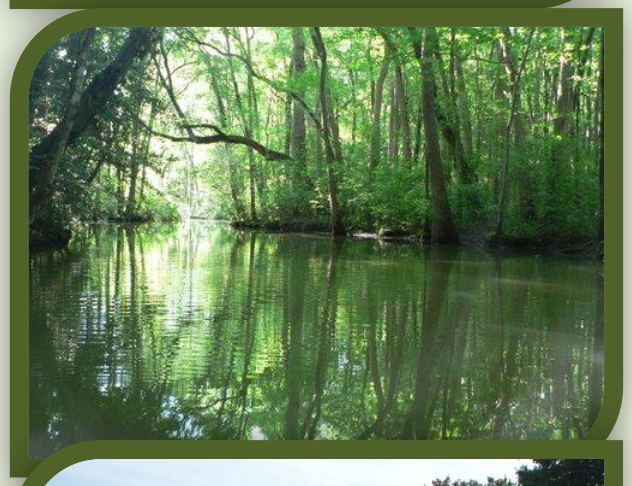

Final Wicomico River Watershed Management Plan

March 1, 2013

PREPARED FOR:

Wicomico Environmental Trust
Clean Water, Smart Growth

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20 YEARS 1992-2012
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EXECUTIVE SUMMARY

E.1 Introduction

Located on the Eastern Shore of Maryland, the Wicomico River Watershed is approximately 230 square miles in size, encompassing portions of Wicomico County, Somerset County, Worcester County, City of Salisbury, City of Fruitland and Sussex County, Delaware. The stream network includes the Wicomico River main stem and seven subwatersheds as delineated by the United State Geological Survey: the North Prong, South Prong (referred to locally as the East Prong), Tony Tank, Shiles Creek, Wicomico Creek, Ellis Bay and Monie Bay. The watershed is dominated by a mix of agricultural, wetland, forest, and developed land covers. The Wicomico River has 13 local Total Maximum Daily Load (TMDL) impairments on various parts of the river. Most of the impairments are for nutrients (nitrogen and phosphorus), sediment and fecal coliform (see Section 2.2.1). The Wicomico River also falls under the Chesapeake Bay TMDL that allocates nutrient and sediment reductions for each Bay state. For Maryland, this equates to a 25% reduction in nitrogen, 24% reduction in phosphorus and 20% reduction in sediment. These reductions were further broken down by county and major river basin. At the state level, Phase I and Phase II Watershed Implementation Plans (WIPs) were developed to determine how each state will help meet pollutant reductions.

According to the Maryland Department of Environment (MDE) TMDL reports, the probable sources of fecal coliform in the watershed are wildlife, human, livestock and pets (MDE, 2008). Other potential sources include manure spreading, direct deposition from livestock, failing septic systems and leaking sanitary infrastructure. Sources of nutrients include non-point sources and agricultural land, particularly for phosphorus. Point sources for nutrients have also been identified and these include the wastewater treatment plants (Salisbury, Fruitland and Delmar) and Perdue Farms, Inc.

In June, 2012 and October, 2012, extensive retrofit, upland and stream field assessments were conducted throughout two Wicomico subwatersheds – the South Prong and Tony Tank - to evaluate pollution management and watershed restoration opportunities. During these assessments, field crew teams visited over 352 locations in the watershed and used one of four field assessment methodologies to evaluate the feasibility of implementing a management or restoration practice. Approximately 100 potential stormwater retrofit sites, 44 potential hotspot locations, 47 residential neighborhoods and 13.4 miles of stream (44 stream reaches) were assessed. Common problems observed in the watershed included a lack of stormwater management at older development sites, inadequate stormwater treatment at some sites, improper outdoor material storage and waste management, inadequate riparian buffer areas, trash, and impoundments throughout. Many opportunities for restoration projects and programs were identified.

One key component of the *Wicomico River Watershed Management Plan (Plan)* was to develop specific watershed protection and restoration objectives and then rank and prioritize the proposed projects identified from the field work according to these watershed objectives.

A list of ranked watershed management and restoration projects along with estimated project costs are listed in Appendices D and E of this *Plan.* Some higher priority projects are discussed in detail by subwatershed in Section 4, and are mapped in Appendices B and C. Watershed projects were ranking according to the following watershed factors:

- *Cost* – The cost associated with project implementation. Project costs represent only planning level estimates and were determined based on guidance provided in Schueler et al. (2007), Wright et al. (2005) and Kitchell and Schueler (2004).
- *Community Education and Involvement* – Project with potential to educate and involve the community.
- *Visibility* – Project with high visibility and potential to raise the public's awareness of the watershed (e.g. visible from street or located in public park).
- *Feasibility* – Project with high potential that it will be implemented. The site has access for equipment, low maintenance burden, serves as a demonstration site and is publicly owned.
- *Water Quality Improvement* – Potential for treatment or prevention of pollutants. Treats water quality volume or eliminates exposure of pollutants to stormwater runoff.
- *Ecological Benefit* – Project provides an ecological, habitat, or natural resource protection benefit.
- *Protection Priority* – Project is located within a high priority or priority protection area as shown by maps in Section 4.1.5.
- *Meeting Watershed Goals* – Potential for project to assist in meeting watershed goals (see section below).

E.2 Watershed Goals, Objectives and Strategies

To guide the development of this plan, a watershed vision, goals and objectives were established by the Core Team, which consists of the City, County, and State representative, local non-governmental organizations and other interested parties, and two public stakeholder meetings. The watershed vision, goals and objectives are stated below.

Wicomico Watershed Vision

The citizens of the Wicomico River Watershed want to reduce pollution entering the Wicomico River and the Chesapeake Bay through partnerships and cooperative efforts to restore and protect watershed lands. We envision a river healthy enough to sustain robust fish and shellfish populations, human recreational activities, and surrounding wildlife. We believe that a healthy river reflects our rural, small town values and protects our natural landscape.

Goal 1. Improve water quality.

Objective 1 – Contribute to County nutrient and sediment reductions for the Chesapeake Bay Total Maximum Daily Load (TMDL) and local TMDLs for the River.

Objective 2 – Decrease stream erosion and sedimentation.

Objective 3 – Promote behavior change for local residents and property owners to change practices through education and demonstration projects.

Objective 4 – Determine most effective water quality improvement actions for each lake/pond in the watershed.
Objective 5 – Encourage enforcement of existing laws and policies that includes best management practice (BMP) inspection and oversight of construction sites.
Objective 6 – Reduce the impact of impervious surfaces.

Goal 2. Protect existing resources.

Objective 1 – Protect green infrastructure and ecologically significant areas.
Objective 2 – Protect farmland.
Objective 3 – Protect existing wetlands and natural areas.
Objective 4 – Protect the community's drinking water supplies and aquifers.

Goal 3. Restore watershed function.

Objective 1 – Restore green infrastructure, in-stream and upland habitat, and shellfish beds.
Objective 2 – Reduce localized flooding.
Objective 3 – Plan for the impacts of sea level rise.
Objective 4 – Promote residential homeowner practices (i.e. rain gardens, rain barrels), including the reduction in the application of fertilizer, esp. during certain times of the year.
Objective 5 – Promote the use of Agricultural BMPs.

Goal 4. Educate the Public on Watershed Restoration Efforts.

Objective 1 – Integrate public education with project implementation where possible.
Objective 2 – Involve the youth in restoration activities.
Objective 3 – Promote recreational opportunities in the watershed.

Based on these watershed objectives and the results of the watershed characterization assessment and field findings, eleven key strategies were developed that are presented in order of implementation priority. These strategies focus on a range of activities from municipal practices and programs, natural resources protection, the treatment of polluted runoff, and source control and education.

1. **Transition the Core Team into a long term management structure.**
2. **Prevent further degradation in the subwatersheds by implementing protection efforts.**
3. **Implement pollution prevention measures at municipal and private sites, including employee training.**
4. **Encourage pollution prevention practices as well as tree planting and landscape management in residential neighborhoods.**
5. **Plant trees watershed-wide to increase tree canopy.**
6. **Implement high priority stormwater retrofit practices, particularly educational/demonstration projects.**
7. **Implement priority stream improvement projects.**
8. **Investigate strategies for pond management.**

9. **Minimize the creation of impervious surfaces during the development review process.**
10. **Educate homeowners regarding advanced nutrient removal septic systems and connect failing septic systems to the sewer system as per the County's Water and Sewerage Plan (2010).**
11. **Track and monitor the implementation progress.**

These strategies are detailed in Section 5 of this *Plan.* Section 5 also details recommended short-term, mid-term, and long-term actions to support these strategies.

E.3 Implementation Costs and Timeline

Implementation is by far the longest and most expensive step in the watershed management process. In fact, restoration and protection costs for a single suburban subwatershed can easily range in the million dollars depending on the extent of restoration and protection activities, number of jurisdictions involved, land costs, and other factors. Section 5 of this Plan presents information on planning partners, planning level costs, and phasing and resources for implementing watershed strategies. Table E.1 below provides a draft implementation schedule and associated costs for implementing each short term, mid-term and long term action. Additional tables in Section 5 provide information on the watershed objectives met through implementation of these strategies, responsible parties, and long-term milestones for implementation of each strategy. Project costs and cost ranges associated with the 177 identified individual watershed projects and 47 neighborhoods can be found in Appendices D and E. Some individual projects from these lists are incorporated into the implementation plan as examples. *Project partners should consult the appendices to begin implementation of high priority projects and factor costs from the most feasible projects into the overall implementation strategy.*

The cumulative estimate for implementing the 11 strategies is approximately $1.7 million dollars over the short and mid-term (Table E.1). The largest component of these cost results from the estimated cost of acquiring conservation easements (Strategy 2) and implementing stormwater retrofit and stream projects (Strategy 6 & 7). Additional high-dollar costs are associated with hiring a watershed coordinator and implementing pollution prevention measures and municipal and private sites. Costs associated with watershed strategy 2 alone are estimated at over $600,000 for the mid-term, which assume costs for conservation easements on 250 acres of land and will require the County to become re-certified with the state for the preservation of agricultural land.

E.4 Pollutant load reductions

Pollution load reductions were estimated for stormwater retrofit projects based on assumptions detailed in Schueler et al. (2007) and Hirschman, et al. (2008). Using these assumptions, the identified projects have the potential to reduce nitrogen by 1,290 lb/yr, phosphorus by 213 lb/yr and total suspended sediment by 52,360 lb/yr. These projects, along with tree planting projects, were input into the Maryland Assessment Tool (MAST), a web-based load estimator tool that builds scenarios for pollutant load reduction based on user-input best management practices (BMPs). The MAST tool is promoted for use to Maryland jurisdictions to assess

progress for meeting Chesapeake Bay TMDL reduction targets. The MAST scenarios for the identified *Plan* projects are presented in Appendix G and indicate a percent change in reduction for each land use sector (municipal Phase II MS4 impervious, municipal Phase II MS4 pervious, nonregulated impervious developed and nonregulated pervious developed) from between 0.09-1.5 for nitrogen, 0.015-10.4 for phosphorus and 0.24-100 for total suspended solids. It should be noted that load reduction targets are expected to change and new BMPs are currently being evaluated for inclusion as creditable practices (e.g. illicit discharge elimination, stream restoration, urban nutrient management). These additional BMPs may provide many more cost effective options for local jurisdiction and communities to meet Chesapeake Bay TMDL load reduction targets.

The MAST tool is not necessarily effective for assessing different management scenarios or programmatic elements and, as such, project partners may want to consider an alternative pollution model. The Watershed Treatment Model (WTM; Caraco, 2002) is able to account for restoration action not considered by MAST (e.g. pet waste education, lawn care education, catch basin cleanouts) and the user can more effectively weigh the costs and benefits of each action as well as compare them to each other. In addition, the WTM accounts for bacteria, a known impairment in the Wicomico watershed, and can also account for future growth and land use change.

Table E.1. Implementation Actions and Costs*			
Strategy	**Short-Term Action (year 1)**	**Mid-Term Action (year 2-4)[1]**	**Long-Term Action (year 5+)[2]**
1. Transition the Core Team into a long term management structure	Assign responsible parties for each restoration strategy using this table as well as **Error! Reference source not found.** (20 hrs)	Find funding for support of Watershed Coordinator staff position (80 hrs =$2400).	Develop long-term work plan for Watershed Coordinator
	Determine most logical entity to host a Watershed Coordinator staff position (20 hrs)	Hire Watershed Coordinator ($35,000/yr/3 yrs)	Ensure that Coordinator actions are effectively directed to meet water quality and watershed restoration goals, which may change over time
	Determine specific roles and responsibilities for Watershed Coordinator (20 hrs)		Annual salary for Watershed coordinator
Strategy 1 Costs	$3,300	$109,400	$$$
2. Prevent further degradation in the subwatershed by implementing protection efforts	Consider passing a 100 foot stream buffer regulation for perennial, intermittent and ephemeral streams (200 hrs)	Adjust restoration and protection planning efforts to account for wetland and buffer migration (100 hrs).	Conduct outreach to landownersof high priority protection areas
	Promote the County's Rural Legacy program through outreach and eductaion to landowners, which can support conservation easements on forested and agricultural parcels (100 hrs)	Conduct outreach to landownersof high priority protection areas (200hr/yr/3 yrs)	Protect 50% of remaining high priority protection areas (1,132 total acres) and 10% of priority protection areas (403 total acres)[3]
	Promote sustainable management of forests through outreach and education to landowners (100 hrs)	Protect 10% of high priority protection areas (251 total acres)[3]	
	County to become re-certified with the MALPH program (40 hours)		
Strategy 2 Costs	$24,200	$615,549	$$$$

Table E.1. Implementation Actions and Costs*			
Strategy	**Short-Term Action (year 1)**	**Mid-Term Action (year 2-4)[1]**	**Long-Term Action (year 5+)[2]**
3. Implement pollution prevention measures at municipal and private sites, including employee training.	Conduct a full hotspot assessment of all municipal facilities (5 days for field work, 3 days to post process)	Provide education on pollution prevention to targeted businesses and implement stormwater retrofits and pollution source control measures (4 trainings/yr at 32 hrs/training/3 yrs)	Develop a *Business Stewardship Outreach Program* that engages the business community in watershed restoration
	Provide internal employee training to municipal employees regarding pollution prevention and good housekeeping practices (4 trainings/yr at 32 hrs/training)	Continue to provide employee training to municipal employees regarding pollution prevention and good housekeeping practices (2 trainings/yr at 15 hrs/training/3 yrs)	Implement BMPs on private facilities (TT_RRI_31, TT_RRI100c, SP_RRI_101)
	Ensure that an enforceable stormwater ordinance for preventing illicit discharges to the storm drain system is in place (320 hrs)	Implement 2 innovative BMPs on municipal properties as demonstration of good stewardship to the community (TT_RRI_55 & SP_RRI_1)	
Strategy 3 Costs	$28,160	$288,070	$$
4. Encourage pollution prevention practices as well as tree planting and landscape management in residential neighborhoods	Identify neighborhood leaders for community stewardship (12 hrs)	Expand the storm drain marking program into older neighborhood (6 trainings at 32 hrs/3 yrs)	Increase neighborhood tree canopy and encourage natural buffer regeneration at residences along stream corridors
	Develop educational materials for pollution prevention and source control (40 hrs)	Disconnect residential downspouts to allow for treatment and volume reduction of rooftop runoff (100 downspouts @ $50/downspout)	
	Encourage tree planting and landscape management in residential neighborhoods (40 hrs + 100 trees at $19/tree)	Develop a targeted residential education program to encompass the proper application of fertilizer and use of alternatives to grass lawns, trash education and promotion of recycling, stream buffer eductaion and conservation landscaping (3/4 FTE staff person)	

Table E.1. Implementation Actions and Costs*			
Strategy	**Short-Term Action (year 1)**	**Mid-Term Action (year 2-4)[1]**	**Long-Term Action (year 5+)[2]**
		Assess ditch restoration opportunities in neighborhoods as strategy to meet water quality goals (100 hrs)	
Strategy 4 Costs	$6,960	$63,680	$$
5. Plant trees watershed-wide to increase tree canopy	Determine responsible entities for implementing and maintaining tree planting projects (20 hours)	Establish a means of supporting community groups and schools to implement their own tree planting projects, including guidance on maintenance (60 hrs)	Assess status of meeting urban tree planting goals and revise implementation as needed
	Align tree planting projects identified in plan with urban tree canopy goals (20 hours)		
	Install some tree planting demonstration projects in highly visible areas (40 hrs each + 100 trees at $19/tree)	Plant 10% of identified tree planting projects (18 acres @ 100 trees/acre @ $19/tree)	Plant 60% of remaining tree planting projects
Strategy 5 Costs	$6,300	$37,500	$$$
6. Implement high priority stormwater retrofit practices, particularly educational / demonstration stormwater retrofit practices	Identify funding sources for retrofits (80 hrs)	Install educational/demonstration stormwater retrofit projects at schools and parks (SP_RRI_15a, SP_RRI_15b:, TT_RRI_48)	Expand the green school program to include additional institutions
	Modify, repair, and/or maintain existing stormwater management facilities to improve water quality performance[4]	Develop a green school program that includes reforestation, stormwater retrofits and pollution prevention (300 hrs)	Implement additional high priority stormwater retrofits (TT_RRI_41a, TT_RRI_41b, TT_RRI_74, SP_RRI_102b, SP_RRI_11)
	Engage the public through implementation of highly visible, low cost demonstration projects (SP_RRI_8b, SP_RRI_24)	Implement stormwater management into existing municipal parking lots during redevelopment (code changes: 200 hrs)	Continue to identify retrofit opportunities at schools, neighborhoods, commercial areas, and outfalls that do not

Table E.1. Implementation Actions and Costs*			
Strategy	**Short-Term Action (year 1)**	**Mid-Term Action (year 2-4)[1]**	**Long-Term Action (year 5+)[2]**
	Engage neighborhood residents in buffer planting project (TT_IB36_1)	Further assess opportunities in neighborhoods with little or no existing stormwater management (72 hrs)	have existing BMPs
Strategy 6 Costs	$21,900	$91,460	$$$
7. Implement priority stream improvement projects	Conduct quarterly stream clean-ups. (4 events/yr)	Implement additional high-priority stream projects, such as buffer restoration (SP_IB2101 and TT_IB36_1).	Incorporate new stream, data into GIS layers and use the data during development plan reviews
	Continue use of bag filters on outfalls and consider expansion of program ($20,000/net@5 nets + $5,000 maintenance costs)[5]	Update watershed mapping to account for and differentiate between perennial and intermittent streams. (40 hrs)	Continue to implement additional high-priority stream projects (SP_IB2601; TT_IB5_1; SP_IB_301).
	Continue implementation of illicit discharge outfall screening program ($25,000/year)[6]	Determine potential for Coast Guard auxiliary to assist with trash clean-ups in the lower watershed that can only be accessed by boat. (40 hrs)	Implement large demonstration project at SP_SC301
	Obtain grant funding to conduct feasibility study of large-scale water quality improvement project at SP_SC_301 (25 hrs)	Hold regular living shoreline and conservation landscape workshops. (4 events at 32 hrs/3yrs)	
	Educate the citizenry regarding invasive species like Japanese knotweed and their control (4 events at 15 hrs each)	Implement 1-2 fish barrier projects (TT_SC26_1)	
	Control Japanese knotweed invasion in the headwaters (SP_IB1701)	Implement feasibility study at SP_SC_301 ($35,000)	
	Conduct outreach to landowners on the river for living shoreline projects (4 events at 32 hrs each)		
Strategy 7 Costs	$149,315	$73,020	$$

Table E.1. Implementation Actions and Costs*			
Strategy	**Short-Term Action (year 1)**	**Mid-Term Action (year 2-4)[1]**	**Long-Term Action (year 5+)[2]**
8. Investigate strategies for pond management	Provide educational workshops to lakeside homeowners regarding neighborhood source control practices, septic system maintenance (strategy 9) and benefits of shoreline buffers. (4 events at 32 hrs each) Foster opportunities for residents to interact with lake systems where pollution problems are less of a concern. (4 events at 32 hrs each)	Comprehensive assessment of lakes in the watershed for future action based on pollution, aquatic weeds, flooding and other concerns (1200 hrs)	Implement actions identified in lake restoration assessments. (unknown cost)
Strategy 8 Costs	$14,080	$66,000	$$$$
9. Minimize the creation of impervious surfaces during the development review process.	Review the City and County development codes using the Codes and Ordinances Worksheet (COW) (60 hrs)	Implemented needed code revisions as determined by the COW (400 hrs)	Where possible, remove excess or unused impervious cover (SP_RRI_22; SP_RRI_100a; TT_RRI_48; TT_RRI_54b).
Strategy 9 Costs	$3,300	$22,000	$$
10. Educate homeowners regarding advanced nutrient removal septic systems and connect failing septic systems to the sewer system as per the County's Water and Sewerage Plan (2010).	Provide educational workshops on septic system maintenance (strategy 7) (4 events at 32 hrs each)	Provide educational workshops on septic system maintenance (strategy 7) (14 events at 32 hrs each)	Extend sanitary infrastructure to high priority lakes with adjacent septic systems
Strategy 10 Costs	$7,040	$24,640	$$$$
11. Track and monitor the implementation progress	Determine capacity limitations of local partners identified in Table X for implementation and identify ways to build capacity in needed areas (e.g. specific training) (40 hrs)	Revisit watershed plan and assess status (40 hrs)	Revise this plan as needed to reflect changes in watershed conditions and new priorities.

