699.10420	204701.78930	Fishing Creek
1016407	Representative Site				367095.53158	204809.48922	Fishing Creek
1021201	Trash Dumping	3	2	2	371293.21642	214735.18464	Owens Creek/Beaver Branch
1022302	Representative Site				371723.08463	214777.37330	Owens Creek/Beaver Branch
1112301	Representative Site				362381.07757	213211.58043	Hunting Creek
1114401	Unusual Condition/Comment	4	2	4	365350.56366	205475.12336	Fishing Creek
1114402	Inadequate Buffer	4	2	3	365337.09912	205360.74775	Fishing Creek
1114403	Representative Site				365244.00948	205067.23854	Fishing Creek
1115405	Representative Site				366286.63641	205249.41181	Fishing Creek
1122201	Representative Site				371712.82253	215353.19146	Owens Creek/Beaver Branch
1122202	Inadequate Buffer	3	2	2	371660.37176	215285.65897	Owens Creek/Beaver Branch
1122203	Pipe Outfall	4	3	3	371651.24989	215278.81756	Owens Creek/Beaver Branch
1122301	Inadequate Buffer	4	4	4	372124.71717	215254.32415	Owens Creek/Beaver Branch
1207201	Representative Site				358947.00118	205825.67793	Fishing Creek
1208201	Erosion Site	4	3	5	359478.62633	205674.43974	Fishing Creek
1208202	Channel Alteration	5	3	5	359943.79835	205722.56098	Fishing Creek
1208203	Trash Dumping	3	5	5	359944.94409	205720.26949	Fishing Creek
1209201	Erosion Site	3	4	1	360881.15785	205717.74890	Fishing Creek

Location	Problem	Severity	Correctability	Acccess	X Coordinate	Y Coordinate	Stream
1209202	Channel Alteration	5	5	1	360816.85517	205882.96512	Fishing Creek
1209203	Erosion Site	4	4	4	360473.20252	205899.51668	Fishing Creek
1209204	Representative Site				360274.91832	205738.60139	Fishing Creek
1210201	Erosion Site	2	4	1	361452.74302	206044.51501	Fishing Creek
1210202	Pipe Outfall	5	3	3	361227.03148	205825.67793	Fishing Creek
1215201	Inadequate Buffer	5	4	4	365979.54001	213665.90476	Hunting Creek
1215202	Inadequate Buffer	5	5	5	365166.55317	213639.67938	Hunting Creek
1216201	Inadequate Buffer	5	4	4	366003.48492	213958.94489	Hunting Creek
1216403	Erosion Site	3	4	4	366744.49576	205871.79070	Fishing Creek
1309201	Channel Alteration	4	3	2	360273.77258	206421.46474	Fishing Creek
1310201	Inadequate Buffer	2	3	4	361912.18631	206671.19385	Fishing Creek
1310202	Representative Site				361803.34064	206506.20674	Fishing Creek
1310203	Pipe Outfall	5	4	4	361756.36515	206406.52702	Fishing Creek
1312101	Inadequate Buffer	1	2	2	363673.19464	206257.58032	Fishing Creek
1315401	Inadequate Buffer	3	4	4	365991.03449	206271.32924	Fishing Creek
1315402	Erosion Site	3	4	3	365991.60286	206271.39241	Fishing Creek
1315407	Inadequate Buffer	4	3	3	365889.48018	206610.64886	Fishing Creek
1315408	Unusual Condition/Comment	3	3	2	366376.00443	206162.48358	Fishing Creek
1316101	Inadequate Buffer	4	2	2	366738.93584	213998.85308	Hunting Creek
1316401	Inadequate Buffer	2	2	1	366467.66394	206191.12717	Fishing Creek
1316402	Erosion Site	3	4	4	366678.84510	206633.10899	Fishing Creek
1322101	Trash Dumping	4	1	3	372199.70244	216759.46413	Owens Creek/Beaver Branch
1322201	Erosion Site	4	3	3	371554.08032	216792.89951	Owens Creek/Beaver Branch
1322202	Inadequate Buffer	4	2	4	371716.11568	216793.46121	Owens Creek/Beaver Branch
1407301	Fish Barrier	3	3	1	358626.28706	214662.42770	Hunting Creek
1408301	Representative Site				358923.88813	214712.12836	Hunting Creek
1411201	Erosion Site	3	3	1	362481.62102	207190.17278	Fishing Creek
1411202	Inadequate Buffer	3	3	3	362391.10725	207083.61860	Fishing Creek
1413201	Trash Dumping	2	3	4	364202.52831	206878.53044	Fishing Creek
1415101	Inadequate Buffer	2	2	2	365579.31788	214812.98015	Hunting Creek
1415401	Representative Site				370169.56535	205020.56747	Glade Creek
1415406	Representative Site				365862.71117	206758.22734	Fishing Creek
1416201	Inadequate Buffer	4	4	5	366628.33314	214660.18879	Hunting Creek
1421201	Inadequate Buffer	4	3	3	371444.86754	217401.15717	Owens Creek/Beaver Branch
1509101	Channel Alteration	5	1	2	360875.28811	207783.75420	Fishing Creek
1510101	Channel Alteration	4	3	1	361843.44168	207515.65014	Fishing Creek
1510102	Exposed Pipe	2	4	3	361630.33332	207593.43157	Fishing Creek
1510103	Exposed Pipe	4	3	3	361610.85567	207565.93371	Fishing Creek
1510104	Fish Barrier	2	5	3	361603.98121	207554.47627	Fishing Creek
1510105	Fish Barrier	4	1	3	361550.13125	207530.41565	Fishing Creek
1510106	Fish Barrier	2	3	3	361390.87285	207536.14437	Fishing Creek
1510107	Representative Site				361081.52201	207732.06657	Fishing Creek
1510108	Inadequate Buffer	4	1	1	361914.10700	207443.84463	Fishing Creek
1510109	Fish Barrier	4	2	4	361915.62354	207341.36791	Fishing Creek
1510110	Exposed Pipe	4	3	3	361929.37247	207320.74453	Fishing Creek
1511101	Fish Barrier	3	1	3	362059.98727	207268.04031	Fishing Creek
1511102	Pipe Outfall	3	3	1	362677.54322	207449.06784	Fishing Creek
1512308	Inadequate Buffer	4	2	4	363456.64905	207775.60484	Fishing Creek
1512309	Fish Barrier	3	2	1	363548.30856	207648.42727	Fishing Creek
1512310	Pipe Outfall	3	2	2	363539.14261	207368.86577	Fishing Creek
1512311	Representative Site				363524.24794	207370.01151	Fishing Creek