Table E.1. Implementation Actions and Costs*			
Strategy	**Short-Term Action (year 1)**	**Mid-Term Action (year 2-4)[1]**	**Long-Term Action (year 5+)[2]**
	Expand a Creekwatcher monitoring program by adding Total suspended solids as parameter (450 samples @ $15/sample = $6,750); conduct detailed synoptic survey of Tony Tank and South Prong ($2500); establish new station in Monie Bay and use as a reference site (40 hrs)	Provide continuing education regarding project maintenance to homeowners, HOAs, schools, municipalities, etc. (4 trainings at 32 hrs each/3 yrs)	
	Develop project tracking database in GIS and spreadsheets (40 hrs)		
Strategy 11 Costs	$15,850	$23,320	$
Sub Totals	**$280,405**	**$1,414,639**	
Grand Total (Short & Mid Term Only)	**$1,695,044**		

*Note: These cost estimates include staff time, materials, supplies, and construction costs where applicable. A $55 hourly rate was assumed in all calculations. Best professional judgment was used for staff time estimates, projects costs are from Appendices D and E. Other cost assumptions are documented with footnotes.

[1]Costs are calculated for three years within this category where noted, otherwise for one year. A range of 50-150% of estimated costs is provided to account for uncertainty.

[2]Costs are calculated for 10 years within this category where noted, otherwise for one year. Since these costs are so unpredictable for the long-term, and likely to change based on inflation and other unknown factors, best professional judgment was used to assign a relative value as such: "$"=$1,000-$10,000; "$$"=$10,000-$100,000; "$$$"=$100,000-$500,000; and "$$$$"=>$500,000.

[3]Protection costs based on $2,200/acre, 3% administrative fee to sponsor the project and 1.5% compliance fee.

[4]Funding a stormwater post-construction program depends on many factors. See "Managing Stormwater in Your Community: A Guide for Building an Effective Post-Construction Program" (Hirschman and Kosco, 2008) for more information and guidance on developing a budget.

[5]Costs from ongoing CWP Gross Solids project in Talbot County.

[6] Brown et al (2004).

Long-term goals have been set in the implementation strategy to mark progress to ensure the implementation of the *Plan* adheres to a schedule to meet the defined outcomes.

- Meet interim milestones from Table E.1 for each strategy
- Reduce baseflow concentrations of nitrogen, phosphorus and bacteria at Creekwatcher monitoring stations to meet local and Chesapeake Bay TMDL reductions. Implementation plans are needed to address bacteria impairments; this is currently not addressed in local TMDLs.
- Evaluate at five years any improvements in trends that may have occurred due to implementation efforts.

After 5 years time, this *Plan* should be updated to include recent watershed developments and monitoring results.

SECTION 1. INTRODUCTION

1.1 Process for Developing the Wicomico Watershed Management Plan

The *Wicomico River Watershed Management Plan (the Plan)* is the culmination of over one year of extensive desktop analyses, field assessments, and stakeholder meetings conducted by the Center for Watershed Protection (the Center) and project partners. The work was completed under two different contracts, one with the City of Salisbury (the City) under a National Fish & Wildlife Foundation grant and one with the Wicomico Environmental Trust (WET) under a Chesapeake Bay Trust grant. The tasks identified within the scope of work with the City included:

1. Develop a Watershed Characterization Report for the Wicomico River Watershed
2. Holding one stakeholder meeting;
3. Identify potential restoration and protection opportunities by conducting riparian corridor, upland pollution prevention, and stormwater retrofit assessments; and
4. Craft a Wicomico Watershed Plan and one Subwatershed Action Plan for a prioritized subwatershed, which was determined to be the South Prong.

The tasks identified within the scope of work with WET included:

1. Identify potential restoration and protection opportunities in the Tony Tank subwatershed by conducting riparian corridor, upland pollution prevention, and stormwater retrofit assessments;
2. Estimate pollutant load reductions for the identified projects; and
3. Craft a Subwatershed Action Plan for the Tony Tank.

Although not included in either scope of work, one additional public stakeholder meeting was held as it was determined that engaging the public was deemed an integral part of the overall success of the project. Identified projects and their locations are listed in separate appendices for the South Prong and Tony Tank subwatersheds (Appendices B & C contain location maps for each of the subwatersheds and Appendices D & E contain project tables for each of the subwatersheds. Because watershed restoration action strategies contain broader recommendations that are applicable to both subwatersheds, these were combined in one overall Action Plan detailed in Section 5. For prioritized project lists identified within each subwatershed, see the appropriate appendices.

The initial task in developing this *Plan* was to develop an understanding of the baseline, or current, conditions of the Wicomico River watershed. To accomplish this, the Center first reviewed existing watershed data, studies, and reports. In addition, the Center analyzed watershed Geographical Information System (GIS) data. As part of the baseline assessment, the Center conducted a Comparative Subwatershed Assessment to broadly characterize each subwatershed, its restoration potential and associated restoration strategies as well as to prioritize one subwatershed in which to conduct field assessments.

The next major task in developing this *Plan* was to identify stormwater retrofit, pollution prevention, and stream restoration opportunities in the watershed. The Center conducted upland and stream field assessments in the South Prong subwatershed in June, 2012. During this assessment period, field crews assessed approximately 46 potential retrofit sites, 25 potential hotspot locations, 23 residential neighborhoods, and 8.4 miles of stream (22 stream reaches). The Center conducted upland and stream field assessments in the Tony Tank subwatershed in October, 2012. During this assessment period, field crews assessed approximately 54 potential retrofit sites, 19 potential hotspot locations, 24 residential neighborhoods, and 5.0 miles of stream (22 stream reaches). The findings of the fieldwork are summarized in Section 4 of this *Plan*.

Using input from the Core Team, the Center developed a ranking system to prioritize identified management and restoration practice opportunities. Using best professional judgment, each project was assigned points and ranked according to several factors including: cost; community education and involvement, visibility; feasibility; water quality improvement; ecological benefit; protection priority; and the ability to meet the watershed objectives.

The Center, using input from the Core Team, developed watershed management objectives. The Center then re-examined all data collected over the course of the project – baseline information, field observations, field assessment results, Wicomico River Watershed goals and objectives – and developed 11 key management and protection strategies for the watershed, as described in Section 5. These 11 strategies are the core of this *Plan.* They provide a framework for implementing the numerous management and restoration practices identified through field assessments as well as program and education related recommendations.

Recommended short-term, mid-term, and long-term actions to support the 11 watershed strategies are presented in Section 5. A detailed implementation plan was compiled that outlines the key watershed actions and information on individuals responsible for implementation, an implementation timeline, and summary cost information. Information on project tracking and monitoring are also provided.

1.2 U.S. EPA Watershed Planning "A-I Criteria"

In 2003, the U.S. Environmental Protection Agency (EPA) began to require that all watershed restoration projects funded under Section 319 of the federal Clean Water Act to be supported by a watershed plan that includes the following nine minimum elements, known as the "a-i criteria":

a. Identification of the causes and sources that will need to be controlled to achieve the load reductions estimated in the watershed plan
b. Estimates of pollutant load reductions expected through implementation of proposed nonpoint source (NPS) management measures
c. A description of the NPS management measures that will need to be implemented
d. An estimate of the amount of technical and financial assistance needed to implement the plan
e. An information/education component that will be used to enhance public understanding and encourage participation
f. A schedule for implementing the NPS management measures

g. A description of interim, measurable milestones
h. A set of criteria to determine load reductions and track substantial progress towards attaining water quality standards
i. A monitoring component to determine whether the watershed plan is being implemented

This *Plan* meets the a-i criteria. Table 1. 1 shows where these criteria are addressed throughout this document.

Table 1. 1. U.S. EPA Watershed Planning "A-I" Criteria

Section of the report	A	B	C	D	E	F	G	H	I
Section 1. Introduction									
Section 2. Watershed Characterization	X								
Section 3. Watershed Assessment Protocols									
Section 4. Watershed Assessment Findings		X	X						
Section 5. Action Strategies			X	X	X	X	X	X	X
Appendix A. Watershed Characterization Report Appendices									
Appendices B and C. Site Location Maps			X						
Appendix D and E. Summary of Projects in the South Prong & Tony Tank Subwatersheds		X	X	X					
Appendix F. Ranking Metrics									
Appendix G. Maryland Assessment Scenario Tool Scenarios									X
Appendix H. Best Management Practice Profile Sheets					X				
Appendices I and J. Field Forms									

1.3 Plan Organization

The *Plan* is organized as follows:

Section 1. Introduction – provides an introduction to the Wicomico River Watershed Management Plan.

Section 2. Watershed Characterization of the Wicomico River Watershed – describes the baseline, or current, conditions of natural features, community features, and land use and cover in the Wicomico watershed.

Section 3. Watershed Assessment Protocols – provides an overview of retrofit, stream and upland assessment methodologies.

Section 4. Findings – provides key findings from the subwatershed field assessments.

Section 5. Action Plan – presents the 11 key watershed management strategies based on watershed assessments and desktop analyses conducted by the Center; describes actions that support the key strategies, along with information on planning partners, project phasing, planning level costs, and resources for implementing watershed strategies.

1.4 Caveats

It is important to keep in mind that this *Plan* is limited in scope and should be updated as more information on the watershed is acquired. Recommendations are based on desktop analysis and observations made during targeted upland and stream assessments. While representative sites from across the watershed were assessed, all stream miles and upland areas were not assessed. In the future, additional assessments should be conducted in areas of concern and this *Plan* updated to reflect watershed changes and developments.

SECTION 2. WATERSHED CHARACTERIZATION

2.1 Introduction

The Wicomico River Watershed (the watershed) is 230 square miles in size located on the lower eastern shore of Maryland (Figure 2. 1). The Wicomico River headwaters drain a small portion of Sussex County, Delaware (1%) with the majority of the watershed contained in Wicomico County (69%) and Somerset County (30%), Maryland. The watershed drains to the Tangier Sound and ultimately the Chesapeake Bay. The diverse watershed is composed of saltwater and freshwater tidal wetlands, productive agricultural land, superior recreational areas for boating, fishing, crabbing and other water-based activities; contains the Monie Bay National Estuarine Research Reserve and a primary navigation hub that is also the Maryland Eastern Shore's biggest city and Maryland's second largest port, Salisbury, MD.

The watershed contains a total of 481 linear stream miles of which 22 percent are impaired (MD DNR, 2012a). The watershed is dominated by agricultural (27%), wetland (25%), forest (18%), and developed (15%) land cover. The agricultural areas contain an extensive drainage ditch system (MDE, 2000b). Wicomico County, MD is the top agricultural producing county in the state that includes beef cattle and leads the state in broiler chicken production with the Perdue Farms Headquarters and processing plant located near Salisbury, MD. Popular crops include corn, soybeans, wheat and vegetables (MD BED, 2012), many of which receive poultry waste as fertilizer.

For this study, the watershed is divided into seven subwatersheds provided in Table 2. 1 and Figure 2. 1. The North Prong drains the headwaters north of Delmar, MD just over the Delaware border. Located near the outlet of North Prong is Johnson Pond a 136 acre impoundment. The pond contains a concrete dam built in 1933 that serves as the designated dividing line between tidal and non-tidal waters in the Wicomico River (MDE, 2001). The pond is a recreational warmwater bass fishery.

Flowing south, the South Prong joins the mainstem to the east of the Salisbury, MD and Tony Tank Creek enters just south of Salisbury, MD. The South Prong is referred to locally as the "East Prong." Tony Tank Lake is an impoundment on Tony Tank Creek that was created in 1948 and is used for recreational purposes. The dam serves as the designated dividing line between tidal and non-tidal waters in Tony Tank Creek (MDE, 1999). Shiles Creek and Wicomico Creek enter the mainstem south of Fruitland, MD. Ellis Bay and Monie Bay contribute to the tidal portion of the River. Monie Bay is a restricted shellfish harvesting area where no harvesting is permitted due to potential contaminated shellfish from bacteria that can make people sick. Monie Bay comprises 3,165 acres that extends from Wingate Point (near the mouth of the Wicomico River) to just beyond Hall Point where Monie Bay meets Tangier Sound. The entire shoreline is comprised of tidal marsh (MDE, 2004).

Local jurisdictions in the watershed have undertaken a number of activities to improve water quality in the Wicomico River. For example, the Town of Delmar and the City of Fruitland have recently completed upgrades to their wastewater treatment plants (WWTP) in order to meet new design standards. The City of Salisbury has also made improvements to its WWTP. The City of

Salisbury has also taken actions to reduce pollution in Beaverdam Creek (South Prong) by installing nets on the outflow pipes as a means to collect debris from the stormwater drainage system. The City of Salisbury and Wicomico County are in the initial stages of creating an urban tree canopy for the purpose of preserving pervious / natural surfaces. These additional tree plantings will remove nutrient contributions from entering local waterways, in addition to the plethora of other benefits that trees provide. More information on local government activities to improve water quality can be found by contacting the governments directly.

Table 2. 1. Wicomico River Watershed Summary Characteristics

Subwatershed	Area (acres)	Jurisdiction (%)	Stream Length (mi)	303d Stream Miles (% Impaired)	Impervious Cover (%)	Major Land Cover
Monie Bay	18,448.93 (12.5%)	Somerset Co. (100%)	78.55	0.00 (0.0%)	0.35	Evergreen Forest (16.3%), Woody wetlands (24.5%), Emergent Herbaceous wetlands (19.4%)
Wicomico Creek	20,424.44 (13.8%)	Wicomico Co. (39.9%), Fruitland (0.3%), Somerset Co. (59.6%)	91.65	13.38 (14.6%)	0.84	Evergreen Forest (14.9%), Woody wetlands (22.6%), Cultured Crop (24.3%)
South Prong	14,816.08 (10.0%)	Wicomico Co. (83.2%), Salisbury (16.8%)	32.82	17.73 (54.0%)	11.24	Developed, open space (13.7%), Cultured Crop (24.3%), Woody Wetland (16.9%)
Ellis Bay	28,805.25 (19.5%)	Wicomico Co. (55.1%), Somerset Co. (44.9%)	113.46	7.15 (6.3%)	0.57	Open Water (31.6%), Woody wetland (14.5%), Emergent herbaceous wetland (25.7%)
Shiles Creek	21,541.96 (14.6%)	Wicomico Co. (98.5%), Fruitland (0.7%), Somerset Co. (0.7%)	82.04	16.11 (19.6%)	1.86	Evergreen Forest (10.8%), Cultured Crop (27.2%), Woody Wetland (17.9%)
Tonytank Creek	18,563.77 (12.6%)	Wicomico Co. (72.8%), Salisbury (15.6%), Fruitland (11.7%)	37.68	9.98 (26.5%)	9.94	Developed, open space (16.7%), Cultured Crop (25.9%), Developed, low intensity (10.9%)
North Prong	24,833.91 (16.8%)	Wicomico Co. (75.9%), Salisbury (14.2%), Delmar, MD (4.3%), Delaware Co. (4.3%), Delmar, DE (1.3%)	44.76	41.10 (91.8%)	7.84	Developed, open space (10.2%), Cultured Crop (27.2%), Woody Wetland (11.9%)
Total	**147,434.34**		**480.96**	**105.45 (21.9%)**		

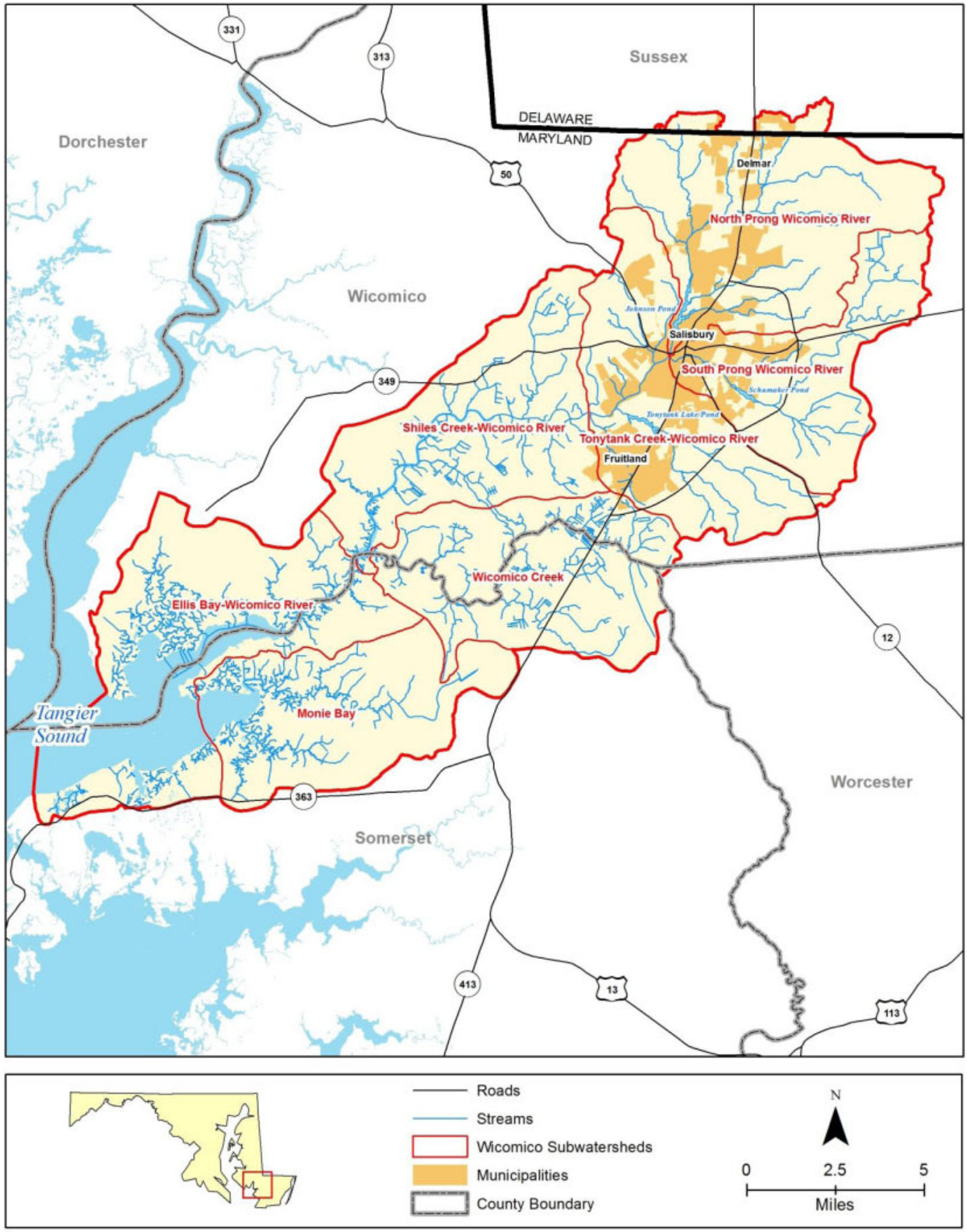

Figure 2. 1. Wicomico River Watershed

2.2 Stream Conditions

In order to fulfill Clean Water Act, Section 303(d) requirements, all states are required to maintain and update a list of impaired and threatened waters (stream segments) and submit the list to the US EPA for approval every two years. This list is then used to develop total maximum daily loads (TMDLs), which quantify the maximum amount of a pollutant that a waterbody can receive and still meet its designated uses. A TMDL also involves a detailed investigation into the sources of the impairment and reductions required to achieve the TMDL. TMDLs must be developed for every stream listed as impaired on the 303(d) list of the Clean Water Act.

The Chesapeake Bay TMDL was finalized in 2010 by the EPA to restore the Chesapeake Bay and local waterbodies by 2025. This TMDL allocates nutrient and sediment reductions for each bay state and, for Maryland, that includes a 25 percent reduction in nitrogen, 24 percent reduction in phosphorus and 20 percent reduction in sediment. These reductions were further broken down by county and major river basin. At the state level, Phase 1 Watershed Implementation Plans (WIPs) were developed to determine how each state will help meet pollutant reductions. Phase II WIPs are being developed by each county to outline a strategy to meet pollutant load allocations.

The State of Maryland performed a series of monitoring efforts related to these Clean Water Act requirements. As described in the Code for Maryland Regulations (COMAR) Surface Water Use Designation, Wicomico River is a Use I, defined as water contact recreation and protection of nontidal warmwater aquatic life, and Use II, defined as shellfish harvesting waters. This means that streams in the watershed should be able to support these identified uses.

The Wicomico River watershed is listed as impaired in the Maryland 303(d) list of impaired waters for several pollutants of concern including: Total Phosphorus (2000, 2002, 2012), Sediment/Siltation (2000, 2002), Fecal Coliform (2009), Total Nitrogen (2012), E. Coli (2008), and Total Suspended Solids (2002) (MDE, 2012). To date, there are no TMDL implementation plans developed to address the impairments and meet water quality goals. Table 2. 2 provides a summary of each impairment listing and status. A summary of each TMDL is provided below.

Table 2. 2. Water Quality Impairment Listing and Status

Waterbody	Water Type	Impairment	TMDL Status	Applicable Designated Use
Tony Tank Lake	Impoundment	Phosphorus Sediment	TMDL Approved (2000)[1]	Aquatic Life and Wildlife
Lower Wicomico River	Chesapeake Bay segment	Total Nitrogen, Total Phosphorus, Biological Oxygen Demand	TMDL Approved (2001)	Water contact recreation, fishing, Aquatic Life and Wildlife, and shellfish harvesting

Table 2. 2. Water Quality Impairment Listing and Status

Waterbody	Water Type	Impairment	TMDL Status	Applicable Designated Use
Johnson Pond	Impoundment	Phosphorus Sediment	TMDL Approved (2002) [1]	Aquatic Life and Wildlife
Wicomico River Headwaters	Non-tidal 8-digit watershed	Fecal Coliform	TMDL Approved (2006)	Aquatic Life and Wildlife
Lower Wicomico River Mainstem	Shellfish Harvesting Area	Fecal Coliform	TMDL Approved (2008)	Shellfish harvesting
Wicomico Creek	Chesapeake Bay segment	Total Nitrogen and Total Phosphorus	TMDL Approved (2001)	Water contact recreation, fishing, aquatic life and wildlife
Monie Bay	Restricted Shellfish Harvesting Area	Fecal Coliform	TMDL Approved (2010)	Shellfish harvesting

[1] One TMDL developed for both sedimentation and total phosphorus.

2.2.1 Total Maximum Daily Loads

Johnson Pond Sediment and Phosphorus TMDL (MDE, 2001)

A single TMDL was developed for phosphorus and sediment for Johnson Pond. The pond has violations of dissolved oxygen below the numeric criteria of 5.0 mg/l. The pond also exhibits nutrient enrichment that results in excessive plant and algae growth that causes odors and impedes direct contact use, fishing, and boating. Finally, the lake has experienced excessive sediment loads that carry phosphorus and have reduced the lake's volume from 62.1 to 41.4 million cubic feet since 1933.

Tony Tank Lake Phosphorus and Sediment TMDL (MDE, 1999)

Similar to the TMDL for Johnson Pond, in Tony Tank Lake, a single TMDL was developed for phosphorus and sediments as phosphorus binds to sediment and is transported to the lake. The lake has violations of dissolved oxygen below the numeric criteria of 5.0 mg/l. The lake also exhibits excessive nutrient enrichment resulting in excessive plant and algae growth that causes odors and impedes direct contact use, fishing, and boating. Finally, the lake is experiencing excessive sediment loads. The goals of the TMDL are to maintain a dissolved oxygen concentration that meets state criteria of 5.0 mg/l and reduce phosphorus and sediment loads.

Lower Wicomico River Total Nitrogen, Total Phosphorus and Biological Oxygen Demand TMDL (MDE, 2000b)

In the Lower Wicomico River, a TMDL was developed for Total Nitrogen, Total Phosphorus and Biological Oxygen Demand. These impairments have caused eutrophication of the waterbody. Water quality analysis indicates that dissolved oxygen levels often fall below the standard of 5.0 mg/l and chlorophyll a concentrations are above standards. Nonpoint sources and point sources should be controlled to reduce the dissolved oxygen and chlorophyll a concentrations.

Fecal Coliform TMDLs

The three fecal coliform TMDLs for the watershed are summarized below. Fecal bacteria are microscopic single-celled organisms found in the wastes of warm-blooded animals. Found in excessive amounts, fecal bacteria are an indicator of an increased risk of pathogen induced illness to humans (MDE, 2006).

Lower Wicomico River Mainstem Fecal Coliform TMDL (MDE, 2008)

The Lower Wicomico River mainstem is a designated shellfish harvesting area that was closed due to fecal coliform monitoring that exceeded the water quality criterion. A TMDL for fecal coliform was developed based on the water quality criteria of a median concentration of 14 MPN/100 ml and a 90th percentile concentration of less than 49 MPN/100 ml. Bacteria Source Tracking was conducted to determine the predominant nonpoint sources of fecal coliform.

Monie Bay Fecal Coliform TMDL (MDE, 2010)

A TMDL for fecal bacteria was developed for the restricted shellfish harvesting area of Monie Bay (2010). Water quality sampling indicated exceedances of the standards of a median fecal coliform concentration of 14 MPN/100 ml and a 90th percentile concentration of less than 49 MPN/100 ml.

Wicomico River Headwaters Fecal Coliform TMDL (MDE, 2006)

A TMDL for fecal bacteria was developed for the Wicomico River Headwaters (2006). Bacteria were attributed to migratory Canadian geese, which are present throughout late fall and early winter, and septic systems. Point sources in the subwatershed include the Delmar Wastewater Treatment Plant (WWTP) and a Perdue industrial and wastewater treatment plant. Poultry litter applications may not present a potential bacteria loading source because local farmers indicate fairly universal application of anhydrous ammonia for fertilizer purposes. Maximum Practical Reduction Targets were established as follows: Human – 95%, Domestic – 75%, Livestock – 75%, and Wildlife – 0%.

Wicomico Creek Nitrogen and Phosphorus TMDL (MDE, 2000a)

Wicomico Creek has a TMDL for total nitrogen and total phosphorus based on violations of the dissolved oxygen level criteria for a Use I waterbody. The Use I waterbody supports water contract recreation, fishing, aquatic life and wildlife. The dissolved oxygen criteria for Use I waters is not less than 5.0 mg/l at any time. Due to these conditions, the creek is eutrophic and exhibits nuisance algal blooms in the summer.

2.2.2 Biological Conditions

Biological monitoring data were collected from the Maryland Biological Stream Survey (MBSS). MBSS is a random design stream sampling program intended to provide unbiased estimates of stream conditions with known precision at various spatial scales. Goals of the program are to assess the current condition of ecological resources in Maryland's streams and rivers; identify the impacts of acidic deposition, climate change, and other stressors on ecological resources in Maryland's streams and rivers; provide an inventory of biodiversity in Maryland's streams; assess the efficacy of stream restoration and conservation efforts to stream ecological resources; continue to build a long-term database and document changes over time in Maryland's stream ecological condition and biodiversity status and communicate results to the scientific community, the public, and policy makers.

The fish community data were collected using the MBSS protocols (MDE, 2007). Results of the fish data analysis include a Fish Index of Biological Integrity (FIBI) score based on the fish community characteristics at a sampling site. The benthic macroinvertebrate data were collected using the MBSS protocols. Benthic macroinvertebrates are organisms without a backbone that live on the bottom of streams and can be seen with the naked eye. They are an important part of stream ecosystems as they are a source of food for other aquatic life such as fish. The presence, condition, numbers, and types of benthic macroinvertebrates also convey information about a water body's quality. Similar to the fish data, results include a benthic Index of Biological Integrity (IBI) score based on the benthic community characteristics at a sampling site. Qualitative ratings of stream biological integrity are based on FIBI and IBI scores and range from good (4.0 – 5.0), denoting minimally impacted conditions, to very poor (1.0 – 1.9), indicating severe degradation. Figure 2. 2, Figure 2. 3, and Appendix A-A provide a summary of the fish community data and benthic macroinvertebrate data for the watershed, respectively.

In the North Prong subwatershed, FIBI and IBI scores range from very poor to good. At the five sites along the Leonard Pond Run, FIBI and IBI scores are similar as they are very poor in the headwaters and increase to good (FIBI score) to very good (IBI score) near the mainstem. Similarly, along the Little Burnt Branch, FIBI scores improve closer to the mainstem from very poor to fair while the IBI scores decline slightly from fair to poor. The Peggy Branch and Middle Neck branch each have one site with good IBI and FIBI scores.

The South Prong subwatershed contains similar FIBI and IBI scores with very poor and poor scores in the headwaters and a fair (FIBI score) and good (IBI score) near the mainstem. The exception is Halloway Branch that has one site in the headwaters scored as poor for IBI and no

data for FIBI. Four sampling sites didn't have FIBI data and two didn't have IBI data due to dry stream conditions during sampling.

In the Tony Tank Creek - Wicomico River subwatershed, the Owen's Branch to the north has one site with an IBI score of poor and one site without data while the FIBI along the same branch has a score of good. To the south, the White Marsh Creek has an IBI and FIBI score of poor. The site located in the City of Fruitland at the TonyTank Pond has both an IBI and FIBI score of good. There is one site along Cox Branch without data.

Shiles Creek subwatershed has one site located on Rockawalkin Creek with an IBI and FIBI score of poor.

The Wicomico Creek subwatershed also has one site that is located on the Passerdyke Creek with an IBI score of poor and an FIBI score of fair. There are no IBI or FIBI sites in both the Monie Bay and Ellis Bay subwatersheds.

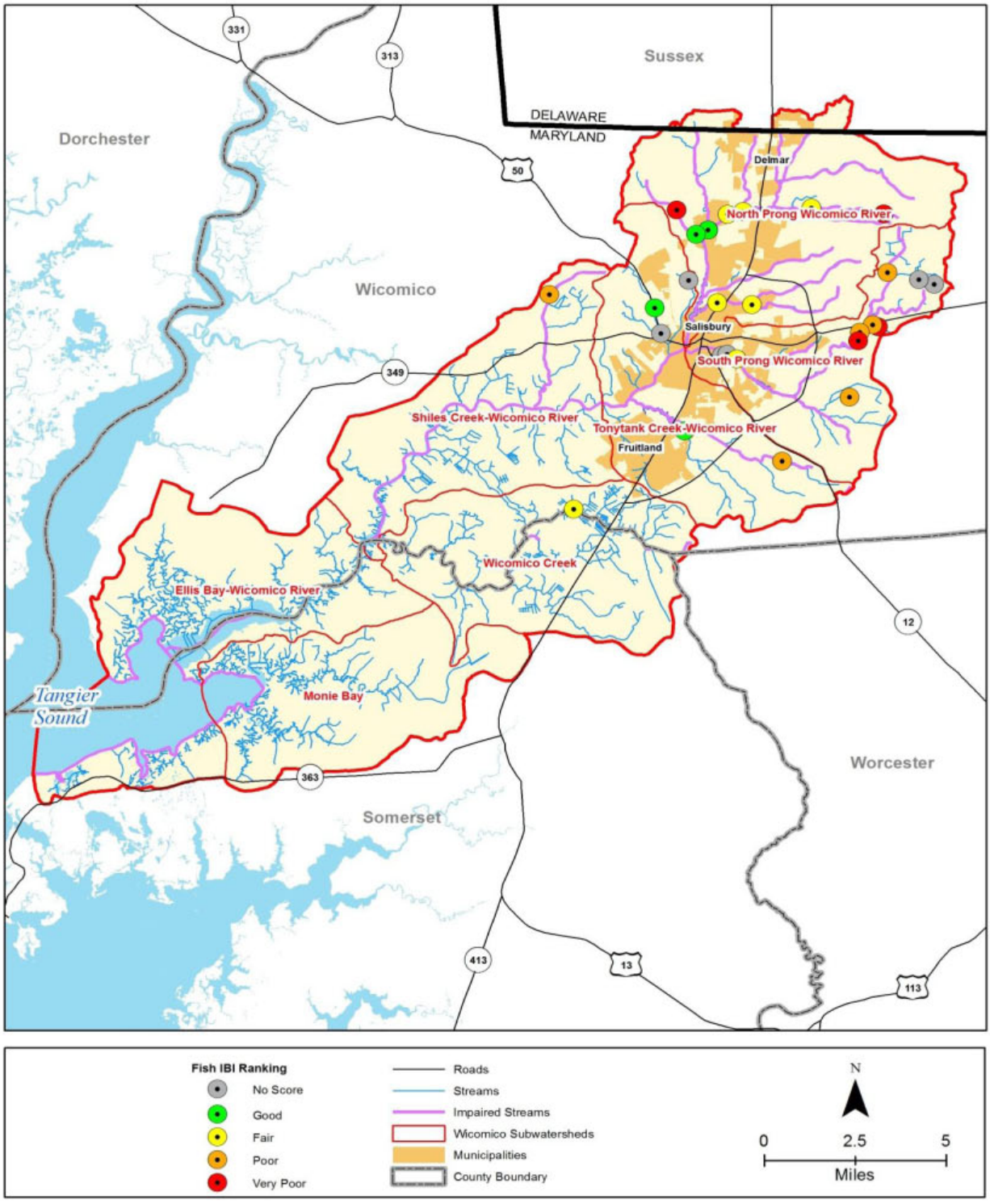

Figure 2. 2. Location and Ranking of Fish Index of Biological Integrity (FIBI) Sites

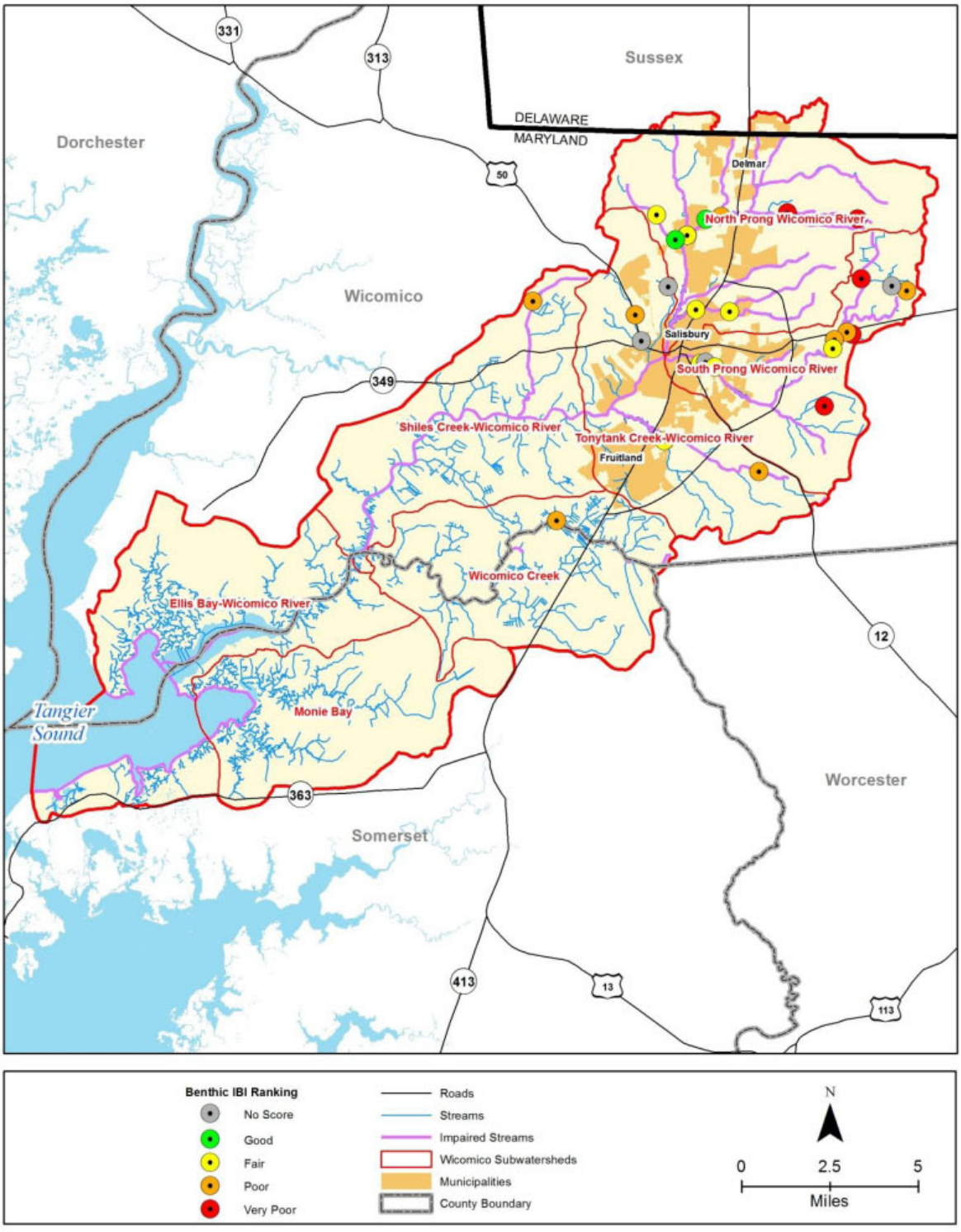

Figure 2. 3. Location and Ranking of Benthic Macroinvertebrate Index of Biological Integrity (IBI) Sites

2.2.3 Water Quality Conditions

The Wicomico Creekwatchers program is a community partnership between the Chesapeake Bay Foundation (CBF), Wicomico Environmental Trust, the City of Salisbury and Salisbury University. The program's mission is to collect and develop objective, scientifically-credible water quality data through a grassroots volunteer force that monitors the waters of the Wicomico River and its tributaries. The program works to ensure that public policies and other management tools adequately protect and preserve Wicomico River water quality. Since its inception in 2002, the program has begun to establish a set of baseline data for identifying water quality conditions and trends over time. Volunteers collect samples from 25 sites on the Wicomico river mainstem, several Wicomico tributaries and dammed water features (Salisbury University, 2010). For this study, six of the Creekwatcher sample sites were chosen to represent water quality conditions for six of the seven subwatersheds (Table 2. 3). Monie Bay was excluded from this analysis as no Creekwatcher sample site exists in this subwatershed. Using 2010-2011 Creekwatcher data, average monthly total nitrogen (TN) and total phosphorus (TP) values were analyzed for these six sites, as shown in Figure 2.4 and Figure 2.5, respectively. Sharps Point only consists of 2011 data as no data was available for 2010. The water quality thresholds provided by Delaware Department of Natural Resources and Environmental Control for TN and TP are shown in Table 2. 4.

Table 2. 3. Subwatersheds and Representative Creekwater Sample Sites

Subwatershed	Creekwatcher Sample Site
North Prong	South Johnson Pond
South Prong	East Branch Downtown
Tony Tank	Sharps Point
Shiles Creek	Geipe
Wicomico Creek	Yacht Club
Ellis Bay	Mount Vernon
Monie Bay	N/A[1]

Table 2. 4. Water Quality Thresholds (mg/l)

	Healthy Value	Moderate Value	High Value
Total Nitrogen	<1	1 - 3	≥3
Total Phosphorus	<0.05	0.05 - 0.1	≥0.1

[1] No Creekwatcher sample site exists for this subwatershed.