Location	Problem		Correctability	Acccess	X Coordinate	Y Coordinate	Stream
1512312	Fish Barrier	1	4	3	363133.54928	207428.44445	Fishing Creek
1512313	Inadequate Buffer	4	1	2	363060.22167	207539.49600	Fishing Creek
1512401	Inadequate Buffer	3	1	1	363590.70108	207365.42854	Fishing Creek
1512402	Erosion Site	3	2	2	363619.34468	207365.42854	Fishing Creek
1513201	Inadequate Buffer	3	4	3	364537.08552	207430.73594	Fishing Creek
1513401	Inadequate Buffer	3	3	4	363801.51795	207396.36362	Fishing Creek
1513402	Erosion Site	2	3	3	363801.01275	207395.72308	Fishing Creek
1514403	Representative Site				365082.45960	207421.56999	Fishing Creek
1514404	Inadequate Buffer	3	3	2	365109.95745	207284.08072	Fishing Creek
1515301	Trash Dumping	4	2	3	365890.71778	215509.36286	Hunting Creek
1515302	Inadequate Buffer	3	3	2	365922.64433	215377.09572	Hunting Creek
1516101	Unusual Condition/Comment	1	3	3	367225.00063	207397.50936	Fishing Creek
1517101	Erosion Site	4	1	3	367575.59826	207779.04207	Fishing Creek
1517401	Fish Barrier	4	1	1	371544.52376	205712.67322	Glade Creek
1517402	Erosion Site	4	4	3	371544.49307	205711.16486	Glade Creek
1521201	Inadequate Buffer	2	4	4	371293.47775	217983.89121	Owens Creek/Beaver Branch
1522201	Inadequate Buffer	3	4	4	372008.60645	217616.34248	Owens Creek/Beaver Branch
1610301	Trash Dumping	3	2	4	361908.74908	208033.35416	Fishing Creek
1611302	Erosion Site	4	4	2	362047.38409	208060.85201	Fishing Creek
1611303	Inadequate Buffer	2	4	4	362143.90862	208097.53339	Fishing Creek
1611304	Erosion Site	3	3	4	362654.62834	208110.11900	Fishing Creek
1612305	Representative Site				362938.77282	208070.01796	Fishing Creek
1612306	Unusual Condition/Comment	-1	-1	4	363348.94912	207882.11597	Fishing Creek
1612307	Inadequate Buffer	5	4	2	363367.28103	207854.61812	Fishing Creek
1614301	Inadequate Buffer	3	2	2	364845.00719	216085.48128	Hunting Creek
1614302	Channel Alteration	5	1	3	364751.62403	215876.25951	Hunting Creek
1615301	Inadequate Buffer	2	3	2	365691.06081	216147.05391	Hunting Creek
1617101	Channel Alteration	4	3	1	367928.48737	208127.47736	Fishing Creek
1617102	Inadequate Buffer	1	3	3	367928.11724	208126.67056	Fishing Creek
1617103	Pipe Outfall	2	1	3	367592.78442	207807.64262	Fishing Creek
1617202	Representative Site				366949.99516	216110.00748	Hunting Creek
1617401	Unusual Condition/Comment	2	5	4	371878.12023	206355.19032	Glade Creek
1617402	Representative Site				371650.46318	205903.25727	Glade Creek
1621201	Erosion Site	2	4	5	371293.21784	218537.56385	Owens Creek/Beaver Branch
1621202	Representative Site				371319.44180	218056.68624	Owens Creek/Beaver Branch
1622201	Pipe Outfall	4	2	5	372127.86770	218066.53644	Owens Creek/Beaver Branch
1714301	Representative Site				364896.43375	216358.57849	Hunting Creek
1716201	Unusual Condition/Comment	3	3	1	366877.02018	216300.68524	Hunting Creek
1717201	Inadequate Buffer	4	5	5	366888.03631	216280.85307	Hunting Creek
1721201	Inadequate Buffer	2	3	5	371311.46016	218735.59510	Owens Creek/Beaver Branch
1721202	Erosion Site	3	4	5	371294.38216	218675.05601	Owens Creek/Beaver Branch
1725301	Representative Site				378819.51104	223726.45556	Toms Creek
1813301	Fish Barrier	1	5	1	363585.16466	217077.54875	Hunting Creek
1813302	Fish Barrier	2	1	1	363773.30327	217249.72408	Hunting Creek
1814301	Fish Barrier	5	1	3	364512.17489	217190.43192	Hunting Creek
1814302	Erosion Site	3	2	3	364516.73583	217184.73075	Hunting Creek
1814303	Channel Alteration	4	1	1	364612.51548	216948.07946	Hunting Creek
1820201	Inadequate Buffer	1	5	5	370504.17450	219645.24313	Owens Creek/Beaver Branch
1820201	Representative Site				374432.80703	224320.83320	Toms Creek
1820202	Inadequate Buffer	2	4	4	374382.89052	224532.51255	Toms Creek
1821201	Fish Barrier	4	3	4	370865.62867	219292.91083	Owens Creek/Beaver Branch

Location	Problem		Correctability	Acccess	X Coordinate	Y Coordinate	Stream
1824301	Inadequate Buffer	3	3	4	378051.47584	224586.51419	Toms Creek
1907201	Fish Barrier	3	4	3	362405.10859	224841.23412	Toms Creek
1913301	Channel Alteration	4	1	2	364101.69066	217447.50194	Hunting Creek
1914101	Pipe Outfall	4	4	1	364702.59397	217773.09148	Hunting Creek
1914102	Inadequate Buffer	4	3	1	364713.88028	217757.06430	Hunting Creek
1914103	Erosion Site	2	3	1	364761.88614	217730.64413	Hunting Creek
1917401	Inadequate Buffer	1	3	3	371982.17221	207554.37031	Glade Creek
1920201	Pipe Outfall	5	2	4	374758.99714	224717.52499	Toms Creek
1920301	Erosion Site	5	3	3	370443.43980	219736.73989	Owens Creek/Beaver Branch
1923301	Erosion Site	3	4	4	376985.76143	225115.89108	Toms Creek
1923302	Inadequate Buffer	3	3	4	377299.00656	225157.88409	Toms Creek
1924301	Fish Barrier	2	2	3	378002.67316	224698.23091	Toms Creek
2006201	Erosion Site	3	4	4	361459.07562	225702.71078	Toms Creek
2006202	Representative Site				361563.77963	225493.53294	Toms Creek
2014101	Inadequate Buffer	4	1	2	364631.89946	218429.34888	Hunting Creek
2014102	Channel Alteration	5	4	2	364645.58227	218146.46538	Hunting Creek
2019101	Fish Barrier	3	3	3	373449.26931	225568.09164	Toms Creek
2020201	Fish Barrier	3	3	4	374359.49610	225260.52125	Toms Creek
2020202	Inadequate Buffer	3	4	4	374438.94233	225397.84973	Toms Creek
2020301	Erosion Site	5	2	3	369888.67120	220503.45563	Owens Creek/Beaver Branch
2020302	Inadequate Buffer	3	4	3	370475.82536	220279.69085	Owens Creek/Beaver Branch
2020302	Unusual Condition/Comment	5	1	2	369848.53996	220398.42041	Owens Creek/Beaver Branch
2103201	Representative Site				359248.96859	226298.92610	Toms Creek
2104201	Inadequate Buffer	4	3	2	360407.89938	226361.62201	Toms Creek
2105201	Exposed Pipe	4	3	4	360578.98028	226190.53412	Toms Creek
2105202	Pipe Outfall	5	2	2	360584.65501	226175.77982	Toms Creek
2105203	Trash Dumping	2	3	2	360615.29855	226156.48574	Toms Creek
2105204	Pipe Outfall	4	4	2	360757.16682	226119.03252	Toms Creek
2105205	Inadequate Buffer	3	3	4	360946.08533	226015.06101	Toms Creek
2105206	Trash Dumping	2	1	1	361015.93454	225951.06049	Toms Creek
2107101	Representative Site				362929.43786	226275.98963	Toms Creek
2117301	Inadequate Buffer	2	4	2	371410.90608	226097.46854	Toms Creek
2117302	Pipe Outfall	4	1	1	371783.16841	226024.83199	Toms Creek
2117303	Pipe Outfall	4	1	2	372061.23021	225926.09168	Toms Creek
2118101	Pipe Outfall	5	1	2	372592.38499	226237.06692	Toms Creek
2118102	Inadequate Buffer	2	1	2	372628.70327	226042.99113	Toms Creek
2118301	Pipe Outfall	5	1	1	372275.73502	225917.01211	Toms Creek
2119301	Representative Site				369716.27282	220946.61427	Owens Creek/Beaver Branch
2120303	Representative Site				370614.77720	220813.20689	Owens Creek/Beaver Branch
2122301	Representative Site				376391.16448	226118.87481	Toms Creek
2204201	Inadequate Buffer	4	3	3	360215.79752	226926.47122	Toms Creek
2204202	Pipe Outfall	4	3	3	360245.30612	226497.46158	Toms Creek
2204203	Inadequate Buffer	5	2	3	360351.62928	226396.80427	Toms Creek
2204204	Pipe Outfall	4	3	3	360026.26152	226483.84223	Toms Creek
2204205	Pipe Outfall	4	3	2	359997.88786	226488.38201	Toms Creek
2206101	Inadequate Buffer	2	4	2	361845.58015	226629.11533	Toms Creek
2206102	Fish Barrier	4	1	1	362220.11237	226768.71371	Toms Creek
2208201	Erosion Site	2	4	2	363620.69920	226889.38404	Toms Creek
2208202	Inadequate Buffer	3	3	3	364037.16112	226609.82125	Toms Creek
2209201	Representative Site				364320.11770	226377.23318	Toms Creek
2209203	Inadequate Buffer	3	3	3	364715.85890	226766.44381	Toms Creek