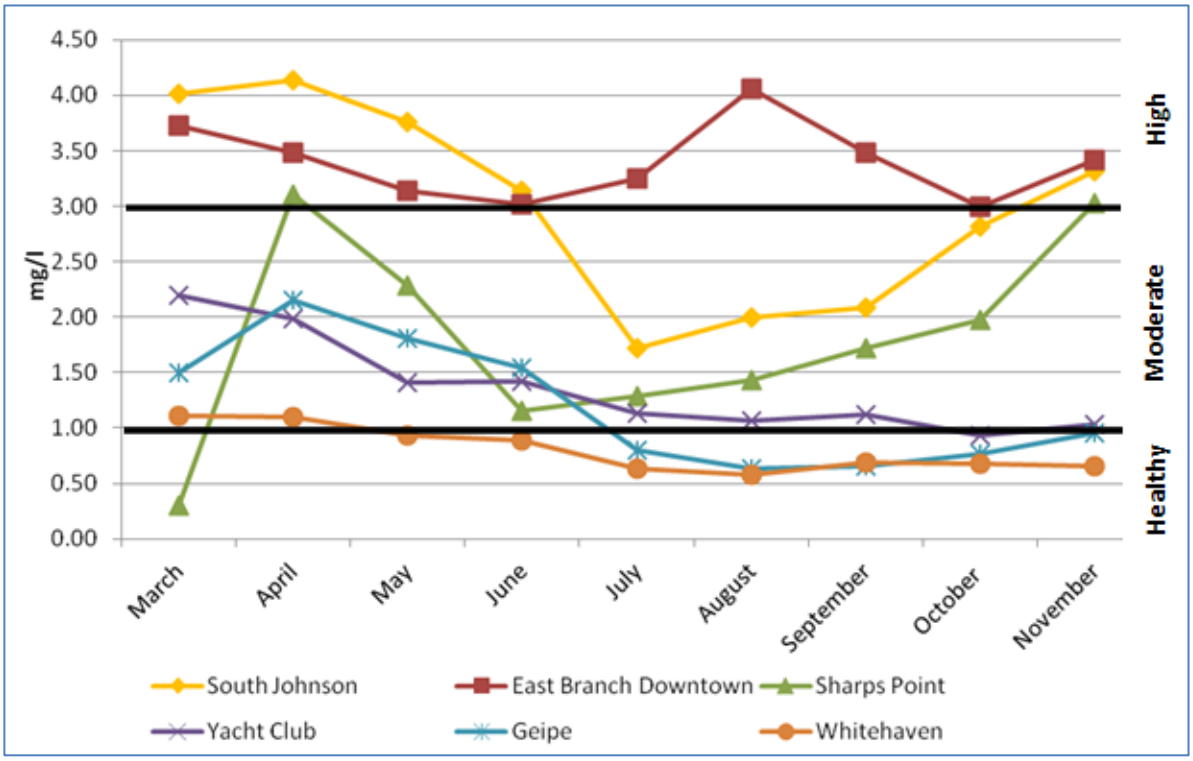

Figure 2. 4. Average Monthly Total Nitrogen Concentration (mg/l)

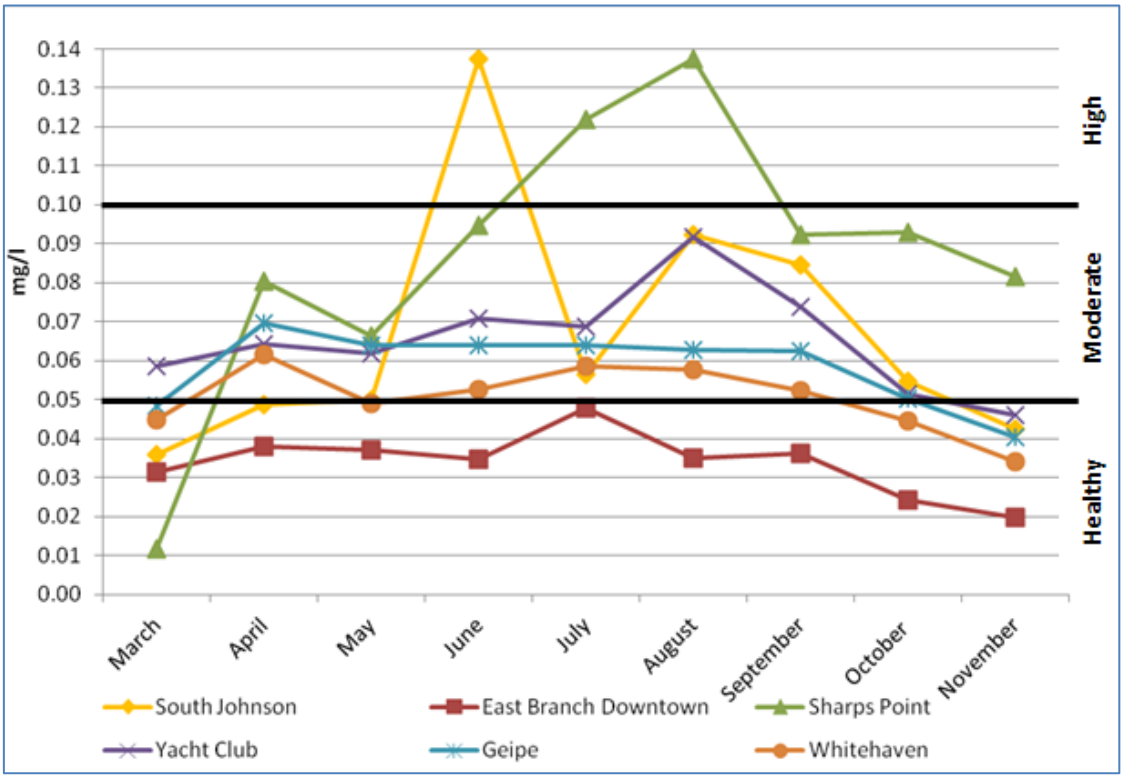

Figure 2. 5. Average Monthly Total Phosphorus Concentration (mg/l)

Figure 2.4 shows that in general, average monthly total nitrogen (TN) values are higher in the spring, lower in the summer months and levels off or increases in the fall. Except for the months of March and April, Whitehaven sampling station is within the TN healthy value threshold of below 1 mg/l. Sampling station Geipe, is within the healthy value threshold from July to November. East Branch Downtown sampling station and South Johnson sampling station (March – June) are above the TN high value threshold of 3 mg/l. All other sampling station sites are within the moderate value threshold values from 1 to 3 mg/l.

Figure 2.5 shows in general, average monthly total phosphorus (TP) values increase in the summer months. East Branch Downtown sampling station is the only station below the TP healthy value threshold of below 0.05 mg/l. With the exception of a few monthly samples for South Johnson and Sharps Point, the other sampling stations fall within the TP moderate value threshold from 0.05 to 0.1 mg/l.

Figure 2. 6 and Figure 2. 7 show the locations of the Creekwatcher sample sites. In addition, for the six selected sites, the figures summarize the percent number of samples whose values fall within the water quality thresholds for TP and TN, respectively. The figures show that sites in the headwaters have more samples with a high value threshold. More samples with a healthy value threshold are located in the lower watershed.

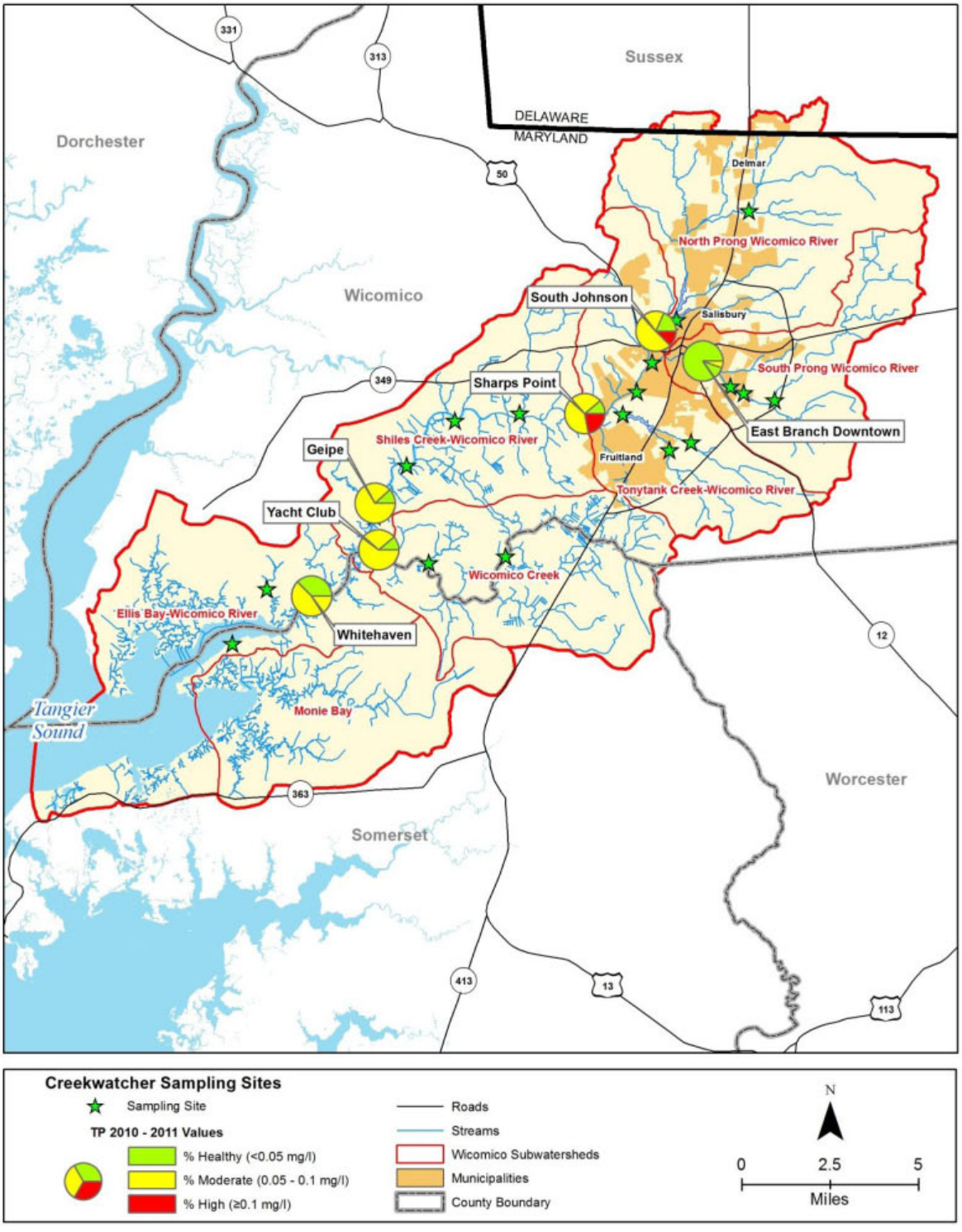

Figure 2. 6. Total Phosphorus Values for Selected Creekwatcher Sampling Sites

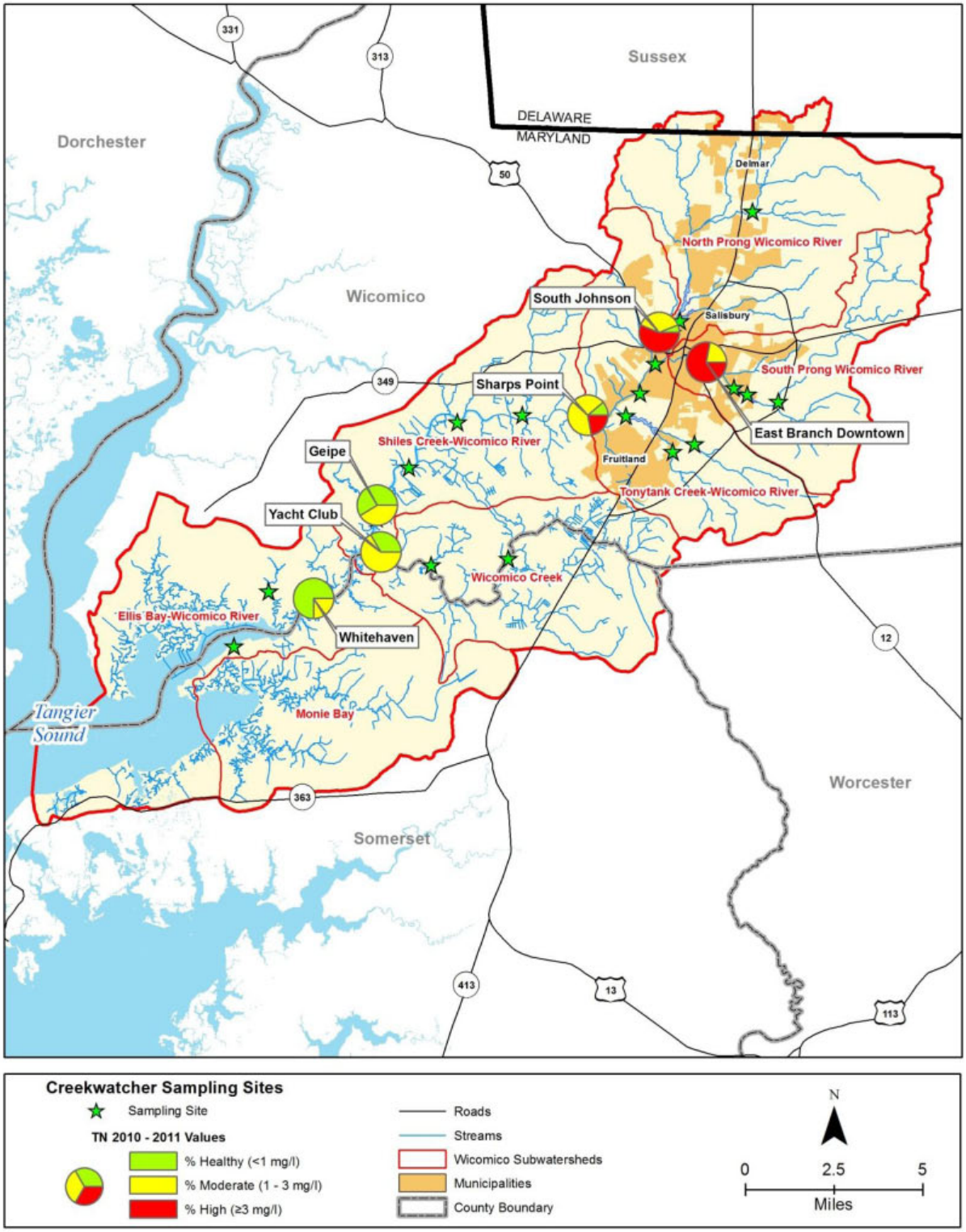

Figure 2. 7. Total Nitrogen Values for Selected Creekwatcher Sampling Sites

2.2.4 Sources of Impairment

TMDL Sources of Impairment

Nonpoint and point sources are identified as contributors of pollutants in the TMDLs for the watershed. In the Tony tank lake phosphorus and sediment TMDL, management strategies should be focused on reducing nonpoint sources, since this is the dominant contributor of pollutants, and on agricultural land, since this land use contributes 55% of the phosphorus load (MDE, 1999). A combination of both structural and nonstructural best management practices (i.e. stream side buffer strips) can significantly reduce sediment loads. Similarly, the Johnson Pond phosphorus and sediment TMDL should focus on a 53% reduction in point sources and a 49% reduction in nonpoint sources. Management strategies for the point sources include the requirement of Chemical Phosphorus Removal (CPR) in the NPDES permits for the Delmar WWTP and Perdue Farms, Inc. WWTP. Nonpoint source management should focus on agricultural BMPs as this land use makes up 41% of the land use (MDE, 2001). In the Lower Wicomico River TMDL for Total Nitrogen, Total Phosphorus and Biological Oxygen Demand, there are two significant point sources, the Salisbury Wastewater Treatment Plant and the Fruitland Wastewater Treatment Plant.

The Wicomico Creek TMDL for nitrogen and phosphorus identified no point sources and identified nonpoint sources to include groundwater, agricultural ditching, animals in the stream, and deposition of nutrients and organic matter to the stream bed from high flow events (MDE, 2000a).

There are three fecal coliform TMDLs in the watershed in the Lower Wicomico River mainstem, Monie Bay and Wicomico River headwaters. In the Lower Wicomico River bacteria source monitoring identified the dominant source of fecal coliform from wildlife (44.1%), followed by unknown/unclassified (20.4%), human (20.1%), livestock (9.5%) and pets (5.9%) (MDE, 2008). In the Monie Bay, potential nonpoint sources of fecal bacteria include manure spreading, direct deposition from livestock, failing septic systems, and excretions from pets and wildlife. Bacterial Source Monitoring was conducted to determine the sources of bacteria in the watershed. The monitoring results show that the majority of the bacteria is from human (28.69%) and wildlife (28.55%), followed by livestock (25.5%) and pets (17.26%) (MDE, 2010). There are no point sources in the watershed. There are many types of nonpoint sources of fecal bacteria identified in the Wicomico River Headwater fecal coliform TMDL. These include manure spreading, direct deposition from livestock during the grazing season, excretions from pets and wildlife, failing septic systems and leaking infrastructure (i.e. sewer systems). Sources near the Leonard Mill Pond include a large Canadian Geese population and septic systems. Sources between Leonard Mill Pond and Johnson Pond include the Leonard Mill Visitor Center that contains a large pet exercise area and the banks of Leonard Mill Run, which contains a goose population.

Sanitary Sewer Overflows (SSO) occur when the capacity of a separate sanitary sewer is exceeded. According to MDE (2006), there were a total of four SSOs reported between 2001 and 2003 that resulted in the discharge of approximately 60,200 gallons of sanitary sewer overflow to the river. In 2005, new regulations were instated regarding reporting and public notification of sewer overflows and wastewater treatment plant bypasses. According to the Maryland Reported Sewer Overflow Database, there have been 95 SSOs between 2005 and 2012 in the Wicomico River, discharging approximately 20.84 million gallons of untreated sewage into the river.

Bacterial Source Monitoring was conducted to determine the sources of bacteria in the watershed. The monitoring results show that the majority of the bacteria are from wildlife (mammals and waterfowl) and domestic uses (pets and septic systems). Based on the TMDL modeling, in three of the five watersheds, where the wildlife contribution is significant, the bacteria reduction to achieve water quality standards could not be achieved.

Implementation of the fecal coliform TMDLs should not focus on removing wildlife but instead address controllable sources first with the understanding that they might also reduce wildlife sources (MDE, 2010).

Illicit discharges are another potential source of bacteria to the watershed. The Center conducted illicit discharge detection and elimination (IDDE) staff training and outfall screening with the City of Salisbury in 2011. The study found 40% of screened outfalls with dry weather flow and 23% of those outfalls with dry weather flow had E. coli concentrations above the EPA's standard for water contact recreation (235 CFU/100 ml for a grab sample) (CWP, 2011). In addition, very high concentrations of total coliforms were seen in many outfalls as well (Figure 2. 8).

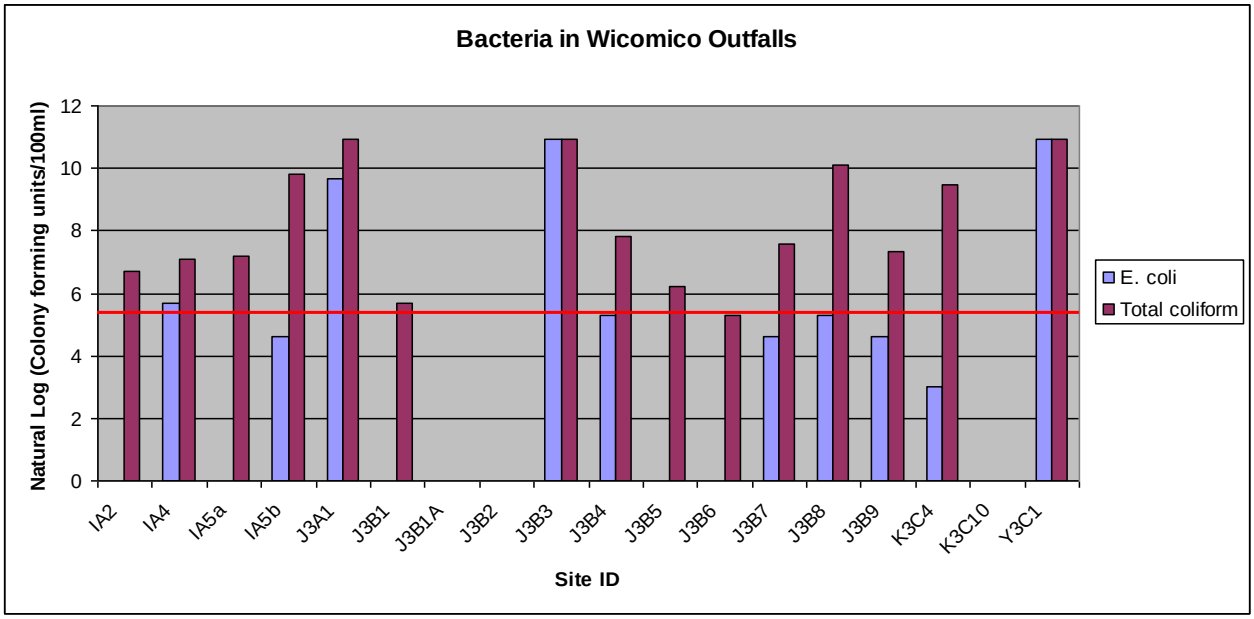

Figure 2. 8. E.coli and Total Coliform Concentrations in Salisbury Outfalls

Point Sources

Facilities that discharge municipal or industrial wastewater or conduct activities that can contribute pollutants to a waterway are required to obtain a National Pollutant Discharge Elimination System (NPDES) permit. The number and type of NPDES-permitted facilities within the watershed is summarized in Appendix A-B. Data was obtained from the US EPA Enforcement and Compliance History Online (ECHO) website (http://www.epa-echo.gov/echo/) on 3/23/2012. There are a total of 39 NPDES permits in the watershed with 34 located in Salisbury, MD; two

each in Fruitland, MD and Eden, MD; and one in Delmar, MD. Table 2. 5 provides a summary of the types of the Major and Minor NPDES individual permits located in the watershed.

Table 2. 5. Summary of Major and Minor NPDES Individual Permits

Jurisdiction	NPDES Individual Permit	Major	Minor
Salisbury, MD	City of Salisbury Wastewater Treatment Plant (WWTP)	X	
	Perdue Farms	X	
	Delmarva Oil		X
	Former Dresser Salisbury Facility		X
	Holly Center		X
	Naylor Mill Road Regional Lift Station		X
	Nustar Terminals Operations Partnership L.P.		X
	Salisbury Portable Water Storage Tank		X
	Sherwood Ford Lincoln Mercury		X
	Sherwood of Salisbury Appearance Center		X
Fruitland, MD	Fruitland WWTP		X
	Hearne-Meadow, LLC		X
Delmar, MD	Delmar WWTP		X

2.3 Natural Resources

2.3.1 Ecological Areas

The Wicomico River contains an abundance of natural resources that include sensitive species, targeted ecological areas, forest interior dwelling species potential habitat, biodiversity conservation network, wetlands of special state concern, green infrastructure hubs and corridors, and critical areas. Table 5 provides a summary of the acres for each subwatershed. The data was calculated for the Maryland portion of the watershed and obtained from Maryland Department of Natural Resources (MD DNR) (MD DNR, 2012a). Similar data was not available for Delaware. A description of each natural resource category follows.

- Sensitive species: The statewide file shows buffered areas that primarily contain habitat for rare, threatened, and endangered species (RTE) and rare natural community types. This data layer was originally created to provide information to local jurisdictions and state agencies to assist with assessing environmental impacts and reviewing potential development projects or land use changes.

  Specific data on RTE species was obtained from the Maryland DNR. Table 2. 6 provides a summary of the RTE plant and animal species found within the watershed. Several species are indicated as critically imperiled in Maryland because of extreme rarity or some factor making it especially vulnerable to extirpation. These species are actively tracked by the Natural Heritage Program.

Table 2. 6. Summary of RTE Plant and Animal Species	
Common Name	**Type**
American Chestnut	Vascular Plant
Bald Eagle	Vertebrate Animal
Banded Sunfish	Vertebrate Animal
Coastal Butterfly-pea	Vascular Plant
Dotted Water-meal	Vascular Plant
Dwarf Iris*	Vascular Plant
Gibbous Panic-grass*	Vascular Plant
Hairy Snoutbean	Vascular Plant
Long's Bittercress*	Vascular Plant
Mitchell's Sedge	Vascular Plant
Pale Bluet*	Invertebrate Animal
Parker's Pipewort	Vascular Plant
Robbins' Spikerush*	Vascular Plant
Seaside Alder	Vascular Plant
Shining Nutrush*	Vascular Plant
Showy Aster*	Vascular Plant
Slender Blue Flag*	Vascular Plant
Vulnerable Species[2]	Vulnerable Species
White-bract Thoroughwort	Vascular Plant
Woolly Witchgrass*	Vascular Plant

* Critically imperiled in Maryland.

- Targeted ecological areas - A limited number of areas that rank exceptionally high for ecological criteria and that have a practical potential for preservation.
- Forest interior dwelling species potential habitat - Potential habitat layer for Forest Interior Dwelling Species (FIDS) developed from the results of a model depicting where FIDS habitat might occur to provide protection of these species.
- Biodiversity conservation network (BioNet) - identifies and prioritizes ecologically important lands to conserve Maryland's biodiversity (i.e., plants, animals, habitats, and landscapes). This dataset aggregates numerous separate data layers hierarchically according to the BioNet Criteria Matrix (MD DNR, 2012c).
- Wetlands of special state concern - In Maryland certain wetlands with rare, threatened, endangered species or unique habitat receive special attention. In general, the US Fish and Wildlife Service's National Wetlands Inventory provides the basis for identifying these special wetlands. Additional information, determined from field inspections, is used to identify and classify these areas.
- Green Infrastructure Hubs and Corridors - Maryland's green infrastructure is a network of undeveloped lands (wetlands, forest and other natural lands) that provide ecosystem

[2] Due to Maryland's vulnerable species policy, the common names of several species were not provided to help ensure additional protection. These are listed as 'vulnerable species'.

services such as filtering water, marketable goods and services like forest products and vital habitat for wild species. The hubs are large continuous areas containing these resources while corridors are linear corridors that provide connectivity between hubs.

- Critical Areas - The Critical Area is all land and water areas within 1000 feet of the tidal waters' edge or from the landward edge of adjacent tidal wetlands and the lands under them. In 1984, the Chesapeake Bay Critical Area Act was created to regulate development, manage land use and conserve natural resources on land in those areas designated as Critical Area.

The total acres of ecological areas for each subwatershed are shown in Table 2. **7**, titled 'Combined Ecological Areas' and consists of over half (56.6%) of the watershed. The regulated areas consist of wetlands of special state concern and critical areas that together make up 13% of the ecological areas. The remaining ecological areas are used for planning and permit review during the development process. Of all the subwatersheds, the Wicomico Creek contains the most acres of ecological areas at 79 percent with the Monie Bay in close second at 74 percent. The Tonytank creek is the most developed subwatershed and contains the least amount of ecological areas with 29 percent.

Table 2. 7. Summary of Percent Ecological Areas in Wicomico River Watershed								
	Sensitive Species (%)	**Targeted Ecological (%)**	**Forest Interior Dwelling Species Potential Habitat (%)**	**Biodiversity Conservation Network (%)**	**Wetlands of Special State Concern (%)**	**Green Infrastructure Hubs and Corridors (%)**	**Critical Area (%)**	**Combined Ecological Area (%)**
Monie Bay	10.6	20.0	31.9	34.8	0.0	68.9	0.0	74.2
Wicomico Creek	19.6	59.9	35.4	47.5	0.2	64.5	4.8	78.9
South Prong	7.0	13.3	19.6	21.3	0.3	13.0	1.4	35.9
Ellis Bay	3.8	44.1	17.3	17.8	0.0	58.6	11.7	62.7
Shiles Creek	13.7	36.9	26.2	30.2	1.1	56.2	20.5	66.8
Tonytank Creek	9.2	3.0	13.0	15.7	0.8	9.7	6.0	28.9
North Prong	16.6	0.0	26.8	29.6	0.2	29.6	0.4	42.3
Watershed Total	11.4	26.5	24.2	27.9	0.3	44.7	6.9	56.6

2.3.2 Protected Lands

Protected lands were summarized for the watershed from several GIS layers obtained from MD DNR (2012a). Protected land data was not available for the Delaware portion of the watershed. This data includes protected lands owned by the County and various conservation easements. A conservation easement ensures the protection of significant natural resources on a property by removing the development rights of the property. Placing a property under easement may allow the landowner to receive income, or estate and property tax benefits while still maintaining ownership of the property.

The Wicomico River watershed contains several types of protected lands held under various preservation programs described in more detail below. Table 2. 8 summarizes the area of protected land within each subwatershed. A description of each category of protected land follows. In addition, Wicomico County Code requires subdivisions located within the Agricultural – Rural Zoning District to set aside 50 percent of the total land area as preserved open space (Keith Hall, pers. comm).

Table 2. 8. Summary of Protected Land in Wicomico River Watershed

	Area (Acres)	Protected Land Area (Acres)	Protected Land Area (%)
Monie Bay	18,448.93	6,303.55	34.17
Wicomico Creek	20,424.44	4,423.22	21.66
South Prong	14,816.08	258.07	1.74
Ellis Bay	28,805.25	7,209.96	25.03
Shiles Creek	21,541.96	1,317.57	6.12
Tonytank Creek	18,563.77	306.80	1.65
North Prong	24,833.91	1,385.15	5.58
Watershed Total	147,434.34	21,204.32	14.38

- Agricultural land preservation foundation easements - This program is dedicated to preserving farmland and promoting commercial agriculture. To qualify for this program, a farm must be a minimum of 50 acres or located adjacent to a preserved property.
- Environmental trust easements – This is a statewide local land trust with the main goal of preservation of open land, such as farmland, forest land, and significant natural resources. The primary tool for doing this is the conservation easement.
- Forest conservation easements – Contains the conserved and planted forest areas required by the Forest Conservation Act.
- MD DNR lands and conservation easements – Contains the public lands and protected open space owned by MD DNR.
- Private conservation easements – Contains properties that are protected from development by ownership of a private conservation group or society.

- Protected county lands – Consists of land areas that are run and maintained by county and municipal authorities.

The single largest protected area in the watershed is located in the Monie Bay Subwatershed. Here, the 3,426 acre Monie Bay National Estuarine Research Reserve (the Reserve) is located on the Deal Island Peninsula in Somerset County, MD. The Reserve is comprised of wetland creeks and rivers, marshes, scrub-shrub wetlands, forested wetlands, forested uplands and coastal grasslands.

Fish species occurring in the numerous tidal creeks in the Reserve include mummichog, white perch, spot and menhaden. Common invertebrates include fiddler and blue crabs, American oysters, marsh periwinkles and common grass shrimp (NERRS, 2012). Shellfish waters in Monie Bay extend from Wingate Point (near the mouth of the Wicomico River) to just beyond Hall Point where Monie Bay meets Tangier Sound (MDE, 2004). There is also an abundance of resident and migratory bird populations, including bald eagles, osprey and numerous hawk species. Waterfowl species include Canada geese, mallards, black ducks and green-winged teals. Birds of interest spotted in the Reserve include the hooded merganser, the sora rail, the American bittern, the pied-billed grebe, the marsh hawk, the sedge wren, the least tern, the common gallinule and the least bittern (NERRS, 2012).

2.4 Classification of Subwatersheds

Subwatersheds were classified based on protection and restoration needs to identify broad goals and strategies for each subwatershed type. Since the watershed includes several jurisdictions (Wicomico and Somerset Counties and City of Salisbury in MD, Sussex County in DE), one limiting factor is the need to use data layers that are available for all jurisdictions.

A simple proposed subwatershed management classification was developed based on the Center's Impervious Cover Model, but modified to account for the rural nature of portions of the watershed (e.g., the approach considers that impairments may be the result of urbanization or agricultural activities). The exact metrics used depended on data availability. The thresholds for determining the classification are primarily determined based on the spread of the data using the quartile approach. Table 2. 9 provides the definition, management strategies and subwatersheds included for each management classification.

Table 2. 9. Subwatershed Classification and Management Strategies

Management Classification	Definition	Management Strategies
Ecological (Monie Bay, Ellis Bay)	<5% Impervious cover >60% forested/wetland and <25% crop and pasture land >40% targeted ecological areas	Attempt to ensure the preservation of important ecological areas, sensitive streams, wetlands, and contiguous forest. Protect agricultural and forest lands and work on the long-term protection and sustainable

Table 2. 9. Subwatershed Classification and Management Strategies		
Management Classification	**Definition**	**Management Strategies**
		management of these resources.
Sensitive Rural (Wicomico Creek, Shiles Creek)	<5% Impervious cover <60% forested/wetland and >25% crop and pasture land 10-25% stream length impaired	Protect agricultural and forest lands and work on the long-term protection and sustainable management of these resources. Reduce pollutant sources, restore degraded streams and protect streams from further degradation.
Impacted Rural / Urban Mix (North Prong)	5-10% Impervious cover <60% forested/wetland and >25% crop and pasture land >25% stream length impaired	Protect agricultural and forest lands and work on the long-term protection and sustainable management of these resources. Target growth to most appropriate areas. Reduce pollutant sources, restore degraded streams and protect streams from further degradation.
Impacted Urban (South Prong, Tonytank Creek)	≥10% Impervious cover >25% stream length impaired	Target expected growth to most appropriate areas, while preventing significant degradation from occurring in the future from additional new development. Reduce pollutant sources, restore degraded streams and protect streams from further degradation.

Priority subwatersheds for protection are those that have a lot of sensitive and important natural features, good water quality and are vulnerable to impacts from development or other land use activities. Priority subwatersheds for restoration are those that are impacted (but not so impacted that they cannot be restored) and have a lot of opportunities to install restoration projects. The metrics and scoring rules used to rank each subwatershed for protection and restoration are provided in Appendix A-C, the final ranking scores are provided in Appendix A-D and map is shown in Figure 2. 9.

The same data was used to select the subwatershed to conduct field investigations for the development of a subwatershed action or implementation plan. The Core Team decided to identify the top ranked restoration subwatershed for field investigations, which was identified as the South Prong subwatershed.

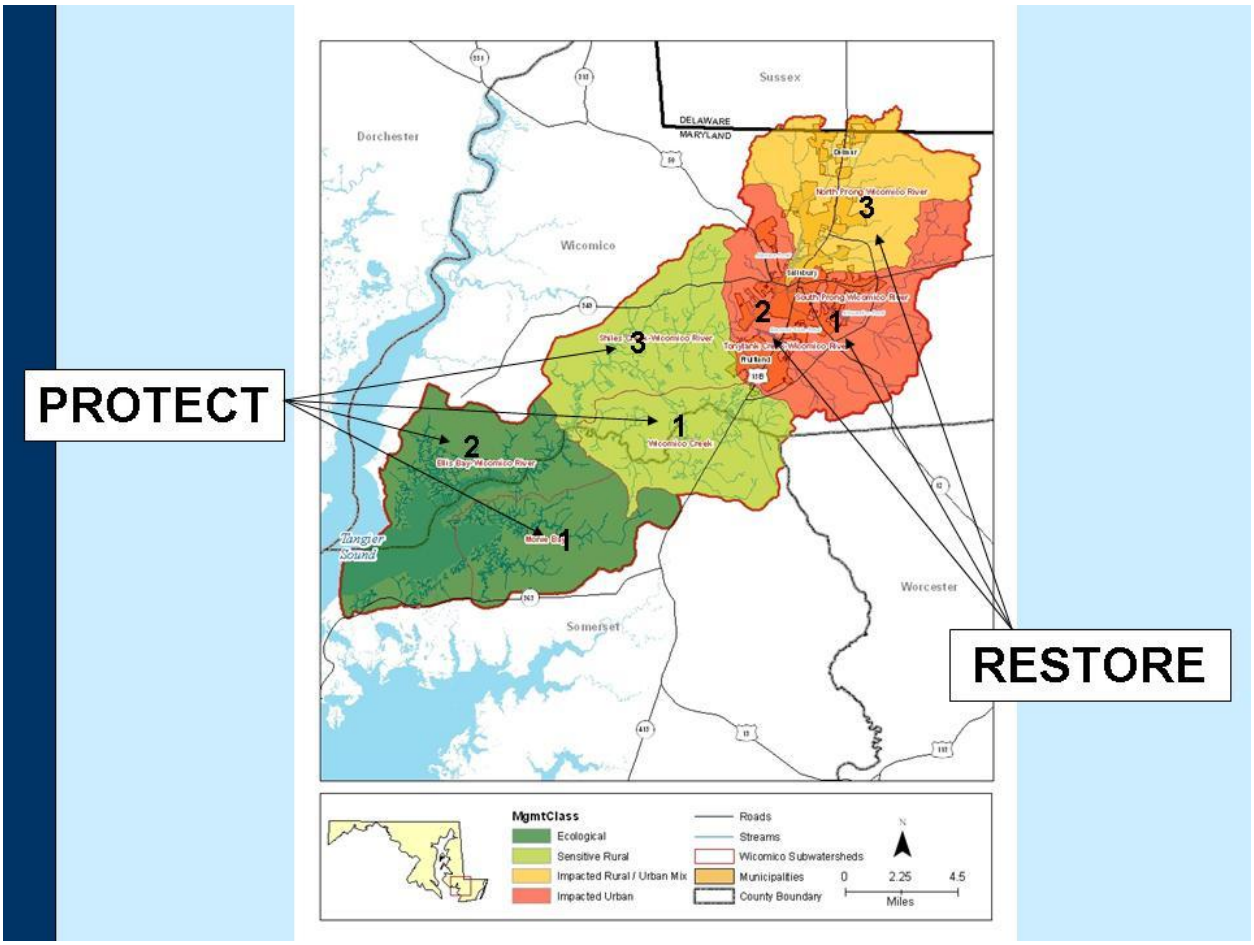

Figure 2. 9. Protection and restoration subwatershed priorities as identified by the Core Team

2.5 Sea Level Rise

Maryland's Lower Shore region is extremely vulnerable to sea level rise (SLR) from climate change. Maryland's A Sea Level Rise Response Strategy for the State of Maryland (Johnson, 2000) states the problem for Maryland and the Lower Shore is as follows, "The average rate of SLR along Maryland's coastline has been 3-4 mm/yr, or approximately one foot per century. Such rates are nearly twice those of the global average (1.8mm/year), a result probably due to substantial land subsidence. Furthermore, research has demonstrated that SLR rates will accelerate in response to global warming, resulting in a rise of 2 to 3 feet by the year 2100 (Leatherman et al., 1995). A rise in sea level of this magnitude will undoubtedly have a dramatic effect on Maryland's coastal environment." GIS data was obtained from Maryland Department of Natural Resources (DNR) on sea level rise inundation vulnerability. Three inundation scenarios are portrayed in Figure 2. 10. Adaptive management strategies, specific actions, costs, and timelines are needed in local communities such as on the Lower Shore where significant impacts are expected. More information concerning sea level and local impact can be found on MD DNR's web site: http://www.dnr.state.md.us/climatechange/.

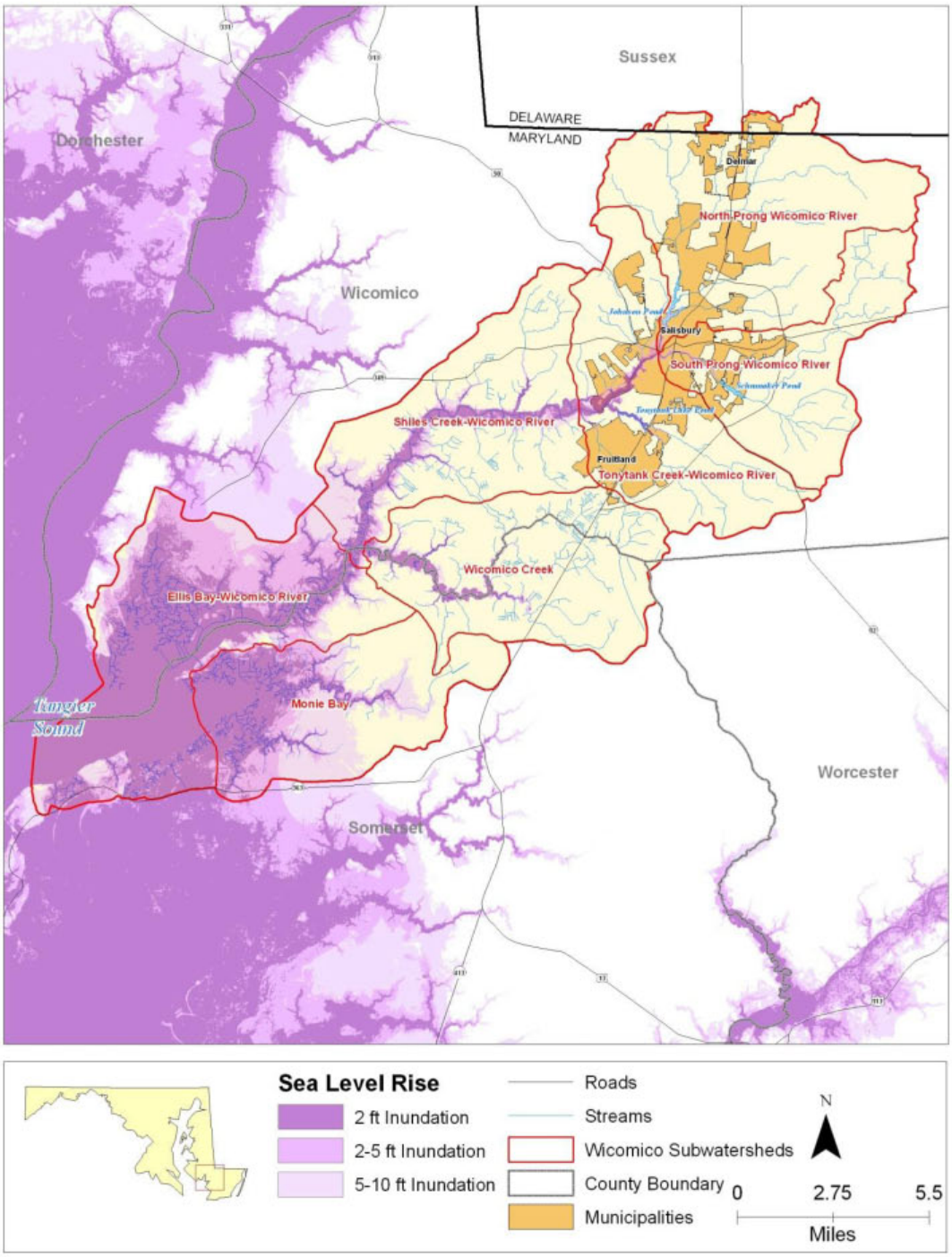

Figure 2. 10. Sea level rise inundation scenarios for the Wicomico River watershed

SECTION 3. WATERSHED ASSESSMENT PROTOCOLS

3.1 Introduction to the Watershed Assessment

The watershed assessment protocols used during this study are based on a series of manuals written by the Center to restore small urban watersheds and compiled into a format that can easily be accessed by watershed groups, municipal staff, environmental consultants and other users. The manuals outline a practical, step-by-step approach to develop, adopt and implement a subwatershed plan. The manuals provide specific guidance on how to identify, design, and construct the watershed restoration practices, describe the range of techniques used to implement each practice, and provide detailed guidance on subwatershed assessment methods to find, evaluate and rank candidate sites.

3.2 Stormwater Retrofit Inventory

Stormwater retrofits are structural stormwater management practices that can be used to address existing stormwater management problems within a watershed. These practices are installed in upland areas to capture and treat stormwater runoff before it is delivered to the storm drainage system, and ultimately, the Wicomico River. They are an essential element of a holistic watershed restoration program because they can help improve water quality, increase groundwater recharge, provide channel protection, and control overbank flooding. Without using stormwater retrofits to address existing problems and to help establish a stable, predictable hydrologic regime by regulating the volume, duration, frequency, and rate of stormwater runoff, the success of many other watershed restoration strategies -- such as stream stabilization, reduced erosion, and aquatic habitat enhancement -- will be threatened. In addition to the stormwater management benefits they offer, stormwater retrofits can be used as demonstration projects, forming visual centerpieces that can be used to help educate residents and build additional interest in watershed restoration.

Assessment Protocol

Potential stormwater retrofit opportunities at a number of candidate project sites in the South Prong subwatershed were assessed during the retrofit inventory. A Retrofit Reconnaissance Inventory (RRI) field form was used to evaluate retrofit opportunities at candidate sites. Field crews look specifically at drainage patterns, the amount of impervious cover, available space, and other site constraints when developing concepts for a site. Candidate retrofit sites identified for the assessment generally had one or more of the following characteristics:

- Situated on publicly-owned or publically-operated lands or open spaces (e.g. school sites, parks)
- Located on commercial and industrial sites with large areas of impervious cover
- Could serve as a demonstration project; and
- Located at existing stormwater management facilities

It should be noted that the pre-identified sites represent only a portion of the potential retrofit opportunities in the subwatershed. A more thorough search will likely yield more retrofit opportunities.