Location	Problem		Correctability	Acccess	X Coordinate	Y Coordinate	Stream
2216101	Inadequate Buffer	1	3	2	370990.11771	226680.81745	Toms Creek
2217101	Fish Barrier	5	1	1	371502.83671	226599.60673	Toms Creek
2217102	Trash Dumping	3	1	2	371539.15499	226590.52716	Toms Creek
2217103	Fish Barrier	3	1	2	372096.41354	226627.98039	Toms Creek
2217104	Pipe Outfall	5	1	1	372129.32697	226629.11533	Toms Creek
2217105	Pipe Outfall	3	1	1	372138.40654	226629.11533	Toms Creek
2218101	Representative Site				372411.37428	226665.08587	Toms Creek
2219301	Inadequate Buffer	3	3	3	369336.84508	221744.24105	Owens Creek/Beaver Branch
2219302	Erosion Site	5	4	3	369558.49775	221415.81206	Owens Creek/Beaver Branch
2219303	Inadequate Buffer	5	1	2	369524.06479	221603.81477	Owens Creek/Beaver Branch
2219304	Inadequate Buffer	1	5	4	369744.16211	221580.70084	Owens Creek/Beaver Branch
2219305	Inadequate Buffer	4	2	3	369360.92546	221339.36901	Owens Creek/Beaver Branch
2220201	Inadequate Buffer	4	4	3	374672.74123	226697.21210	Toms Creek
2307101	Pipe Outfall	2	2	3	362382.40967	226934.90784	Toms Creek
2307301	Inadequate Buffer	3	4	2	363211.58641	227159.75036	Toms Creek
2307302	Representative Site				362594.56541	227327.12609	Toms Creek
2307303	Fish Barrier	2	3	1	362507.25374	227387.75135	Toms Creek
2308101	Representative Site				363343.23262	227113.81692	Toms Creek
2308201	Inadequate Buffer	4	2	3	363348.24882	227106.28471	Toms Creek
2310201	Trash Dumping	3	3	4	365117.62982	227118.76912	Toms Creek
2319101	Inadequate Buffer	4	3	3	369352.53817	222414.71826	Owens Creek/Beaver Branch
2320201	Inadequate Buffer	3	4	3	369739.81626	222402.17277	Owens Creek/Beaver Branch
2320201	Representative Site				374828.46112	227293.86821	Toms Creek
2320202	Unusual Condition/Comment	2	4	3	369882.74698	222317.79837	Owens Creek/Beaver Branch
2322301	Inadequate Buffer	2	4	3	376102.03327	227130.73839	Toms Creek
2406301	Inadequate Buffer	4	3	5	361921.62154	227833.14223	Toms Creek
2407301	Inadequate Buffer	3	3	2	362995.28057	228011.50162	Toms Creek
2417101	Representative Site				367891.89844	222865.99223	Owens Creek/Beaver Branch
2418101	Representative Site				372290.95782	227856.13479	Toms Creek
2419101	Inadequate Buffer	3	1	2	368843.39601	222825.18732	Owens Creek/Beaver Branch
2419102	Representative Site				368989.94377	222726.88368	Owens Creek/Beaver Branch
2419103	Fish Barrier	1	2	1	369140.45465	222668.73175	Owens Creek/Beaver Branch
2420301	Unusual Condition/Comment	2	4	2	374363.18850	210523.84005	Glade Creek
2420302	Fish Barrier	3	4	4	374245.97893	210615.12827	Glade Creek
2420303	Erosion Site	5	1	4	374209.35014	210665.46472	Glade Creek
2420304	Inadequate Buffer	3	3	4	374209.17494	210665.61271	Glade Creek
2420305	Representative Site				374330.50506	210713.17859	Glade Creek
2421301	Inadequate Buffer	4	4	4	375099.68392	210721.08753	Glade Creek
2421302	Pipe Outfall	3	2	3	374967.26859	210659.08186	Glade Creek
2517101	Trash Dumping	2	3	4	367741.38755	223012.82372	Owens Creek/Beaver Branch
2519101	Inadequate Buffer	3	4	2	373974.82844	211337.74271	Glade Creek
2521302	Erosion Site	3	3	3	375400.65638	210878.44536	Glade Creek
2620401	Unusual Condition/Comment	5	1	3	374073.54562	211693.68171	Glade Creek
2620402	Inadequate Buffer	5	4	3	374059.38198	211498.97437	Glade Creek
2719201	Inadequate Buffer	4	4	4	373981.13843	212287.08025	Glade Creek
2719202	Inadequate Buffer	5	4	4	374042.41816	212168.43071	Glade Creek
2719203	Fish Barrier	5	1	4	373824.47529	211983.68007	Glade Creek
2719204	Inadequate Buffer	3	4	4	373521.26403	212031.40729	Glade Creek
2719205	Erosion Site	1	5	1	373688.18181	212288.49844	Glade Creek
2720401	Representative Site				374325.99700	212240.63951	Glade Creek
2721101	Fish Barrier	5	1	4	375605.15913	212170.76457	Glade Creek

Location	Problem		Correctability	Acccess	X Coordinate	Y Coordinate	Stream
2721102	Representative Site				375607.41316	212197.81293	Glade Creek
2819201	Trash Dumping	2	3	1	373179.82266	212649.74598	Glade Creek
2819202	Erosion Site	2	5	2	373186.70543	212650.46735	Glade Creek
2819203	Representative Site				373643.02586	212739.90719	Glade Creek
2819204	Inadequate Buffer	4	4	4	374056.11699	212578.31132	Glade Creek
2821401	Inadequate Buffer	1	3	4	375351.35303	212614.05136	Glade Creek
2821402	Erosion Site	2	3	4	375351.50595	212613.10078	Glade Creek
2921101	Inadequate Buffer	3	3	2	375718.22925	213375.09070	Glade Creek

Appendix B

Listing of sites by problem category

Inadequate Buffers

Note: Please see the Methods Section-Overall Ranking System (page 9) for discussion of severity, correctibilty, and access rankings. For wetland ranking 1=best wetland potential, 5=worst wetland potential

Survey	Location	Sides	Unshaded	Width Left (ft)	Width Right (ft)	Length Left (ft)	Length Right(ft)	Land Use Left	Land Use Right	Recently Established Buffer	Livestock	Severity	Correctability	Access	Wetland
Fishing Creek	1016406	Both	Both	0	0	1000	3400	Crop field	Paved	No	No	3	3	1	5
Fishing Creek	1114402	Both	Both	0	0	2200	2200	Pasture	Pasture	No	No	4	2	3	3
Fishing Creek	1310201	Left	Left	3		1000		Crop field	Forest	No	No	2	3	4	3
Fishing Creek	1312101	Both	Left	0	0	2700	2700	Pasture	Crop field	No	No	1	2	2	1
Fishing Creek	1315401	Both	Both	0	0	1800	1800	Pasture	Pasture	No	Cattle	3	4	4	5
Fishing Creek	1315407	Both	Neither	15	15	2400	2400	Shrubs/Small Trees	Shrubs/Small Trees	No	Cattle/Horses	4	3	3	4
Fishing Creek	1316401	Both	Both	0	0	4200	6400	Pasture	Pasture	No	Horses	2	2	1	4
Fishing Creek	1411202	Right	Neither		0		500	Forest	Lawn	No	No	3	3	3	4
Fishing Creek	1510108	Both	Neither	10	5	600	500	Lawn	Forest	No	No	4	1	1	4
Fishing Creek	1512308	Both	Neither	15	15	400	400	Pasture	Pasture	No	No	4	2	4	5
Fishing Creek	1512313	Both	Both	10	10	1400	1400	Shrubs/Small Trees	Pasture	No	No	4	1	2	1
Fishing Creek	1512401	Both	Both	0	0	1600	1600	Lawn	Lawn	No	No	3	1	1	2
Fishing Creek	1513201	Both	Both	0	0	2300	2300	Lawn	Pasture	No	No	3	4	3	1
Fishing Creek	1513401	Both	Both	0	0	2000	2400	Lawn	Lawn	No	No	3	3	4	5
Fishing Creek	1514404	Right	Neither		10	1700	1700	Forest	Pasture	No	Cattle	3	3	2	4
Fishing Creek	1611303	Both	Both	15	15	2000	2000	Pasture	Pasture	No	No	2	4	4	1
Fishing Creek	1612307	Both	Neither	25	25	300	300	Multiflora Rose	Multiflora Rose	No	No	5	4	2	1
Fishing Creek	1617102	Both	Both	15	20	7280	7280	Crop field	Crop field	No	No	1	3	3	4
Glade Creek	0711201	Both	Both	5	0	9399	9399	Crop field	Crop field	No	Cattle	2	4	4	1
Glade Creek	0712201	Both	Both	0	0	1466	1466	Crop field	Crop field	No	Cattle	3	4	4	1
Glade Creek	0713201	Both	Both	0	0	5006	5006	Lawn	Lawn	Yes	No	3	4	4	1
Glade Creek	1917401	Both	Both	10	0	25245	25245	Crop field	Crop field	No	Cattle	1	3	3	4
Glade Creek	2420304	Both	Neither	20	10	2777	2777	Crop field	Crop field	No	No	3	3	4	1
Glade Creek	2421301	Both	Neither	10	30	3337	3337	Forest	Forest	No	Cattle	4	4	4	1
Glade Creek	2519101	Both	Both	0	0	3845	3845	Crop field	Pasture	Yes	No	3	4	2	4