Water Quality and Pollutant Removal Calculations

A water quality volume (WQv), or the storage needed to capture and treat the runoff volume for 90% of the average annual rainfall, was calculated for each retrofit drainage area. This volume captures high pollutant loads in the "first-flush" of stormwater runoff from all rainfall events. The WQv was calculated for each proposed retrofit as follows:

$$WQ_v = [(P)(R_v)(A)] / 12$$

Where WQ_v = water quality volume (acre-feet)
P = design storm runoff depth (1 inch)
$R_v = 0.05 + 0.009(I)$, where (I) is the percent impervious cover of the site
A = site drainage area (acres)

This volume reflects the water quality design volume defined in Chapter 2 of the Maryland Stormwater Design Manual (MDE, 2009), and is used to assess each retrofit's sizing and pollutant removal potential.

Nutrient load reductions for nitrogen, phosphorus, and total suspended solids (TSS), were calculated based upon several factors:

- The expected nutrient loading to the practice, which is derived from event mean concentrations (EMCs) for nitrogen (2.0 mg/L), phosphorus (0.27 mg/L), and total suspended solids (59 mg/L) (Schueler, et al. 2007)
- Estimated pollutant removal percentages for full-sized practices (designed to treat the WQv) (Hirschman, et al. 2008)
- Adjustments to the pollutant removal percentages based upon the % of the WQv that a proposed retrofit treats. (An undersized practice will treat less of the annual rainfall, and therefore provide a smaller nutrient load reduction. However, the relationship is not linear due to rainfall variability; smaller rain events happen more frequently, so even "undersized" practices can treat a significant portion of annual rainfall.)

Cost Estimates

Planning level cost estimates were developed for each proposed retrofit. The per cubic foot cost estimates for each type of practice were adapted mainly from *Costs of Stormwater Management Practices in Maryland Counties* (King and Hagan, 2011), although information from CWP's *Urban Stormwater Retrofit Practices Manual* (Schueler et al. 2007) and professional judgment were utilized as well to refine the estimates for certain proposed retrofits.

3.3 Unified Subwatershed and Site Reconnaissance

The Center conducted the Unified Subwatershed and Site Reconnaissance (USSR) to evaluate pollution-producing behaviors and restoration potential in upland areas of the subwatersheds. The USSR is a "windshield survey" where field crews drive watershed roads to determine specific pollution sources and identify areas outside the stream corridor where pollution prevention possibilities exist. The USSR can be a powerful tool in shaping initial subwatershed restoration strategies and locating potential stormwater retrofit or restoration opportunities. The goal of the USSR is to quickly identify source areas that are contributing pollutants to the stream, and reduce these pollutant loads through source controls, outreach and change in current practice, and improved municipal maintenance operations. Additional information on the USSR is found in Wright et al. (2005).

3.3.1 Hotspot Investigations

Pollution source control includes the management of potential "hotspots" which are certain commercial, industrial, institutional, municipal, and transport-related operations in the watershed. These hotspots tend to produce higher concentrations of polluted stormwater runoff than other land uses and also have a higher risk for spills. They include auto repair shops, department of public works yards, restaurants, etc. Specific on-site operations and maintenance combined with pollution prevention practices can significantly reduce the occurrence of "hotspot" pollution problems. After evaluating each hotspot site for pollution producing problems, each site was evaluated for retrofit opportunities as indicated above under the retrofit reconnaissance inventory.

Assessment Protocol

The Hotspot Site Investigation (HSI) is used to evaluate commercial, industrial, municipal or transport-related sites that have a high potential to contribute contaminated runoff to the storm drain system or directly to receiving waters. At hotspot sites, field crews look specifically at vehicle operations, outdoor materials storage, waste management, building conditions, turf and landscaping, and stormwater infrastructure to evaluate potential pollution sources (Table 3. 1). Based on observations at the site, field crews may recommend enforcement measures, follow-up inspections, illicit discharge investigations, retrofits, or pollution prevention control and education.

The overall pollution prevention potential for each hotspot site is assessed based on observed sources of pollution and the potential of the site to generate pollutants that would likely enter the storm drain network. A hotspot designation criterion set forth in Wright et al. (2005) was used to determine the status of each site based on field crew observations. Sites are classified into four initial hotspot status categories:

- Not a hotspot – no observed pollutant; few to no potential sources
- Potential hotspot – no observed pollution; some potential sources present
- Confirmed hotspot – pollution observed; many potential sources
- Severe hotspot – multiple polluting activities directly observed

Table 3. 1. Potential Hotspot Pollution Sources		
Type	**Description**	**Examples**
Vehicle Operations	Routine vehicle maintenance and storage practices, as well as vehicle fueling and washing operations	• Vehicle storage and repair • Fueling areas • Vehicle washing practices
Outdoor Materials	Exposure of outdoor materials stored at the site	• Loading and unloading • Outdoor materials • Secondary containment
Waste Management	Housekeeping practices for waste materials generated at the site	• Dumpster practices
Stormwater Infrastructure	Practices used to convey or treat stormwater, including the curb and gutter, catch basins, and any stormwater treatment practices	• Catch basins • Stormwater treatment practices

3.3.2 Neighborhood Source Assessment

Residents engage in behaviors and activities that can influence water quality. Some behaviors that negatively influence water quality include over-fertilizing lawns, using excessive amounts of pesticides, and poor housekeeping practices such as inappropriate trash disposal or storage. Alternatively, positive behaviors such as tree planting and using native plants, disconnecting rooftops, and picking up pet waste can help improve water quality.

Assessment Protocol

The Neighborhood Source Assessment (NSA) was conducted to evaluate pollution source areas, stewardship behaviors, and restoration opportunities within individual residential areas. The assessments focus specifically on yards and lawns, rooftops, driveways and sidewalks, curbs, and common areas. Table 3. 2 provides examples of the types of restoration opportunities that were evaluated for each site.

An NSA field form was used to assess neighborhoods in terms of age, lot size, tree cover, drainage, lawn size, general upkeep, evidence of pollution sources, and evidence of resident stewardship (i.e., storm drain stenciling, pet waste management signage, etc.). Each site was assigned a pollution severity rating of "severe," "high," "moderate," or "low," using a set of benchmarks set forth in Wright et al. (2005). Pollution severity is an index of the amount of non-point source pollution a neighborhood is likely generating based on easily observable features (i.e., lawn care practices, drainage patterns, oil stains, etc.). A restoration potential rating of "high," "moderate," or "low" was also assigned to each neighborhood. Restoration potential is a measure of how feasible onsite retrofits or behavior changes would be based on space, number of opportunities, presence of a strong homeowner association (HOA), and other similar factors.

Table 3. 2. Types of Projects Identified during Neighborhood Source Assessment		
Type	**Description**	**Examples**
On-site Retrofits	Homeowners reduce stormwater runoff generated by their lots	• Rain gardens • Rain barrels • Other rooftop disconnection
Lawn and Landscaping Practices	Better lawn and landscaping practices minimize the use of chemicals and encourage the use of native landscaping, particularly in neighborhoods where high input lawns and extensive turf cover are prevalent	• Improved buffer protection • Native plantings • Turf reduction • Proper fertilizer and pesticide application • Ditch restoration
Open Space Management	Management of neighborhood common areas or courtyards	• Landscaping • Tree planting • Pet waste education • Stream buffer restoration • Trash removal
Education and Outreach	Providing homeowners with additional information to better manage pollution in their residential lots	• Lawn and nutrient management outreach • Rain barrel and rain garden education • Septic system education • Storm drain stenciling

3.4 Unified Stream Assessment

Assessment Protocol

The primary assessment protocol used to assess stream corridors in the South Prong subwatershed was the Unified Stream Assessment (USA), which is a comprehensive stream walk protocol developed by the Center for evaluating the physical riparian and floodplain conditions in small urban watersheds. The USA integrates qualitative and quantitative components of various stream survey and habitat assessment methods and is used to identify locations of severely eroded stream banks, utility crossings, stormwater outfalls, impacted riparian buffers, excessive trash accumulation and dumping, stream crossings, and channel modifications within the stream corridor. Restoration opportunities for discharge prevention, stream restoration, stormwater retrofits, and riparian reforestation are also identified. More detail on conducting the USA protocol can be obtained directly from Kitchell and Schueler (2004).

SECTION 4. FINDINGS

4.1 Subwatershed Assessment General Findings

4.1.1 Nomenclature

A key to the nomenclature used by field teams during the assessment work is provided in Table 4. 1. The naming convention was designed to be flexible for multiple field teams and to immediately impart key information about the site. Identifiers consist of three parts: 1) the abbreviation of the subwatershed in which the site or reach is located, in this case "SP" for South Prong and "TT" for Tony Tank; 2) the type of assessment conducted, and 3) a unique identifier that is employed as a team evaluates a site, reach or project. This nomenclature was carried through the project and is used elsewhere in this *Plan*.

Table 4. 1. Site Naming Nomenclature

Assessment Type	Abbreviation
Retrofit	RRI
Hotspot	HSI
Neighborhood	NSA
Stream Reach	RCH
Outfall	OT
Stream Crossing	SC
Trash and Debris	TR
Impacted Buffer	IB
Eroded Bank	ER
Channel Modification	CM
Miscellaneous	MI

A summary of general observations made by field crews during the stream and upland assessments of the South Prong and Tony Tank subwatersheds are discussed below. The locations of assessed sites are shown in Appendices B and C and a list of all the sites and identified projects are listed in Appendices D and E.

After the field assessments were completed, a ranking system was developed to prioritize identified management and restoration practices within each practice group. Using best professional judgment, each practice location was assigned points and ranked according to the factors listed below:

- *Cost* – The cost associated with project implementation. Project costs represent only planning level estimates and were determined based on guidance provided in Schueler et al. (2007), Wright et al. (2005), Kitchell and Schueler (2004) and King and Hagan, 2011.
- *Community Education and Involvement* – Project with potential to educate and involve the community .
- *Visibility* – Projects with high visibility and potential to raise the public's awareness of the watershed (visible from street or located in public park).

- *Feasibility* – Project with high potential that it will be implemented. The site has access for equipment, low maintenance burden, serves as a demonstration site and is publicly owned.
- *Water Quality Improvement* – Potential for treatment or prevention of pollutants. Treats water quality volume or eliminates exposure of pollutants to stormwater runoff. Additional points awarded for projects located in the watershed headwaters.
- *Ecological Benefit* – Project provides an ecological, habitat, or natural resource protection benefit.
- *Protection Priority* – Project is located in a high priority or priority protection area (see Section 4.1.5 of this report).
- *Meeting Watershed Objectives* – Potential for project to assist in achieving watershed objectives (see the Watershed Plan Executive Summary).

The ranking system was based on 120 points. The ranking factors and criteria are described in more detail in Appendix F. A list of all the sites visited along with their ranked priority and planning level cost estimates is included in Appendices D and E. The estimated costs are preliminary and should be used to guide the watershed stakeholders. These estimates should be adapted to include more appropriate local cost estimates where available. Additional information on project costs can be found in Section 5.

4.1.2 General Findings

The following are general findings from the field assessments that field crews encountered throughout the South Prong and Tony Tank subwatersheds.

Stormwater Retrofit Assessment General Findings

1. Sandy soils

Sandy soils with high infiltration rates appear to make up much of the subwatershed, which makes infiltration-based retrofits a viable option in many locations (if there is suitable depth between surface and groundwater elevation). Infiltration retrofits can be implemented in many locations that are unsuitable for other practices (such as filters or bioretention), as there is no need to connect an underdrain to the storm sewer system. Less infrastructure installation makes infiltration-based practices less costly as well. A basic infiltration test should be part of the next stage of design for most of the practices identified, in order to determine if infiltration will be feasible.

2. High water table

It appears that in some parts of the subwatershed, the water table is very shallow – two feet or less below existing grade. Several types of retrofit practices (infiltration, filters, bioretention, etc.) require several feet of depth, and are therefore inappropriate in high water table conditions. Water table elevations should be checked for sites that proceed to the next stage of design to ensure the proposed practices' feasibility.

3. Existing wet ponds

Several sites inspected as a part of the reconnaissance inventory included existing wet ponds. While some of these wet ponds included an outlet structure that maintains a permanent pool while providing detention capacity for large storms, many did not. These other wet ponds generally had a single weir overflow that directs water to a road ditch or other structure (Figure 4. 1). These types of wet ponds provide less treatment during storm events, and may be difficult to retrofit effectively. It appeared that the outlet structures (usually overflow weirs) did not provide any significant restriction of flow, especially for smaller storm events, such as the 2-year storm. If the ponds are not providing detention of storm events, they still have a water quality benefit, but not as much as if detention were provided.

Figure 4. 1. Wet pond with weir outlet structure to road ditch

4. Municipal parking lots

Several municipal parking lots near downtown Salisbury are apparently slated for re-development. In their current state, almost all of these parking lots have some opportunity for stormwater retrofits. If the sites are re-developed, the proposed retrofits may no longer be appropriate. However, redevelopment of these sites would require the implementation of stormwater management practices in accordance with Chapter 5 of the Maryland Stormwater Design Manual, which will lead to an improvement in runoff quality from these sites.

5. Lack of stormwater treatment

Throughout the watershed, a lack of stormwater treatment was observed for many development sites. At many of these sites, untreated stormwater discharges directly to wetlands, stream channels, or the stormdrain system. Unmanaged stormwater can contribute high pollutant loads to the receiving waterbodies, and can also result in high stormwater runoff flow rates that cause streambank erosion and degrade stream habitat.

6. Schools and Parks

Some of the schools and parks visited during field work had no stormwater management practices. In addition, there were often large areas of turf grass or bare soils with very little or no trees. Opportunities were often present to disconnect downspouts to discharge runoff across grassy areas or to treat rooftop runoff in a rain garden or bioretention system (Figure 4. 2).

Schools and parks are great places for stormwater retrofits because of the educational and demonstration component associated with projects. An understanding of stormwater and the environment can be incorporated into school science curriculums. Students can learn about the

connection between stormwater, Wicomico River, and how they can play a part in improving water quality. Additionally, these sites can serve as good community demonstration projects.

Figure 4. 2. Rain garden opportunity at Prince Street School

Neighborhood Source Assessment General Findings

1. Lawn and Landscaping Practices

Generally, the single family neighborhoods had high amounts of grass but were not highly managed. High amounts of fertilization were noted in the common areas and lawns of some single family neighborhoods, however, evidence of high fertilization was found mainly in the multifamily neighborhoods. High fertilization was evidenced by highly manicured lawns that were very green. Buffers could be added to lawns that led directly to the stream or ponds. Also, in several neighborhoods, particularly newer ones, a lack of tree canopy was observed.

2. Pollution Prevention Practices

No stormdrain inlet marking or stenciling was observed in the neighborhoods. Several neighborhoods had evidence of organic matter and some trash since in nearby streams. Organic matter and sediment was observed in the street and storm drain network. The following efforts could reduce pollution sources from organic matter and sediment: 1) homeowner education to remove tree and lawn debris from roadways that then enter storm drains; 2) leaf pick up or more frequent leaf pick up program; and/or 3) street sweeping. Finally, some neighborhoods were determined to use sewer however some neighborhoods use septic systems and outreach and education to these neighborhoods, particularly those around lake/pond systems, should be conducted.

3. Residential Retrofit Opportunities

Many neighborhoods were observed to have little or poorly functioning stormwater management practices that treat water quality (many practices were observed that treat water quantity). Onsite retrofits included rain barrels and rain gardens in the neighborhoods to improve stormwater quality, provide lawn landscaping opportunities, and utilize rainwater harvesting. Rain gardens may not be as useful as rain barrels due to the available space and gentle slopes (i.e., low hydraulic head). Evidence of goose waste near stormwater ponds indicates excess bacteria entering the receiving waters. Several opportunities for improved stormwater management noted include the following: 1) bioretention or other stormwater management in street conveyance channels; 2) bioretention or other stormwater management for stormwater pond pretreatment; 3) neighborhood

stormwater pond water quality retrofits; 4) stormwater pond general maintenance and/or repair; 5) stormwater treatment incorporation into wide residential roadways and 6) ditch restoration (SP_NSA_6 and SP_NSA_13). Additionally, 12 specific retrofit projects were identified in the neighborhoods.

Figure 4. 3. Opportunity for ditch restoration in SP_NSA_6.

Hotspot Site Investigation General Findings

1. Municipal Facilities

Municipal facilities were points of concern for vehicle maintenance, storage and repair; outdoor storage; and waste management. Implementation of pollution prevention and good housekeeping procedures on these sites is needed to address water quality concerns and also because these sites represent demonstration opportunities and an important part of a community's overall stormwater education and outreach program.

2. Storage of outdoor materials and waste management

Outdoor materials, including 55 gallon drums and grease barrels, noted at gas stations and restaurants without secondary containment and lids not secure. Dumpsters were found to be leaking with bulk trash dumped and/or spilling outside of the dumpster and some locations had illegal dumping occurring on the premises. Chesapeake Shipbuilding, a severe hotspot with multiple concerns is located in the critical area and further action, as described below is recommended.

3. Vehicle Activities

A commercial car wash (Inside Out Car Care) operates a facility on impervious cover without any treatment for the washwater. Gas pumps without cover were noted at other sites. Municipal facilities store, maintain and fuel vehicles and additional pollution control is warranted.

4. Turf/Landscaping Areas

A Salisbury zoo exhibit for 21 animals has direct interaction with the water. This includes a number of mammals and large birds. Other wildfowl tend to flock with the zoo exhibit animals.

Stream Assessment General Findings

1. Stream Buffer Encroachment

Buffer encroachment from urban and suburban land uses is a primary impairment to streams throughout the subwatersheds. Larger, forested stream buffers were noted in many locations and streams were generally in much better condition in these areas. Stream buffer impacts were noted associated with residential homeowner encroachment on the stream as well as from urban land use in the downtown section of Salisbury. A total length of 48,923 linear feet of the stream corridor was recorded as having an impacted buffer.

2. Channel Modification

The streams have been extensively modified, armored and channelized in many reaches of the lower subwatershed as well as in some upper reaches. In some of these cases, concrete channels can be restored to a more natural channel to provide infiltration and nutrient processing and armoring can be removed and replaced with living shorelines.

3. Illicit Discharges

Several pipes were noted as having dry weather flow or other indicators of potential illicit discharges. These pipes should be sampled for potential illicit discharges as indicated in a report compiled by CWP (2011) to the City of Salisbury.

4. Dams

Nine dams were identified throughout the subwatersheds. Eutrophication is problematic within the impoundments, most likely from phosphorus loading, from failing septics, geese and stormwater runoff. The ponds are typically dominated by aquatic weeds due to shallow depths. The weeds are likely difficult to control because they get their nutrients from the sediment (past loads) rather than the water column (current loads).

4.1.3 Lakes and Ponds

Regarding the lakes in South Prong and Tony Tank Subwatersheds, managers should study the ecological factors that sustain and reinforce dense populations of aquatic weeds. Lake managers may need to resort to in-lake treatment practices such as harvesting, dredging, water level manipulations or applications of herbicides. These practices often need to be combined with emerging "biomanipulation" practices, and the more traditional watershed treatment practices that can reduce phosphorus inputs to lake sediments (Schueler and Simpson, 2001). Better site design and implementation of stormwater treatment practices will also reduce phosphorus loading (see Figure 4. 4).

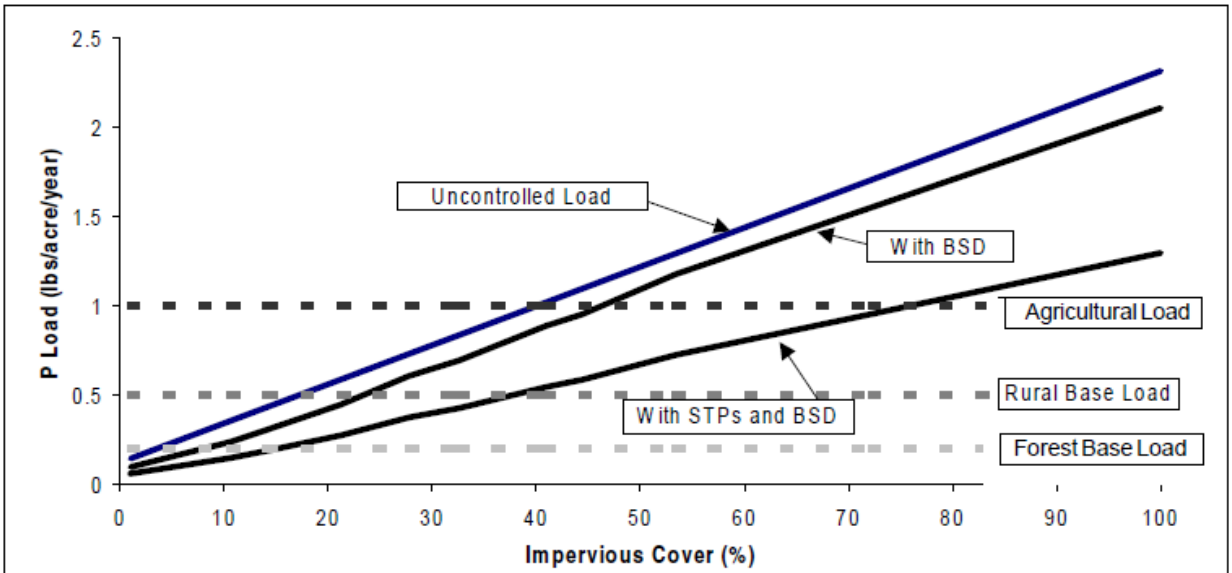

Figure 1. Phosphorus Export for Various Levels of Development and Stormwater Control
This graph shows how phosphorus loads in a watershed increase in response to more impervious cover. Note the impact of better site design and stormwater treatment on reducing phosphorus loads. Typical phosphorus loads for forest, rural and agricultural watersheds are shown for comparison purposes.