Survey	Location	Sides	Unshaded	Width Left (ft)	Width Right (ft)	Length Left (ft)	Length Right(ft)	Land Use Left	Land Use Right	Recently Established Buffer	Livestock	Severity	Correctability	Access	Wetland
Glade Creek	2521301	Both	Neither	0	0	653	653	Pasture	Pasture	No	No	5	1	1	2
Glade Creek	2620402	Both	Both	0	0	1257	1257	Lawn	Lawn	No	Cattle/Horses	5	4	3	1
Glade Creek	2719201	Both	Both	40	0	1094	1094	Forest	Lawn	No	No	4	4	4	2
Glade Creek	2719202	Left	Neither	20		1496		Lawn	Forest	No	No	5	4	4	1
Glade Creek	2719204	Both	Both	0	0	2196	2196	Crop field	Crop field	No	No	3	4	4	1
Glade Creek	2819204	Both	Neither	30	40	1807	1807	Lawn	Crop field	No	No	4	4	4	2
Glade Creek	2821401	Both	Both	0	0	10245	10245	Pasture	Pasture	No	Cattle/Horses	1	3	4	4
Glade Creek	2921101	Both	Both	0	0	8973	8973	Crop field	Crop field	No	No	3	3	2	4
Hunting Creek	0616201	Both	Neither	25	25	14952	14952	Pasture	Lawn	No	No	2	4	3	1
Hunting Creek	0617201	Both	Both	10	10	913	913	Pasture	Pasture	No	No	4	2	3	1
Hunting Creek	0713201	Both	Neither	15	15	5126	5126	Crop field	Crop field	No	No	3	3	2	2
Hunting Creek	0813201	Left	Neither	15		814		Other/Fish hatchery	Forest	No	No	5	5	3	4
Hunting Creek	1215201	Both	Both	10	15	2727	2727	Shrubs/Small Trees	Shrubs/Small Trees	No	No	5	4	4	1
Hunting Creek	1215202	Both	Neither	5	10	2674	2674	Crop field	Multiflora Rose	No	No	5	5	5	2
Hunting Creek	1216201	Left	Neither	10		1783		Shrubs/Small Trees	Forest	No	No	5	4	4	1
Hunting Creek	1316101	Both	Neither	10	10	4918	4918	Lawn	Lawn	No	No	4	2	2	5
Hunting Creek	1415101	Both	Both	0	0	3000	4064	Other/Golf Course	Other/Golf Course	No	No	2	2	2	3
Hunting Creek	1416201	Right	Right		0		3333	Forest	Lawn	No	No	4	4	5	2
Hunting Creek	1515302	Both	Both	5	5	2151	2151	Lawn	Lawn	No	No	3	3	2	2
Hunting Creek	1614301	Both	Neither	0	0	1514	1514	Shrubs/Small Trees	Shrubs/Small Trees	No	No	3	2	2	3
Hunting Creek	1615301	Both	Both	0	0	3782	3782	Lawn	Lawn	No	No	2	3	2	1
Hunting Creek	1717201	Both	Both	0	0	5046	5046	Crop field	Crop field	No	No	4	5	5	1
Hunting Creek	1914102	Both	Both	2	2	5005	5005	Paved	Lawn	No	No	4	3	1	5
Hunting Creek	2014101	Both	Both	0	0	1800	1800	Lawn	Pasture	No	No	4	1	2	1
Owens Creek/Beaver Branch	0821305	Left	Left	0		196		Picnic	Forest	No	No	5	1	5	5
Owens Creek/Beaver Branch	1122202	Right	Right	10		2475		Crop field	Forest	No	No	3	2	2	4
Owens Creek/Beaver Branch	1122301	Both	Neither	30	15	1948	1948	Lawn	Shrubs/Small Trees	No	No	4	4	4	4

Survey	Location		Unshaded	Width Left (ft)	Width Right (ft)	Length Left (ft)	Length Right(ft)	Land Use Left	Land Use Right	Recently Established Buffer	Livestock	Severity		Access	Wetland
Owens Creek/Beaver Branch	1322202	Left	Left	5		1236		Crop field	Forest	No	No	4	2	4	4
Owens Creek/Beaver Branch	1421201	Left	Left	10		1714		Shrubs/Small Trees	Forest	Yes	No	4	3	3	3
Owens Creek/Beaver Branch	1521201	Right	Both		0		2198	Forest	Pasture	No	Horses	2	4	4	2
Owens Creek/Beaver Branch	1522201	Both	Both		2		2022	Forest	Pasture	No	No	3	4	4	2
Owens Creek/Beaver Branch	1721201	Both	Both	0	0	2661	2661	Pasture	Pasture	No	Horses	2	3	5	1
Owens Creek/Beaver Branch	1820201	Both	Both	5	15	6972	6972	Pasture	Shrubs/Small Trees	No	No	1	5	5	2
Owens Creek/Beaver Branch	2020302	Both	Neither	10	40	2102	1800	Pasture	Forest	No	No	3	4	3	2
Owens Creek/Beaver Branch	2219301	Both	Neither	15	15	1700	1885	Crop field	Crop field	Yes	No	3	3	3	3
Owens Creek/Beaver Branch	2219303	Both	Both	5	5	419	419	Crop field	Crop field	Yes	No	5	1	2	2
Owens Creek/Beaver Branch	2219304	Both	Both	5	5	9246	9246	Crop field	Crop field	Yes	No	1	5	4	3
Owens Creek/Beaver Branch	2219305	Left	Neither	5		986		Crop field	Crop field	Yes	No	4	2	3	3
Owens Creek/Beaver Branch	2319101	Both	Neither	2	3	2242	2242	Pasture	Pasture	No	No	4	3	3	3
Owens Creek/Beaver Branch	2320201	Both	Both	0	0	3342	3342	Pasture	Pasture	No	No	3	4	3	2
Owens Creek/Beaver Branch	2419101	Both	Neither	3	10	2265	2265	Lawn	Lawn	No	No	3	1	2	3
Toms Creek	1820202	Both	Both	0	0	2997	2997	Crop field	Crop field	No	No	2	4	4	1
Toms Creek	1824301	Right	Right		5	6700	9340	Forest	Pasture	Yes	Horses	3	3	4	5
Toms Creek	1923302	Both	Both	15	15	1212	1212	Crop field	Crop field	Yes	No	3	3	4	1
Toms Creek	2020202	Both	Both	3	4	5839	5839	Crop field	Crop field	No	No	3	4	4	2
Toms Creek	2104201	Both	Neither	20	5	2227	2227	Lawn	Lawn	No	No	4	3	2	4
Toms Creek	2105205	Both	Both	5	5	4686	4686	Lawn	Lawn	No	No	3	3	4	3
Toms Creek	2117301	Both	Both	0	0	4293	4293	Lawn	Lawn	No	No	2	4	2	4
Toms Creek	2118102	Both	Left	0	5	7916	7916	Lawn	Pasture	No	No	2	1	2	2
Toms Creek	2204201	Both	Both	0	0	2360	2360	Pasture	Pasture	No	No	4	3	3	2

Survey	Location	Sides	Unshaded	Width Left (ft)	Width Right (ft)	Length Left (ft)	Length Right(ft)	Land Use Left	Land Use Right	Recently Established Buffer	Livestock	Severity	Correctability	Access	Wetland
Toms Creek	2204203	Both	Both	10	3	1500	1500	Lawn	Lawn	No	No	5	2	3	1
Toms Creek	2206101	Both	Neither	5	4	5288	5288	Pasture	Crop field	No	No	2	4	2	5
Toms Creek	2208202	Both	Both	0	6	2270	2270	Lawn	Lawn	No	No	3	3	3	2
Toms Creek	2209203	Right	Right	50	10		1800	Forest	Lawn	No	No	3	3	3	2
Toms Creek	2216101	Both	Both	0	0	11124	11124	Pasture	Lawn	No	No	1	3	2	4
Toms Creek	2220201	Left	Left	0		1594		Lawn	Forest	No	No	4	4	3	2
Toms Creek	2307301	Both	Both	0	0	4387	4387	Pasture	Pasture	Yes	No	3	4	2	2
Toms Creek	2308201	Both	Both	15	15	1574	900	Lawn	Pasture	No	Horses	4	2	3	2
Toms Creek	2322301	Both	Both	0	0	8004	8004	Crop field	Crop field	No	No	2	4	3	1
Toms Creek	2406301	Both	Neither	15	15	1170	1170	Crop field	Crop field	No	No	4	3	5	4
Toms Creek	2407301	Both	Both	10	10	4213	4213	Shrubs/Small Trees	Shrubs/Small Trees	No	Cattle	3	3	2	2
Tuscarora Creek	0310301	Both	Both	0	0	3871	3871	Pasture	Pasture	Yes	No	3	4	4	1
Tuscarora Creek	0311302	Both	Both	0	0	2549	2549	Pasture	Lawn	No	No	3	4	4	1
Tuscarora Creek	0407301	Both	Neither	5	5	7047	7047	Lawn	Lawn	No	No	2	4	1	4
Tuscarora Creek	0505401	Both	Both	0	0	2857	1000	Paved/Lawn	Lawn	No	No	4	2	1	4
Tuscarora Creek	0506403	Both	Both		10		924	Shrubs/Small Trees	Shrubs/Small Trees	No	No	5	2	2	3
Tuscarora Creek	0506405	Right	Neither		5		757	Shrubs/Small Trees	Lawn	No	No	5	4	3	4
Tuscarora Creek	0507401	Both	Both	0	5	5098	2600	Pasture	Multiflora Rose	No	No	3	4	2	4
Tuscarora Creek	0510301	Both	Both	0	0	18455	18455	Lawn	Lawn	No	No	2	4	4	3
Tuscarora Creek	0607201	Both	Both	10	12	3993	3993	Crop field	Crop field	No	No	4	3	2	1
Tuscarora Creek	0607206	Both	Both	0	2	7774	7774	Crop field	Lawn	No	No	3	2	3	1
Tuscarora Creek	0608202	Both	Left	0	5	6674	6674	Crop field	Crop field	No	No	3	3	4	4
Tuscarora Creek	0610301	Left	Both	0	20	1433	1433	Pasture	Shrubs/Small Trees	No	No	4	2	2	4
Tuscarora Creek	0704401	Both	Both	0	0	1924	1924	Lawn	Paved	No	No	4	2	1	5
Tuscarora Creek	0704402	Both	Both	0	0	1865	1865	Lawn	Lawn	No	No	4	2	1	3
Tuscarora Creek	0705401	Both	Both	0	1	3645	3645	Lawn	Lawn	No	No	4	2	1	3
Tuscarora Creek	0805402	Both	Both	10	0	593	593	Lawn	Paved	No	No	5	2	1	5

Erosion Sites

Note: Please see the Methods Section-Overall Ranking System (page 9) for discussion of severity, correctibilty, and access rankings

Survey	Location	Type	Possible Cause	Length (ft)	Height (ft)	Land Use On Left	Land Use On Right	Infrastructure Threatened?	Describe	Severity	Correctability	Access
Fishing Creek	1208201	Downcutting	Land use change upstream	300	10	Forest	Forest	No		4	3	5
Fishing Creek	1209201	Downcutting	Bend at steep slope	100	35	Forest	House	Yes	House in right side of stream	3	4	1
Fishing Creek	1209203	Downcutting	Land use change upstream	100	10	Forest	Forest	No		4	4	4
Fishing Creek	1210201	Downcutting	Land use change upstream	900	6	Paved	Crop field	Yes	Nothing major	2	4	1
Fishing Creek	1216403	Widening	Bend at steep slope	8000	4	Forest	Shrubs/Small Trees	Yes	Farmland near erosion	3	4	4
Fishing Creek	1315402	Widening	Land use change upstream	5100	2	Pasture	Pasture	No		3	4	3
Fishing Creek	1316402	Widening	Entrance of tributary	500	4	Crop field	Shrubs/Small Trees	Yes	Farmland beng encroached upon	3	4	4
Fishing Creek	1411201	Widening	Land use change upstream	200	4	Forest	Shrubs/Small Trees	Yes		3	3	1
Fishing Creek	1512402	Widening	Bend at steep slope	1600	3	Shrubs/Small Trees	Shrubs/Small Trees	No		3	2	2
Fishing Creek	1513402	Downcutting	Bend at steep slope	4400	2	Lawn	Lawn	No		2	3	3
Fishing Creek	1517101	Widening	Land use change upstream	800	4	Crop field	Crop field	No		4	1	3
Fishing Creek	1611302	Widening	Bend at steep slope	800	1	Forest	Forest	No		4	4	2
Fishing Creek	1611304	Widening	No buffer	2800	1	Pasture	Pasture	No		3	3	4
Glade Creek	0711202	Downcutting	Land use change upstream	3447	10	Crop field	Crop field	No		2	4	4
Glade Creek	0814401	Widening	Inadequate buffer	522	2	Pasture	Crop field	No		5	2	1
Glade Creek	0914402	Widening	Land use change upstream	336	1.5	Lawn	Lawn	No		5	2	1
Glade Creek	1517402	Widening	Below road crossing	3818	1	Pasture	Pasture	Yes	Next to road	4	4	3

Survey	Location	Type	Possible Cause	Length (ft)	Height (ft)	Land Use On Left	Land Use On Right	Infrastructure Threatened?	Describe	Severity	Correctability	Access
Glade Creek	2420303	Widening	Bend at steep slope	77	4	Crop field	Crop field	No		5	1	4
Glade Creek	2521302	Widening	Bend at steep slope	2050	1.5	Forest	Forest	No		3	3	3
Glade Creek	2719205	Downcutting	Below road crossing	107	10	Forest	Crop field	Yes	Road structuring exposed	1	5	1
Glade Creek	2819202	Downcutting	Below road crossing	69	30	Forest	Forest	Yes	Road crossing	2	5	2
Glade Creek	2821402	Downcutting	Bend at steep slope	10247	2	Crop field	Crop field	No		2	3	4
Hunting Creek	0419201	Downcutting	Land use change upstream	1285	6	Lawn	Lawn	No		4	4	3
Hunting Creek	1012201	Widening	Bend at steep slope	2495	3	Forest	Forest	Yes	Possible threat during flood	3	4	4
Hunting Creek	1814302	Widening	Unknown	253	10	Lawn	Forest	Yes	Erosion cuts into backyard and is close to house	3	2	3
Hunting Creek	1914103	Widening	Below parking lot	409	8	Paved	Shrubs/Small Trees	Yes	Threat to parking lot	2	3	1
Owens Creek/Beaver Branch	0921303	Widening	Bend at steep slope	5438	5	Forest	Forest	No		3	4	5
Owens Creek/Beaver Branch	1322201	Widening	Bend at steep slope	266	7	Forest	Forest	No		4	3	3
Owens Creek/Beaver Branch	1621201	Downcutting	Land use change upstream	1980	6	Shrubs/Small Trees	Shrubs/Small Trees	No		2	4	5
Owens Creek/Beaver Branch	1721202	Downcutting	Land use change upstream	226	5	Pasture	Pasture	No		3	4	5
Owens Creek/Beaver Branch	1920301	Widening	Inadequate Buffer	3833	2	Multiflora Rose	Multiflora Rose	No		5	3	3
Owens Creek/Beaver Branch	2020301	Widening	Bend at steep slope	2079	2.5	Forest/Multiflora Rose	Crop field	No		5	2	3