Figure 4. 4. Better site design and stormwater treatment reduce phosphorus loading (Caraco, 2001)

Some general treatment options for the restoration of urban lakes are presented below.

1) Alum Treatment – This is used to precipitate phosphorus in the water column. It can be good in locations where external phosphorus loading has been controlled and is more suited for algae infested lakes (i.e., to treat phosphorus in the water column).
2) Dredging – Dredging removes bottom sediments (and accumulated toxics) but can be problematic in terms of finding a site for disposal of the dredge spoils. If this technique is pursued, the lake should be tested ahead of time for toxics.
3) Weed Harvesting – Mechanical harvesting of weeds can be successful and there is an advantage in being able to control the size of the treatment area. However, harvesting may spur rapid regrowth of some plants, the initial purchase of equipment can be high, and harvesting may be required at least annually.
4) Hypolimnetic Withdrawal – This technique removes nutrient rich waters at the bottom of the lake. The objectives are to: 1) eliminate mixing of nutrient-rich bottom layers with the epliminion and 2) reduce residence time of water in the hypoliminion, thereby reducing opportunities for anaerobic conditions to form. This technique only works for lakes that are thermally stratified. Consideration should be given to the fact that nutrient laden waters will be discharged downstream unless it is discharged to a constructed wetland for treatment. In addition, this technique could trigger algal blooms.
5) Circulation / Aeration – This refers to circulating lake water to limit algal biomass by limiting light penetration. In lakes where iron binds phosphorus, the increased dissolved oxygen levels can decrease internal phosphorus loads generated by sediment release during anoxia. In lakes where calcium controls phosphorus, the internal loading may increase from circulation. This technique may not work at all in shallow, unstratified lakes.

6) Drawdown – This technique exposes plant roots to drying and / or freezing that can damage roots / seeds. The effects are species dependent and some species may thrive after drawdown. Drawdown can be used to remove sediment, install sediment covers and make repairs. In addition, it can be used to install fish habitat structures in the littoral zone as well as to manage fish populations.
7) Sediment Covers – These are installed flush on lake bottom and securely anchored to prevent aquatic weed growth. Sediment covers may be costly and are usually reserved for small areas around docks and swimming areas. They need to be maintained by removing sediment that accumulates on top.
8) Biological Controls – These are used to control weeds and could include grass carp or insects. Managers need to make sure that the controls go for the target plant and be aware that overstocking can dramatically change the fish community structure. In addition, totally eradicating the aquatic weeds can create an algal dominated lake.
9) Biomanipulation – This technique reduces fish species that consume zooplankton to enhance algal grazing by zooplankton thereby improving water clarity. The technique can be used in shallow lakes. An example of this technique would be to eliminate the existing fish community with rotenone and then restocking with largemouth bass or walleye that consume planktivores.

4.1.4 Tree Planting Opportunities

Tree planting opportunities were identified during the stormwater retrofit assessment, neighborhood assessment and stream assessment. These opportunities are called out specifically because tree planting is a very cost effective restoration action that provides multiple benefits, including ecological, economic and quality of life benefits – protecting air and water quality, reducing energy costs, increasing property values and beautifying neighborhoods and highways. Altogether, 174.6 acres of tree planting opportunities were identified in the subwatersheds. Table 4. 2 provides a breakdown of the different types of tree planting opportunities that were identified. A map of their locations is provided in Appendices B and C and a list of sites is provided in Appendices D and E. It should be noted these opportunities should be field verified before any planting begins. In addition, landowners should be consulted and a local forester engaged to discuss tree planting density, species selection and site constraints.

Table 4. 2. Tree planting opportunities (acres)

	Impacted Buffers	**Institutional**	**Neighborhood Common Areas**	**Neighborhoods Individual Lots**	***Totals***
South Prong	14.8	15.6	10.1	0.0[3]	*40.5*
Tony Tank	15.5	12.6	36.8	69.2	*134.1*
Total	**30.3**	**28.2**	**46.9**	**69.2**	***174.6***

[3] Common area vs individual lot tree planting opportunities were not differentiated during the South Prong Assessment.

4.1.5 Protection Opportunities in the South Prong and Tony Tank Subwatersheds

The second goal for the Wicomico Watershed as identified by the Core Team and stakeholders is to "Protect existing resources, particularly green infrastructure, ecologically significant areas, farmland, and drinking water supplies" via the following objectives: 1) Promote the use of agricultural BMPs; 2) Increase existing tree canopy; and 3) Protect existing wetlands and natural areas. Objective 1, promote the use of agricultural BMPs, has not been specifically addressed in this watershed plan as this objective is primarily being met through activities associated with the Natural Resources Conservation Service and Wicomico Soil Conservation District. The local District Conservationist can be contacted for additional information regarding agricultural BMPs in the subwatersheds: http://www.mascd.net/WicomicoSCD/index.html. Objective 2, increase existing tree canopy has been addressed through restoration projects identified above that promote buffer restoration in the riparian corridor and tree planting in upland areas. This section of the watershed plan primarily addresses objective 3; protect existing wetlands and natural areas.

Protection opportunities in the subwatersheds have been prioritized based on a desktop assessment, which was corroborated in part by the field-based stream assessment conducted for the development of this action plan. The USA identified several excellent stream reaches that were primarily associated with streams that had large (>100') riparian buffers. These areas have excellent in-stream and riparian habitat. To prevent further degradation of the subwatershed and downstream water quality, it is important that these areas remain protected from development and urban/suburban encroachment. Opportunities to protect land from development are available through the State and County. The Lower Shore Land Trust (LSLT) (http://www.lowershorelandtrust.org/pages/home.php) specializes in assisting landowners with identifying the most appropriate means for protecting properties and can be contacted for information regarding protection opportunities in the watershed.

Three GIS layers were used to identify priority areas for protection in the subwatershed. These layers are shown in Table 4. 3. Using these layers, high priority areas were identified for protection.

Table 4. 3. GIS Layers used to Identify Protection Priorities in the South Prong Subwatershed			
GIS Layer	**Source**	**Description**	**Rationale**
Sensitive Species	Maryland Department of Natural Resources	The statewide vector file shows buffered areas that primarily contain habitat for rare, threatened, and endangered species and rare natural community types. It was created over USGS 7.5 minute topographic quadrangle maps and it generally includes, but does not specifically delineate, such regulated areas as Natural Heritage Areas, Wetlands of Special State Concern, Colonial Waterbird Colonies, and Habitat Protection Areas.	Habitat that supports rare, threatened and endangered (RTE) species should be prioritized for protection.
Bionet	Maryland Department of Natural Resources	A biodiversity conservation network that identifies and prioritizes ecologically important lands to conserve Maryland's biodiversity (i.e., plants, animals, habitats, and landscapes). This dataset aggregates numerous separate data layers hierarchically according to the BioNet Criteria Matrix.	These areas have been pre-identified by the state as important ecological areas and should be prioritized for protection.
Protected Land	Maryland Department of Natural Resources	A CWP file that merges MD DNR datasets for agricultural land preservation foundation easements, protected County lands, DNR lands and conservation easements, forest conservation easements and private conservation easements	Sensitive species habitat or important ecological areas adjacent to already protected land should be prioritized for protection to promote habitat connectivity and provide for larger green infrastructure hubs and corridors.

4.2 South Prong Restoration Opportunities

4.2.1 Subwatershed Assessment

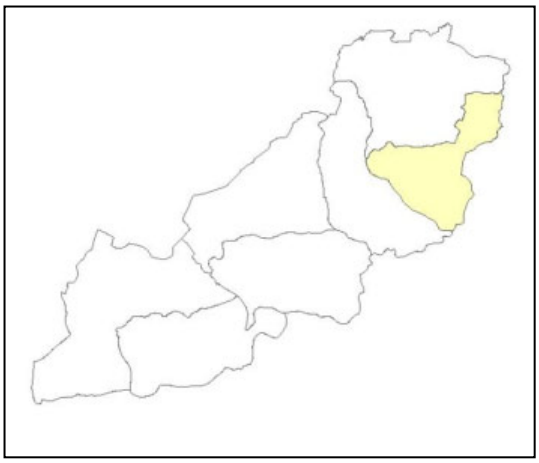

Table 4. 4. South Prong Subwatershed Characteristics		
Drainage Area		14,816 acres
Existing Impervious Cover		1,665 acres (11.2%)
Stream Miles		32.82 miles
2006 Land Use	Developed, Open Space	13.7%
	Developed, Low Intensity	9.8%
	Developed, Medium Intensity	5.6%
	Developed, High Intensity	3.4%
	Forest / Shrub	18.5%
	Cropland and Pasture	30.8%
	Woody & Herbaceous Wetlands	17.0%
Jurisdictions as Percent of South Prong		16.8% Salisbury 83.2% Wicomico County

The South Prong subwatershed is located in the northeast part of the Wicomico Watershed. It has been classified as an Impacted Urban subwatershed for the Wicomico (see the Characterization Report in Section 2). Nearly 17% of the subwatershed falls within the City with the remaining 83.2% is contained within Wicomico County (Table 4. 4). Land use is a mixture of developed (32.5% for all intensities) and cropland / pasture (30.8%). Forest cover (deciduous, evergreen, mixed and shrub/scrub) makes up an additional 18.5% and wetlands (woody and emergent herbaceous) cover 17% of the subwatershed. Soils are primarily in hydrologic soil groups D (high runoff potential, very slow infiltration) and C (moderately high runoff potential, slow infiltration) (Table 4. 5). Hydrologic group A soils have low runoff potential and high infiltration rates and B soils have moderately low runoff potential and moderate infiltration rates. Figure 4. 5 shows the distribution of soils across the subwatershed. D soils are found in the impervious downtown area, along the river valleys and in the northern arm of the subwatershed.

Table 4. 5. Soils in the South Prong Subwatershed	
Hydrologic Soil Group	**Acres (%)**
A	3,023 (20.4%)
B	2,286 (15.4%)
C	3,758 (25.4%)
D	5,574 (37.6%)

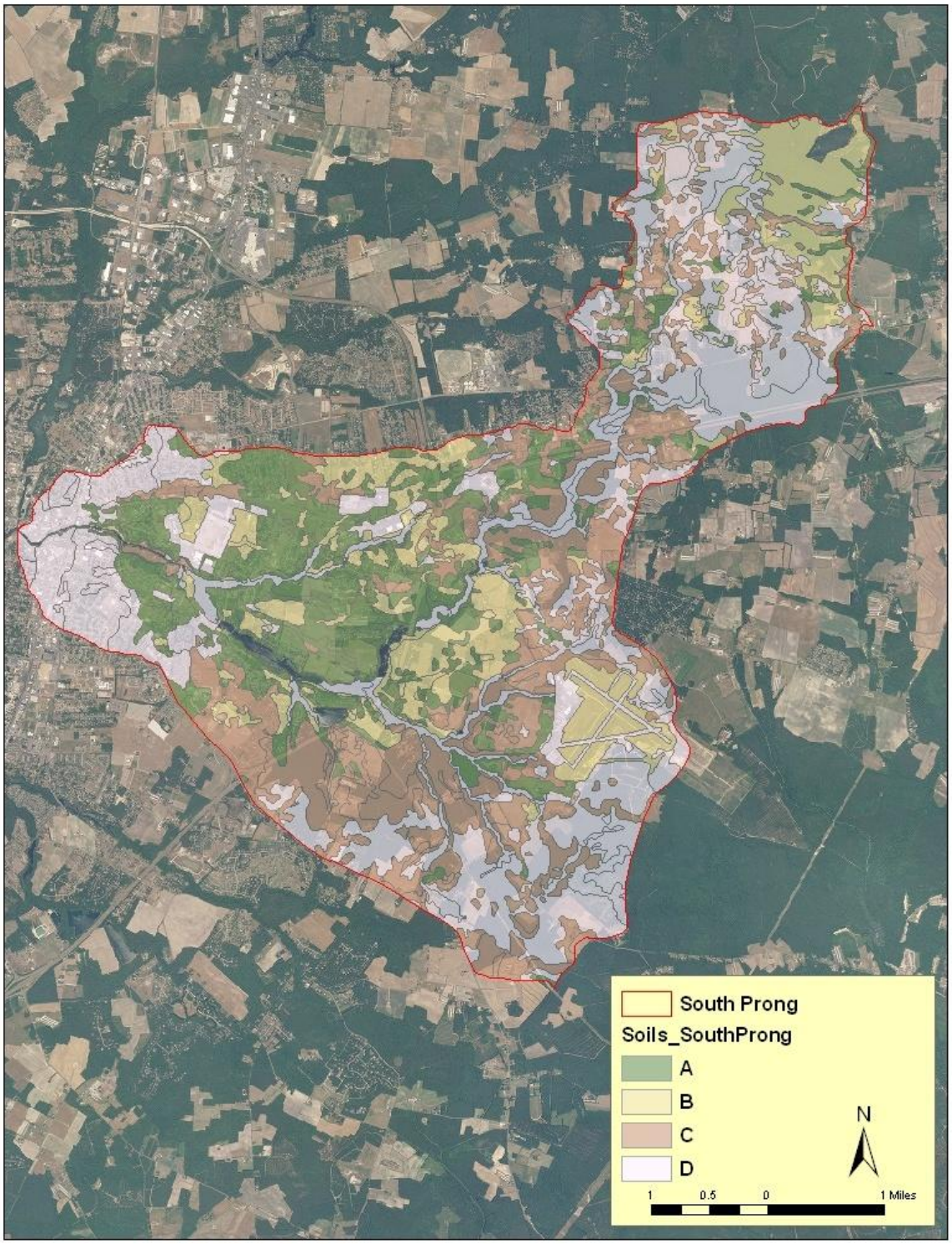

Figure 4. 5. Soil distribution across the South Prong subwatershed

4.2.2 Field Assessments

In June, 2012, field work was conducted in the 23.15 square mile South Prong subwatershed of the Wicomico River. The watershed field assessment strategy aimed to meet initial watershed restoration and protection goals outlined by the watershed planning Core Team and watershed stakeholders. These general watershed goals were to:

- Improve water quality;
- Protect existing resources; and
- Restore watershed function

During these field assessments, the field crew teams, consisting of one Center staff and volunteers from the Wicomico Environmental Trust, Wicomico County, and other interested individuals, visited over 184 locations in the watershed and used one of four field assessment methodologies to evaluate the feasibility of implementing a management or restoration practice. Approximately 46 potential stormwater retrofit sites, 21 potential hotspot locations, 23 residential neighborhoods, and 8.4 miles of stream (22 stream reaches) were assessed in the South Prong subwatershed. Table 4. 6 provides a summary of general findings from the field assessments.

Table 4. 6. General Findings from South Prong Field Assessments

Task	General Findings
Stormwater Retrofit Inventory	• 46 sites visited • 67 potential stormwater retrofits identified for 39 sites • Focus on water quality treatment • Identified 6 high priority projects and 48 medium priority projects • Types of retrofits include bioretention areas, infiltration, constructed wetlands, sand filters, and impervious cover removal
Hotspot Site Investigation	• 25 potential hotspot sites investigated • 5 sites identified as potential, confirmed or severe hotspots
Neighborhood Source Assessment	• 23 neighborhoods assessed • Pollution severity index: 19 moderate, 4 high • Neighborhood restoration potential: 7 low, 13 moderate and 3 high • Neighborhoods were mix of older and newer single family homes, most without downspouts or disconnected • Types of recommendations include rain barrels, demonstration rain gardens, free community trainings, storm drain stenciling, tree planting, buffer management, and nutrient/lawn homeowner management outreach
Unified Stream Assessment	• Walked 8.4 miles of stream • Assessed 22 stream reaches and impacts to 2 ponds • Completed site impact evaluations at 6 stream crossings, 7 modified channels, 1 erosion site, 18 outfalls, 13 impacted buffers, 1 trash site, 3 dams and 1 miscellaneous impact • Identified 20 project, including 7 high priority riparian corridor projects • Major findings include reaches with abundant trash in lower reaches, many dry channels in the headwaters, areas of excellent habitat and intact buffers in the upper reaches, poor stream buffers in the lower reaches, several channel modifications, and invasive Japanese knotweed noted throughout the watershed

Stormwater Retrofit Inventory

A total of 46 stormwater retrofit sites were visited by field crews throughout the South Prong subwatershed and a total of 67 preliminary retrofit concepts were developed at 39 of the sites (Appendix D). Multiple concepts were developed for several of the sites and are indicated by a letter after the site number (i.e., SP-RRI-19B). There were no concepts developed for 7 sites that either had adequate stormwater management or significant site constraints such as access or feasibility. A map of the RRI sites visited is found in Appendix B.

The majority of stormwater retrofit opportunities identified in the watershed were on publicly-owned land in highly visible locations, such as public schools, parks, and municipal parking lots. Some retrofit opportunities were identified on privately-owned land, primarily in existing stormwater management facilities or near commercial parking lots. Twelve high priority retrofit projects were identified throughout the subwatershed (Table 4. 7). Many opportunities for providing stormwater treatment through bioretention practices were identified at the Parkside High School, Ward Museum, Wicomico Middle School, Prince Street School, public lots in downtown Salisbury and at other parks and public places such as the Salisbury Zoo and Courthouse. One of the highest priority projects identified was a constructed wetland at the Maryland Vehicle Administrative building. For a relatively low cost, this project provides significant water quality improvement benefits with high ecological benefits. The projects identified at schools and parks provide ample opportunity for student and public engagement, education and outreach regarding stormwater management and efforts to improve local water quality. These "living classrooms" established through initial demonstration projects will help to set the stage for successful future implementation. A full list of the retrofit opportunities identified in the South Prong can be found in Appendix D.

(a) **(b)** **(c)**

Figure 4. 6. (a) Bioretention opportunity at SP_RRI_15A; (b) sediment build-up in Ward Museum parking lot (SP_RRI_305A); and (c) existing wet pond at SP_RRI_17 could be retrofit to provide additional water quality treatment

Table 4. 7. High Priority Stormwater Retrofit Opportunities in the South Prong

Site ID	Location	Retrofit Concept	Drainage Area (ac)	Impervious Cover (%)	% WQv Treated	Cost	TN Removal (lb/yr)	TP Removal (lb/yr)	TSS Removal (lb/yr)	Priority
SP_RRI_15A	Parkside High School	Bioretention	0.32	90	0.47	$16,328	2.22	0.26	71.49	High
SP_RRI_15B	Parkside High School	Bioretention	1.24	90	0.17	$22,680	4.97	0.58	160.50	High
SP_RRI_15C1	Parkside High School	Bioretention	0.45	90	0.13	$6,573	1.41	0.17	48.98	High
SP_RRI_15C2	Parkside High School	Bioretention	0.43	90	0.14	$6,418	1.37	0.16	47.65	High
SP_RRI_15D1	Parkside High School	Bioretention	0.50	90	0.16	$8,783	1.81	0.22	62.87	High
SP_RRI_15D2	Parkside High School	Bioretention	0.40	90	0.09	$4,074	0.87	0.10	30.32	High
SP_RRI_15E	Parkside High School	Bioretention	4.00	25	0.17	$23,573	5.16	0.60	166.45	High
SP_RRI_15F	Parkside High School	Bioretention	0.30	100	0.65	$23,511	2.60	0.30	84.05	High
SP_RRI_17	MVA	Constructed Wetland	2.52	85	0.42	$21,930	6.17	1.67	364.08	High
SP_RRI_304A	1008 S Schumaker Woods	Infiltration	2.00	30	1.37	$56,320	6.61	0.99	256.49	High
SP_RRI_305A	Ward Museum of Waterfowl	Infiltration	1.23	100	0.38	$28,529	7.66	1.14	297.32	High
SP_RRI_305B	Ward Museum of Waterfowl	Bioretention	0.05	95	0.74	$4,232	0.43	0.05	13.95	High

Neighborhood Source Assessment

A total of 23 neighborhoods were visited by the field crews. A list of the assessed neighborhoods can be found in Appendix D. The assessed neighborhoods were predominantly a mix of older and newer single family homes. Older neighborhoods were largely concentrated near the downtown area. There were a few newer developments that were a mix of single family homes and multifamily homes but they were not concentrated geographically in the watershed. Many neighborhoods were observed to have little or poorly functioning stormwater management practices. In addition, few water quality focused BMPs existed in the neighborhoods. A large majority of the homes observed had downspouts that were disconnected to a pervious area.