Survey	Location	Type	Possible Cause	Length (ft)	Height (ft)	Land Use On Left	Land Use On Right	Infrastructure Threatened?	Describe	Severity	Correctability	Access
Owens Creek/Beaver Branch	2219302	Widening	Farming	1509	1	Crop field	Crop field	No		5	4	3
Toms Creek	1923301	Widening	Bend at steep slope	8322	3	Shrubs/Small Trees	Shrubs/Small Trees	No		3	4	4
Toms Creek	2006201	Widening	Bend at steep slope	2500	4	Pasture	Pasture	No		3	4	4
Toms Creek	2208201	Downcutting	Below road crossing	570	15	Forest	Forest	Yes	Pavement on road falling in	2	4	2
Tuscarora Creek	0311303	Unknown	Bend at steep slope	2227	0.5	Pasture	Pasture	No		5	3	3
Tuscarora Creek	0408301	Widening	Bend at steep slope/Inadequate buffer	939	2	Lawn	Lawn	No		5	1	1
Tuscarora Creek	0408302	Widening	Land use change upstream/Inadequate buffer	513	1.5	Park	Park	No		5	1	1
Tuscarora Creek	0408304	Widening	Land use change upstream	3629	3	Shrubs/Small Trees	Shrubs/Small Trees	No		4	3	2
Tuscarora Creek	0410301	Widening	Land use change upstream	2804	1	Tress planted recently	Trees planted recently	No		4	1	1
Tuscarora Creek	0507402	Widening	Bend at steep slope	3037	2	Pasture	Pasture/Multiflora Rose	Yes	Personal property being destroyed	4	2	1
Tuscarora Creek	0510302	Widening	Bend at steep slope	12464	4	Lawn	Lawn	No		2	4	4
Tuscarora Creek	0605401	Widening	Bend at steep slope	2771	3	Forest	Forest	No		4	4	4
Tuscarora Creek	0607204	Widening	Land use change upstream	1384	4	Crop field	Crop field	No		4	5	4
Tuscarora Creek	0607205	Widening	Land use change upstream	9602	4	Crop field	Lawn	No		3	3	4
Tuscarora Creek	0608203	Widening	Land use change upstream	479	3	Crop field	Crop field	No		5	3	3
Tuscarora Creek	0610302	Widening	Below road crossing/Inadequate buffer	1433	3	Pasture	Shrubs/Small Trees	No		5	2	2
Tuscarora Creek	0805401	Widening	Bend at steep slope	1433	6	Forest	Forest	No		3	2	3

Fish Passage Barriers

Note: Please see the Methods Section-Overall Ranking System (page 9) for discussion of severity, correctibilty, and access rankings

Survey	Location	Blockage	Type	Reason	Drop (In)	Depth (In)	Severity	Correctability	Access
Fishing Creek	1510104	Total	Dam	Too high	96		2	5	3
Fishing Creek	1510105	Partial	Dam	Too fast			4	1	3
Fishing Creek	1510106	Total	Dam	Too shallow		1	2	3	3
Fishing Creek	1510109	Partial	Channelized	Too high	12		4	2	4
Fishing Creek	1511101	Temporary	Debris dam	Too shallow		1	3	1	3
Fishing Creek	1512309	Total	Road crossing	Too high	6		3	2	1
Fishing Creek	1512312	Total	Channelized	Too high	36		1	4	3
Glade Creek	0713401	Partial	Cement crossing	Too high	8		4	2	1
Glade Creek	1517401	Total	Road crossing	Too high	12		4	1	1
Glade Creek	2420302	Total	RR Crossing	Too high	18		3	4	4
Glade Creek	2719203	Partial	Natural falls	Too shallow		2	5	1	4
Glade Creek	2721101	Temporary	Debris dam	Too shallow		2	5	1	4
Hunting Creek	1407301	Total	Road crossing	Too high	12		3	3	1
Hunting Creek	1813301	Total	Channelized	Too high	180		1	5	1
Hunting Creek	1813302	Total	Unknown	Too high/Too fast	32		2	1	1
Hunting Creek	1814301	Total	Natural falls	Too high	12		5	1	3
Owens Creek/Beaver Branch	1821201	Partial	Debris dam	Too high	36		4	3	4
Owens Creek/Beaver Branch	2419103	Total	Road crossing	Too Shallow/Too fast		1	1	2	1
Toms Creek	1907201	Total	Road crossing	Too high	15		3	4	3
Toms Creek	1924301	Total	Channelized	Too high	24		2	2	3
Toms Creek	2019101	Partial	Road crossing	Too shallow		1	3	3	3
Toms Creek	2020201	Total	Debris dam	Too Shallow		2	3	3	4
Toms Creek	2206102	Total	Road crossing	Too Shallow/Too high	12	1	4	1	1
Toms Creek	2217101	Partial	Debris dam	Too Shallow		1	5	1	1
Toms Creek	2217103	Partial	Debris dam	Too high	36		3	1	2
Toms Creek	2307303	Total	Road crossing	Too high	12		2	3	1

Survey	Location	Blockage	Type	Reason	Drop (In)	Depth (In)	Severity	Correctability	Access
Tuscarora Creek	0311301	Total	Road crossing	Too high	24		5	2	1
Tuscarora Creek	0408305	Total	Other/Concrete slab	Too high	24		5	3	2
Tuscarora Creek	0408306	Total	Road crossing	Too high	8		4	2	1
Tuscarora Creek	0505402	Total	Road crossing	Too high	12		4	4	1
Tuscarora Creek	0604401	Total	Debris dam	Too shallow		0.5	4	2	1
Tuscarora Creek	0604402	Partial	Channelized	Too high/Too shallow	48	1	4	3	3
Tuscarora Creek	0607203	Total	Road crossing	Too Shallow		1	4	4	3

Pipe Outfalls

Note: Please see the Methods Section-Overall Ranking System (page 9) for discussion of severity, correctibilty, and access rankings

Survey	Location	Outfall Type	Pipe Type	Location of Pipe	Diameter (in)	Channel Width	Discharge	Color	Odor	Severity	Correctability	Access
Fishing Creek	1210202	Stormwater	Concrete Pipe	Left bank	6		No			5	3	3
Fishing Creek	1310203	Agricultural	Plastic	Right bank	5	3	Yes	Other/Oily		5	4	4
Fishing Creek	1511102	Agricultural	Concrete Channel	Right bank	72		Yes	Clear	None	3	3	1
Fishing Creek	1512310	Stormwater	Smooth Metal Pipe	Left bank	6	15	Yes	Clear		3	2	2
Fishing Creek	1617103	Agricultural	Smooth Metal Pipe	Left bank	6		Yes	Clear	None	2	1	3
Glade Creek	2421302	Stormwater/Agricultural	Corrugated Metal	Right bank	12	36	Yes	Clear	None	3	2	3
Hunting Creek	1914101	Stormwater	Concrete Pipe	Right bank	24		Yes	Clear	None	4	4	1
Owens Creek/Beaver Branch	1122203	Agricultural	Plastic	Right bank	10	2	No			4	3	3
Owens Creek/Beaver Branch	1622201	Agricultural	Plastic	Right bank	4	0	No			4	2	5
Toms Creek	1920201	Agricultural	Plastic	Right bank	6		No			5	2	4
Toms Creek	2105202	Stormwater	Corrugated Metal	Right bank	18	15	No			5	2	2
Toms Creek	2105204	Stormwater	Plastic	Left bank	8	6	Yes	Clear	None	4	4	2
Toms Creek	2117302	Stormwater	Plastic	Right bank	12		Yes	Green Brown	None	4	1	1
Toms Creek	2117303	Stormwater	Concrete Pipe	Right bank	36	3	Yes	Clear	None	4	1	2
Toms Creek	2118101	Other	Plastic	Right bank	4		No			5	1	2
Toms Creek	2118301	Stormwater	Concrete Channel		24		Yes	Clear	None	5	1	1
Toms Creek	2204202	Stormwater	Plastic	Left bank	6		Yes	Clear	None	4	3	3
Toms Creek	2204204	Stormwater	Smooth Metal Pipe	Right bank	7		Yes	Clear	None	4	3	3
Toms Creek	2204205	Stormwater	Plastic	Left bank	7	1.5	Yes	Clear	None	4	3	2
Toms Creek	2217104	Stormwater	Smooth Metal Pipe	Right bank	5		No			5	1	1
Toms Creek	2217105	Stormwater	Concrete Pipe	Right bank	10		Yes	Clear	None	3	1	1
Toms Creek	2307101	Agricultural	Concrete Pipe	Right bank	24		Yes	Clear	None	2	2	3
Tuscarora Creek	0408303	Stormwater	Corrugated Metal	Right bank	12		No			5	2	2
Tuscarora Creek	0708201	Stormwater	Concrete Channel	Right bank	24	2	No			5	2	3

Trash Dumping Sites

Note: Please see the Methods Section-Overall Ranking System (page 9) for discussion of severity, correctibilty, and access rankings

Survey	Location	Type	Truckloads	Extent	Volunteer Project?	Owner Type	Severity	Correctability	Access
Fishing Creek	1208203	Construction	1.5	Single Site	No	Private	3	5	5
Fishing Creek	1413201	Residential	3	Single Site	Yes	Unknown	2	3	4
Fishing Creek	1610301	Residential	7	Single Site	Yes	Private	3	2	4
Glade Creek	2819201	Residential	12	Large Area	No	Public	2	3	1
Hunting Creek	0617202	Residential	4	Single Site	No	Private	4	1	4
Hunting Creek	1515301	Residential	8	Single Site	Yes	Private	4	2	3
Owens Creek/Beaver Branch	1021201	Residential	2	Single Site	Yes	Unknown	3	2	2
Owens Creek/Beaver Branch	1322101	Tires/Construction	5	Single Site	Yes	Private	4	1	3
Owens Creek/Beaver Branch	2517101	Residential	17	Single Site	Yes	Private	2	3	4
Toms Creek	2105203	Residential	4	Large Area	Yes	Private	2	3	2
Toms Creek	2105206	Residential	2	Single Site	Yes	Private	2	1	1
Toms Creek	2217102	Residential	20	Large Area	Yes	Unknown	3	1	2
Toms Creek	2310201	Residential/Tires	10	Single Site	No	Private	3	3	4
Tuscarora Creek	0311304	Industrial	20	Single Site	No	Unknown	5	3	3
Tuscarora Creek	0410302	Industrial	4	Single Site	Yes	Unknown	5	3	3
Tuscarora Creek	0411301	Residential	8	Single Site	Yes	Private	3	4	3
Tuscarora Creek	0707201	Residential/Farm Equipment	3	Single Site	No	Private	5	4	4

Channel Alteration

Note: Please see the Methods Section-Overall Ranking System (page 9) for discussion of severity, correctibilty, and access rankings

Survey	Location	Type	Bottom Width (in)	Length (ft)	Perennial Flow	Sedimentation	Vegetation in Channel	Road Crossing	Length Above Road Crossing (ft)	Length Below Road Crossing (ft)	Severity	Correctability	Access
Fishing Creek	1208202	Concrete	60	2	Yes	No	No	No			5	3	5
Fishing Creek	1209202	Concrete	12	150	Yes	No	Yes	No			5	5	1
Fishing Creek	1309201	Concrete	18	180	Yes	No	No	No			4	3	2
Fishing Creek	1509101	Earth channel	72	40	Yes	Yes	No	No			5	1	2
Fishing Creek	1510101	Concrete	72	150	Yes	No	No	Both	75	75	4	3	1
Fishing Creek	1617101	Concrete	24	50	No	No	No	Below		75	4	3	1
Hunting Creek	1614302	Concrete	0	0	Yes	No	No	No			5	1	3
Hunting Creek	1814303	Rip-rap	48	1000	Yes	No	No	No			4	1	1
Hunting Creek	1913301	Rip-rap	0	1100	Yes	No	No	Below		200	4	1	2
Hunting Creek	2014102	Earth channel	12	10	Yes	Yes	Yes	Both			5	4	2
Tuscarora Creek	0607202	Rip-rap	8	30	Yes	Yes	Yes	Below	3	5	5	2	2

Unusual Conditions/Comments

Note: Please see the Methods Section-Overall Ranking System (page 9) for discussion of severity, correctibilty, and access rankings

Survey	Location	Type	Describe	Description	Potential Cause	Severity	Correctability	Access
Fishing Creek	1114401	Unusual Condition		Large metal pipe acts as a dam barrier. Water flows but motion is limited.		4	2	4
Fishing Creek	1315408	Unusual Condition		Horses and cows enter water, a barrier would be nice.		3	3	2
Fishing Creek	1516101	Unusual Condition	Odor/Water Color/Clarity	Brownish gray green runoff from agricultural land-long section of stream polluted odor of sewage	livestock/fertilizer	1	3	3
Fishing Creek	1612306	Unusual Condition		Land area surrounding stream is very wet w/ lots of small streams- stream branches and is making a small runoff, lots of algae in the still water w/ metallic residue.		-1	-1	4
Glade Creek	0713402	Comment		Buffer of trees has been established		5	1	3
Glade Creek	1617401	Comment		Creek is dried up or runs under the golf course and/or farmland		2	5	4
Glade Creek	2420301	Unusual Condition		Wetland potential very high-grass submerged under water-cattails present		2	4	2
Glade Creek	2620401	Comment		Planting of riparian vegetation begun		5	1	3
Hunting Creek	1716201	Unusual Condition	Excessive Algae		No flow of water, bad use of land on sides (lawn)	3	3	1
Owens Creek/Beaver Branch	2020302	Comment		Buffer established on left side of stream for about 700 feet.	Livestock present on right side-very small buffer established	5	1	2
Owens Creek/Beaver Branch	2320202	Unusual Condition	Excessive Algae		Inadequate buffer, farming upstream, low velocity, run-off	2	4	3
Tuscarora Creek	0510303	Comment		New buffer being established in limited area		5	1	2

Survey	Location	Type	Describe	Description	Potential Cause	Severity	Correctability	Access
Tuscarora Creek	0604403	Comment	Excessive Algae	Looks like there was a dam created to hold water. Water has green tint to it and a lot of algae.		4	3	3
Tuscarora Creek	0610303	Unusual Condition		Stream perpendicular to Tuscarora Creek does not exist		5	1	1
Tuscarora Creek	0710301	Comment		Great potential for wetland restoration project		5	1	1
Tuscarora Creek	0710302	Comment		Unnamed stream that ran off from lakes does not exist		5	1	1

Exposed Pipe

Note: Please see the Methods Section-Overall Ranking System (page 9) for discussion of severity, correctibilty, and access rankings

Survey	Location	Map	Team	Site	Location of Pipe	Type	Diameter(in)	Length(ft)	Purpose	Discharge	Color	Odor	Severity	Correctability	Access
Fishing Creek	1510102	1510	1	02	Above stream	smooth metal	5	12	unknown	Yes	clear	none	2	4	3
Fishing Creek	1510103	1510	1	03	Above stream	smooth metal	5	24	unknown	No			4	3	3
Fishing Creek	1510110	1510	1	10	Above stream	smooth metal	5	4	unknown	No			4	3	3
Glade Creek	0711203	0711	2	03	Above stream	concrete	48	30	unknown	No			3	5	4
Toms Creek	2105201	2105	2	01	Exposed across bottom of stream	smooth metal	4	10	unknown	No			4	3	4
Tuscarora Creek	0506401	0506	4	01	Exposed across bottom of stream	smooth metal	12	20	unknown	No			4	4	3
Tuscarora Creek	0506404	0506	4	04	Exposed across bottom of stream	Smooth metal	6	5	unknown	No			4	3	5

Representative Sites A

Survey	Location	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation
Fishing Creek	1016407	Poor	Marginal	Marginal	Optimal	Marginal	Optimal	Optimal	Suboptimal	Marginal	Suboptimal
Fishing Creek	1114403	Marginal	Marginal	Optimal	Optimal	Suboptimal	Marginal	Suboptimal	Marginal	Marginal	Marginal
Fishing Creek	1115405	Optimal	Optimal	Poor	Optimal	Suboptimal	Optimal	Optimal	Optimal	Suboptimal	Optimal
Fishing Creek	1207201	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Fishing Creek	1209204	Optimal	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal
Fishing Creek	1310202	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Marginal
Fishing Creek	1415406	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Optimal	Suboptimal
Fishing Creek	1510107	Optimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Marginal	Optimal	Optimal	Optimal	Optimal
Fishing Creek	1512311	Optimal	Optimal	Suboptimal	Optimal	Optimal	Marginal	Optimal	Suboptimal	Optimal	Optimal
Fishing Creek	1514403	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Marginal	Suboptimal	Marginal
Fishing Creek	1612305	Suboptimal	Marginal	Suboptimal	Optimal	Optimal	Marginal	Optimal	Suboptimal	Suboptimal	Suboptimal
Glade Creek	0813201	Poor	Marginal	Poor	Optimal	Marginal	Marginal	Marginal	Poor	Poor	Poor
Glade Creek	0914401	Suboptimal	Suboptimal	Poor	Optimal	Optimal	Marginal	Optimal	Marginal	Suboptimal	Poor
Glade Creek	1415401	Marginal	Marginal	Poor	Optimal	Marginal	Marginal	Suboptimal	Marginal	Marginal	Poor
Glade Creek	1617402	Poor	Poor	Poor	Marginal	Poor	Poor	Poor	Marginal	Optimal	Poor
Glade Creek	2420305	Marginal	Poor	Suboptimal	Optimal	Suboptimal	Marginal	Optimal	Suboptimal	Suboptimal	Marginal
Glade Creek	2720401	Optimal	Suboptimal	Poor	Optimal	Suboptimal	Optimal	Optimal	Marginal	Poor	Poor
Glade Creek	2721102	Poor	Poor	Marginal	Optimal	Poor	Marginal	Suboptimal	Suboptimal	Suboptimal	Marginal
Glade Creek	2819203	Suboptimal	Marginal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal
Hunting Creek	0417201	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal
Hunting Creek	0714201	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal
Hunting Creek	0912201	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Hunting Creek	1006101	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal
Hunting Creek	1010301	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal
Hunting Creek	1112301	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Hunting Creek	1408301	Optimal	Optimal	Suboptimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Suboptimal	Optimal
Hunting Creek	1617202	Marginal	Poor	Poor	Marginal	Poor	Poor	Poor	Poor	Poor	Poor

Survey	Location	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation
Hunting Creek	1714301	Optimal	Optimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal
Owens Creek/Beaver Branch	0921304	Optimal	Suboptimal	Marginal	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal
Owens Creek/Beaver Branch	1022302	Optimal	Marginal	Suboptimal	Optimal	Suboptimal	Marginal	Optimal	Suboptimal	Suboptimal	Suboptimal
Owens Creek/Beaver Branch	1122201	Optimal	Suboptimal	Suboptimal	Suboptimal	Marginal	Optimal	Optimal	Optimal	Optimal	Suboptimal
Owens Creek/Beaver Branch	1621202	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Marginal	Marginal	Marginal
Owens Creek/Beaver Branch	2119301	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal
Owens Creek/Beaver Branch	2120303	Poor	Poor	Suboptimal	Optimal	Poor	Poor	Poor	Marginal	Marginal	Optimal
Owens Creek/Beaver Branch	2417101	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal
Owens Creek/Beaver Branch	2419102	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Optimal
Toms Creek	1725301	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Optimal	Marginal
Toms Creek	1820201	Optimal	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Marginal	Suboptimal	Marginal
Toms Creek	2006202	Optimal	Optimal	Marginal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Suboptimal	Poor
Toms Creek	2103201	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Suboptimal
Toms Creek	2107101	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal
Toms Creek	2122301	Marginal	Marginal	Suboptimal	Optimal	Marginal	Poor	Marginal	Optimal	Optimal	Marginal
Toms Creek	2209201	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Suboptimal
Toms Creek	2218101	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Optimal
Toms Creek	2307302	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Marginal
Toms Creek	2308101	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Suboptimal	Optimal
Toms Creek	2320201	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Toms Creek	2418101	Optimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal
Tuscarora Creek	0312301	Suboptimal	Suboptimal	Poor	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Poor
Tuscarora Creek	0405101	Optimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal

Survey	Location	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation
Tuscarora Creek	0506402	Optimal	Optimal	Suboptimal	Optimal	Suboptimal	Optimal	Optimal	Marginal	Suboptimal	Suboptimal
Tuscarora Creek	0508301	Marginal	Marginal	Marginal	Optimal	Optimal	Suboptimal	Optimal	Marginal	Marginal	Suboptimal
Tuscarora Creek	0606401	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal	Marginal
Tuscarora Creek	0608201	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Optimal

Representative Sites B

Survey	Location		Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
Fishing Creek	1016407	240	160	300	8	24	40	Gravel
Fishing Creek	1114403	24	18	30	2	3.5	6	Sand
Fishing Creek	1115405	200	240	242	10	30	40	Cobble
Fishing Creek	1207201	12	12	10	6	6	12	Cobble
Fishing Creek	1209204	45	50	55	16	20	28	Boulder
Fishing Creek	1310202	120	144	180	12	24	48	Boulder
Fishing Creek	1415406	300	250	360	18	24	40	Cobble
Fishing Creek	1510107	48	24	12	1	12	18	Gravel
Fishing Creek	1512311	180			36			Cobble
Fishing Creek	1514403	15	20	22	5	36	52	Gravel
Fishing Creek	1612305	48	36		2	3		Gravel
Glade Creek	0813201	20	20	20	2	3		Silt
Glade Creek	0914401	36	12	12	8	8	8	Gravel
Glade Creek	1415401	24	48	60	4	8	18	Sand
Glade Creek	1617402							Silt
Glade Creek	2420305	24	36		6	8		Silt
Glade Creek	2720401	36	72	48	4	6	24	Silt
Glade Creek	2721102	48	36	24	1	8	10	Silt
Glade Creek	2819203	72	60	120	4	20	30	Boulder
Hunting Creek	0417201	240	360	420	10	36	48	Cobble
Hunting Creek	0714201	90	120	140	9	21	39	Cobble
Hunting Creek	0912201	80	85	100	8	24	36	Cobble
Hunting Creek	1006101	60	24	12	1	3	3	Gravel
Hunting Creek	1010301	36	36	60	24	12	36	Boulder
Hunting Creek	1112301	36	60	48	12	16	24	Boulder
Hunting Creek	1408301	24	24	48	8	12	24	Cobble

Survey	Location	Width Riffle	Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
Hunting Creek	1617202		10			5		Silt
Hunting Creek	1714301	240			6			Cobble
Owens Creek/Beaver Branch	0921304	120	30	36	6	6	8	Cobble
Owens Creek/Beaver Branch	1022302	24	12	36	2	8	4	Gravel
Owens Creek/Beaver Branch	1122201	84	96	144	7	9	24	
Owens Creek/Beaver Branch	1621202	96	80	100	5	15	30	Bedrock
Owens Creek/Beaver Branch	2119301	36	18	16	8	6	4	Cobble
Owens Creek/Beaver Branch	2120303	0	0	0	0	0	0	Dry
Owens Creek/Beaver Branch	2417101	72	48	36	2	5	8	Cobble
Owens Creek/Beaver Branch	2419102	40	30	24	1	4	7	Cobble
Toms Creek	1725301	36	96	144	6	4	14	Cobble
Toms Creek	1820201	240	240	264	5	10	18	Cobble
Toms Creek	2006202	72	48	60	3	4	6	Gravel
Toms Creek	2103201	24	48	50	5	4	10	Boulder
Toms Creek	2107101	78	96	24	1	5	10	Cobble
Toms Creek	2122301	12	18	84	1	14	24	Silt
Toms Creek	2209201	144	144	180	7	8	24	Cobble
Toms Creek	2218101	96	180	60	1	8	12	Cobble
Toms Creek	2307302	48	84	72	3	5	8	Cobble
Toms Creek	2308101	84	60	36	2	6	12	Cobble
Toms Creek	2320201	288	360	408	11	20	30	Boulder
Toms Creek	2418101	132	240	96	2	18	36	Cobble
Tuscarora Creek	0312301	228	180	300	5	7	36	Gravel
Tuscarora Creek	0405101	72	72	48	2	10	30	Cobble
Tuscarora Creek	0506402	72	96	144	4	18	36	Cobble
Tuscarora Creek	0508301	24	24	48	4	8	15	Silt
Tuscarora Creek	0606401	24	40	48	3	5	7	Cobble

Survey	Location	Width Riffle	Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
Tuscarora Creek	0608201	50	60	80	12	20	40	Boulder