The South Prong neighborhoods assessed tended to rate as moderate in terms of pollution severity. Four neighborhoods received a rating of high for pollution severity, mostly due to high amount of grass cover in yards and lawns, highly managed turf lawns, evidence of sediment/organic matter in the curb and gutter, and field observed pollution indicators.

Neighborhoods generally rated moderate for restoration potential, with three rating high and seven rating low. Opportunities identified in moderate neighborhoods included rain barrels, rain gardens, tree planting, nutrient and lawn management education and storm drain stenciling. Restoration opportunities in the neighborhoods rated low for restoration potential were limited in opportunity primarily because they were older, smaller, confined lots located near downtown that had little opportunity for targeted restoration campaigns. Downspout disconnection typically offers the best chance to reduce runoff volumes, but most downspouts were disconnected to pervious areas and the low relief (i.e., flat lots) also limited the use of residential rain gardens to capture and treat rooftop runoff. In addition, lawns were not highly managed. The neighborhoods identified as having high restoration potential were multifamily neighborhoods with highly managed turf and low tree cover. In these neighborhoods, projects were identified that included nutrient and lawn management outreach, tree planting, ditch restoration and storm drain stenciling (Figure 4.7). There is an opportunity to engage and reach many residents in these neighborhoods.

Several neighborhoods were identified in the South Prong subwatershed with high priority restoration actions (Table 4. 8). Restoration opportunities at these sites include lawn management, tree planting to increase forest canopy, storm drain markers or stenciling, rain barrels and improved management of stormwater ponds. Several neighborhoods were identified as having opportunities for ditch restoration.

Table 4. 8. Priority Neighborhood Source Control Opportunities in the South Prong Subwatershed

Site_ID	Location	Pollution Severity	Restoration Potential	Opportunity	Cost*	Ranking
SP_NSA_15	South Kaywood Community	Moderate	Low	Rain barrels, storm drain stenciling, homeowner education for lawn and tree management (reduce organics in street & storm drain); RRI-300 Amended Soils in green	$	High

Table 4. 8. Priority Neighborhood Source Control Opportunities in the South Prong Subwatershed

Site_ID	Location	Pollution Severity	Restoration Potential	Opportunity	Cost*	Ranking
				space median.		
SP_NSA_21	New Bedford Way and Long Warf Road	Moderate	Moderate	Homeowner lawn management outreach, back yard buffers for homes adjacent to pond, storm drain stenciling; See RRI-302 pond retrofit.	$	High
SP_NSA_8	Highland Park	Moderate	Moderate	Tree planting or retrofit for islands with BMP (no retrofit proposed during field visit).	$	High
SP_NSA_9	Mallard Landing Lakeside	Moderate	High	Tree planting at community park, storm drain stenciling, nutrient & lawn mgt outreach/education.	$	High
SP_NSA_10	East Lake Subdivision	High	Moderate	Nutrient management outreach, septic education, buffer at Riden Court, better management for pond trail at Riden Court.	$	High
SP_NSA_14	Walston Switch	Moderate	Moderate	Rain barrels, buffer management & education, storm drain stenciling, tree planting in green space; Many geese and droppings near pond.	$	High
SP_NSA_5	Stonegate	Moderate	Moderate	Plant trees at BMP sites (ponds), storm drain stenciling.	$	High

$: Estimated Planning Level Cost < $5,000
$$: Estimated Planning Level Cost $5,000-$20,000
$$$: Estimated Planning Level Cost > $20,000

(a) (b) (c)

Figure 4. 7. (a) Opportunity for stormwater treatment at SP_NSA_15; (b) Opportunity for tree planting around a stormwater pond at SP_NSA_5; and (c) Opportunity for ditch restoration at SP_NSA_6

Hotspot Site Investigation

A total of 25 hotspot sites were assessed in the South Prong subwatershed. Two sites were identified as severe hotspots, two sites were identified as confirmed hotspots, and one site was identified as a potential hotspot. An additional 20 locations were assessed and not determined to be hotspots using the USSR criteria. Pollution producing behaviors that were noted include: outdoor commercial vehicle washing, lack of secondary containment, leaking dumpsters and a zoo exhibit that has direct interaction with the water (Figure 4. 8). Three stormwater retrofits were identified during the hotspot assessment (SP_HSI3, SP_RRI100 and SP_RRI101). Priority hotspot sites are shown in Table 4. **9** and a full list of all sites assessed can be found in Appendix D.

(a) **(b)**

Figure 4. 8. (a) Commercial vehicle washing on impervious cover (HSI_20a) and (b) improperly stored materials (HSI_20b)

Table 4. 9. Priority Hotspot Sites in the South Prong Subwatershed

Site_ID	Location	Type of Hotspot	Description	Recommended Actions	Status	Cost	Priority
SP_HSI_53	Salisbury Zoo	Waste Management / Turf Landscaping	Animal exhibits have direct interaction with the river. Direct pollution source and contributor of bacteria. Large mammals and birds in exhibits	Exhibit should be moved if possible. Consideration could be given for treatment such as with floating wetlands.	Confirmed	$$$	High
SP_HSI_40	Center of Hope (Harvest Baptist Church at 119 South Blvd # A)	Outdoor Material Storage, Waste Management	Garbage on the ground; 50 gallon drum w/out secondary containment; evidence of dumpsters leaking; bulk material outside dumpster on ground	Suggest follow-up on-site inspection and discuss proper trash management; determine contents of 50 gallon drum & discuss proper management/storage	Severe	$	High
SP_HSI_20C	Restaurants & Businesses near Hazel Avenue and South Salisbury Boulevard	Outdoor Material Storage, Waste Management	Dumpsters with broken lids, cooking oil in plastic container w/ lid down but evidence of oil spills and empty 5 gallon buckets with cooking oil residue; trash on ground around dumpster area	Schedule a review of stormwater pollution prevention plan; Suggest follow-up on-site inspection; discuss proper cooking oil and waste management; check out the pipe that has flow and algae to the right of dumpsters.	Confirmed	$	Medium
SP_HSI_20A	Inside Out Car Care (726 South Salisbury Boulevard # G)	Vehicle Operations	Outdoor car wash that conveys the waste water to the parking lot storm drain (also visible from Google Earth view)	Schedule a review of stormwater pollution prevention plan; Suggest follow-up on-site inspection; divert water from storm drain and provide education.	Confirmed	$	Medium

$: Estimated Planning Level Cost < $5,000
$$: Estimated Planning Level Cost $5,000-$10,000
$$$: Estimated Planning Level Cost > $10,000

Unified Stream Assessment

Thirty-four stream reaches were initially identified in the South Prong subwatershed via a desktop assessment (Appendix B). Two of these "stream reaches," Schumaker Pond and Parker Pond, are actually impoundments and the stream reach assessment form is not applicable to these types of systems. Therefore, a stream reach form was not completed; however, impacts to the ponds from the surrounding watershed were assessed to the extent possible. Due to the limited amount of time available to conduct the stream assessments plus limited access on private property, field crews were not always able to walk entire stream lengths. In some cases, stream reaches were assessed from road crossings or by walking a short section of stream where property access had been granted.

Eight reaches that were assessed had no observable baseflow. These reaches were mostly in the headwaters. Two of these were marked as blue line streams in the GIS system, however, they appear to be intermittent streams. Other streams that were identified as intermittent actually had baseflow at the time of the field assessment. Two dry stream reaches were not assessed using the USA protocol due to time constraints.

An overall quantitative score for each reach was assigned based on average physical condition of various in-stream and riparian parameters (i.e. diversity of instream habitat, floodplain connectivity, vegetative buffer width, etc.). These scores were used to classify stream reaches into condition categories ranging from *excellent* to *very poor* (Table 4. 10).

The best reach score in the study area was SP_RCH15, which scored 150 points. This can be considered a representative score for the best attainable condition for a reach within the watershed. A score of at least 89% or greater than this number ($\geq$134) is considered comparable to the reference condition and represents excellent stream conditions for the watershed. A score less than 19% ($\leq$68 pts) of the reference score is considered very poor. Between these two extremes, 46% of the reference score (107$\geq$68 pts) represents poor stream conditions, 71% of the reference score (122$\geq$107 pts) represents fair stream conditions, and 81% of the reference score (134$\geq$122 pts) represents good stream conditions.

Table 4. 10. Stream Reach Scoring Criteria

Classification	Percentile	Point Threshold
Excellent	89%	$\geq$134
Good	81%	122 $\geq$134
Fair	71%	107 $\geq$122
Poor	46%	69 $\geq$ 107
Very Poor	19%	$\leq$ 69

While these criteria serve to place the assessed reaches in context, they are somewhat subjective. A reach scoring a few points higher than another may be placed in a higher category, but the qualitative aspects of the method make differences of a few points insignificant. Maps of the stream reaches assessed and the observed impacts can be found in Appendix B.

(a) (b)

Figure 4. 9. (a) RCH 13 - "excellent reach" and (b) channelized section of RCH4 - "poor" reach

A total of 22 stream reaches were assessed in the South Prong subwatershed. Six reaches were assessed as excellent, two were assessed as good, one was assessed as fair, eleven were assessed as poor and two were assessed as very poor. Two additional reaches were visited but not assessed due to time constraints and no flow present in the stream channel. Stream reaches scoring low had problems with channelization, buffer encroachment, trash and armored banks. Stream reaches scoring higher had favorable habitat conditions, large, intact buffers, wetland habitat and river access to the floodplain. Seven high priority stream opportunities were identified (Table 4. 12). Numerous opportunities for buffer planting on private and public land were identified. A number of retrofit opportunities were identified at the airport for natural channel design and constructed wetlands. Invasive Japanaese knotweed was noted throughout the subwatershed with a significant seed source in the headwaters at SP_IB1701. Geese were also noted throughout the watershed and are contributors to nutrients and bacteria in the local streams and ponds.

A summary of notable restoration opportunities and stream impacts observed in the stream reaches are presented in Table 4. 11. A complete list of the stream reaches assessed and the stream impacts observed can be found in Appendix D. Seven high priority and nine medium priority opportunities to restore the riparian corridor in the South Prong subwatershed were identified. Specific techniques prescribed to these seven locations include buffer planting, invasive plant removal, natural channel design and discharge inspection. Further study is needed to determine the most effective options at SC301, a sight west of the zoo on the mainstem of the South Prong. There is potential at this site to treat the majority of the subwatershed, however, due to the large drainage area and amount of water to be treated, further investigation into treatment opportunities are needed.

Table 4. 11. Summary of Noted Stream Improvement Opportunities and Impacts

Impact Type	Site Description
Stream Buffer Restoration	• Impacted buffer identified along 15,190 linear feet of stream (2.9 miles) • Invasive Japanese knotweed impacting buffer (SP_IB1701) • Buffer mowed to edge (SP_IB701)

Table 4. 11. Summary of Noted Stream Improvement Opportunities and Impacts	
Impact Type	**Site Description**
Channel Modification	• Channel modification identified along 5,987 linear feet of stream (1.1 miles) • Streams on the airport property (SP_CM3101) modified to concrete channel as well as other areas (SP_CM701) • Lower river in downtown Salisbury completely armored (SP_IB101)
Stream Crossing	• Under-sized culverts acting as grade control and fish barriers (SP_SC601, SP_SC1501)
Discharge Investigation	• SP_OT1102[4], RCH-5 • Strong sewage odor noted in stormwater pond at the airport[5]
Other	• Beaverdam Creek feasibility study for water quality treatment options at SP_SC301

(a) **(b)**

Figure 4. 10. (a) Impacted buffer (IBI 701) has been overrun with invasive Japanese knotweed and (b) channel modification (CM 3101) at the airport

Table 4. 12. High Priority Stream Impacts in the South Prong Subwatershed					
Site ID	**Location**	**Impacts**	**Opportunity**	**Cost**	**Priority**
SP_IB2101	Southwest of WorWic Community College	Impacted Buffer	Buffer Enhancement	$	High
SP_IB2601	Walston Switch Rd and Airport Rd	Impacted Buffer	Buffer Enhancement	$	High
SP_IB301	Between Snow Hill Rd and plastic fencing marking the downstream boundary of the zoo.	Impacted Buffer	Buffer Enhancement	$$	High
SP_IB3101	Along Fooks Rd	Impacted Buffer	Buffer Enhancement	$$	High

[4] Y3C1 and Y3C2 from Salisbury IDDE project
[5] Reported to City of Salisbury 6/28/2012. Resolution unknown.

Table 4. 12. High Priority Stream Impacts in the South Prong Subwatershed					
Site ID	**Location**	**Impacts**	**Opportunity**	**Cost**	**Priority**
SP_IB501	Upstream of Memorial Plz	Impacted Buffer	Buffer Enhancement	$$	High
SP_OT1102	E College Ave	Outfall	Illicit discharge investigation	$	High
SP_TR1301	Downstream of Parker Pond on small tributary of RCH13	Trash	Trash clean-up	$	High
$: Estimated Planning Level Cost < $2,000 $$: Estimated Planning Level Cost $2,000-$8,000 $$$: Estimated Planning Level Cost > $8,000					

(a) (b) (c)

Figure 4. 11. (a) Very poor stream reach with no buffer and hardened banks (SP_RCH_8); (b) Excellent stream reach with floodplain access and good buffer (SP_RCH_33); and (c) Opportunity for buffer enhancement (SP_IB_501)

4.2.3. Protection Opportunities in the South Prong Subwatershed

Using the process identified above in Section 4.1.5, three high priority areas were identified for protection (1,558 acres); these areas are shown in Figure 4. 12. High priority areas 1 and 2 are areas that have been identified as important ecological areas that also support sensitive species. In addition, high priority area 1 is a large riparian corridor and high priority area 2 is a headwater stream. High priority area 2 contains a large portion of property that is already owned by Wicomico County so properties adjacent to those should be targeted. High priority area 3 is an important ecological area that is adjacent to a large protected area, the Nassawango Creek preserve owned by The Nature Conservancy that drains to the adjacent Pocomoke watershed. High priority area 3 does not contain blue line streams but drains to headwater streams of the South Prong. The area has large contiguous forest tracts that may be important for forest interior dwelling bird species. The remaining priority protection areas (2,153 acres) should be targeted for preservation efforts in order to maintain the current quality of the watershed and prevent further degradation.

GIS was used to identify the acres of protection area that are not currently protected via the State, municipalities, easements or other means. This analysis identified 1,211 acres of high priority land (77% of the originally identified area) to be protected and 1,904 acres of priority land (88% of the originally identified area) to be protected.

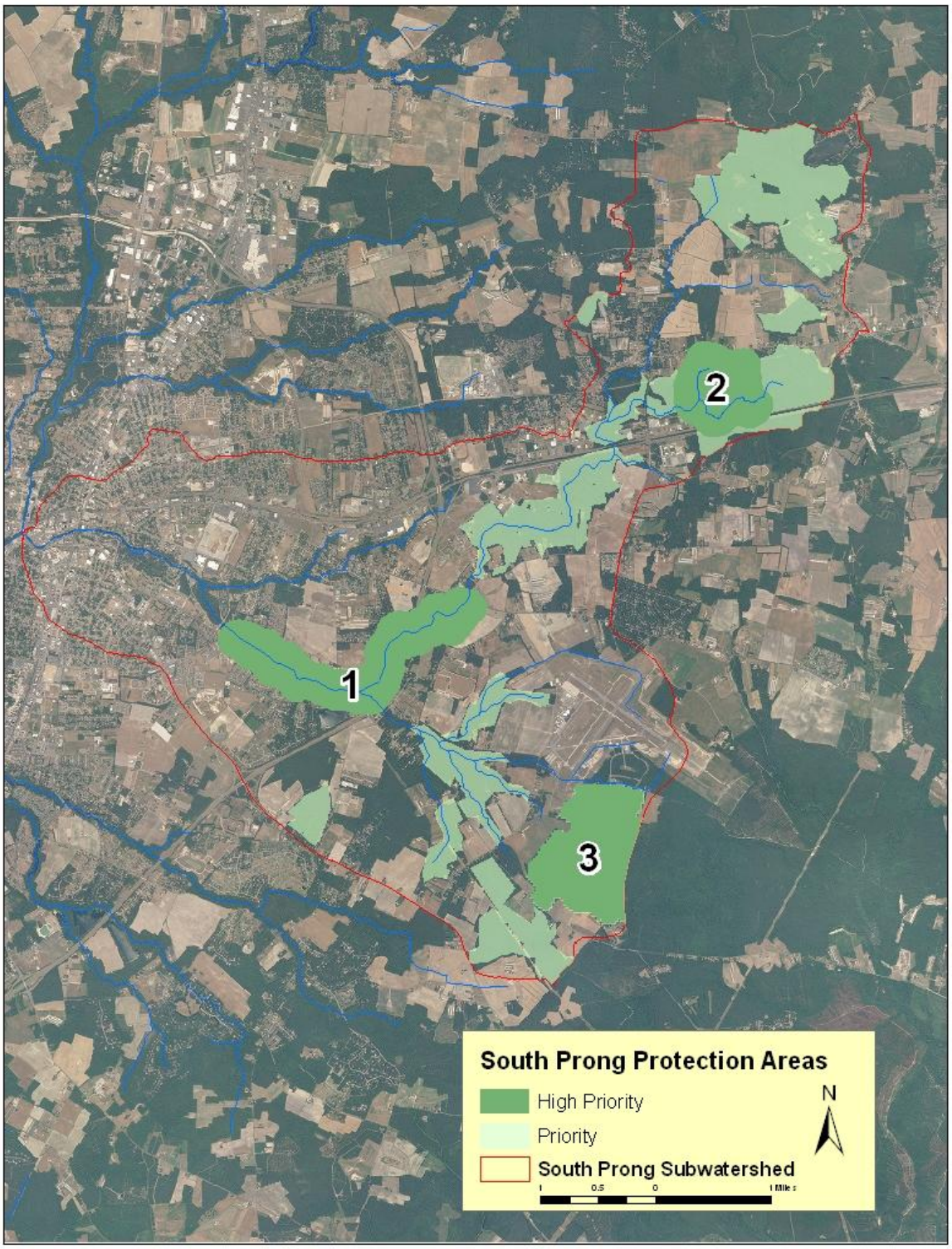

Figure 4. 12. Priority areas for protection in the South Prong subwatershed

4.3 Tony Tank Restoration Opportunities

4.3.1 Subwatershed Assessment

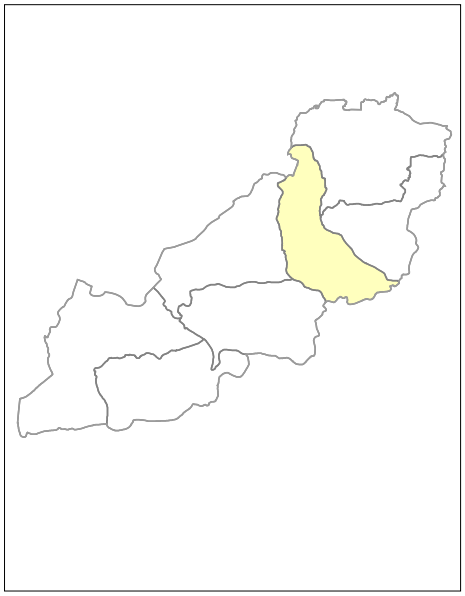

Table 4. 13. Tony Tank Subwatershed Characteristics		
Drainage Area		18,564 acres
Existing Impervious Cover		1,845 acres (9.94%)
Stream Miles		37.68 miles
2006 Land Use	Developed, Open Space	16.7%
	Developed, Low Intensity	10.9%
	Developed, Medium Intensity	5.1%
	Developed, High Intensity	1.7%
	Forest / Shrub	21.8%
	Cropland and Pasture	25.9%
	Woody & Herbaceous Wetlands	9.9%
Jurisdictions as Percent of South Prong		15.6% Salisbury 11.7% Fruitland 72.9% Wicomico County

The Tony Tank subwatershed is located in the central part of the Wicomico Watershed. The subwatershed boundary, as defined by the US Geological Survey mapping layers, spans the mainstem of the Wicomico River. From a management perspective, this delineation is not ideal and should be factored into management scenarios and monitoring restoration restoration progress and success. The Tony Tank has been classified as an Impacted Urban subwatershed, similar to the South Prong, for the Wicomico (see Characterization Report in Section 2). Nearly 16% of the subwatershed falls within the City of Salisbury, ~12% is within the City of Fruitland and the remaining 73% is contained within Wicomico County (Table 4. 13). Land use is a mixture of developed (34.4% for all intensities) and cropland / pasture (25.9%). Forest cover (deciduous, evergreen, mixed and shrub/scrub) makes up an additional 21.8% and wetlands (woody and emergent herbaceous) cover 10% of the subwatershed. Soils are primarily in hydrologic soil groups A (have low runoff potential and high infiltration rates) and C (moderately high runoff potential, slow infiltration) (Table 4. 14). There is a significant portion of D soils (high runoff potential, very slow infiltration) and these are found in the impervious developed areas of Salisbury and Fruitland as well as in southern headwaters (Figure 4. 13).

Table 4. 14. Soils in the Tony Tank Subwatershed	
Hydrologic Soil Group	**Acres (%)[6]**
A	5,941 (32.0%)
B	2,246 (12.1%)
C	5,506 (29.7%)
D	4,287 (23.1%)

[6] 582 acres of water not accounted for under soils.

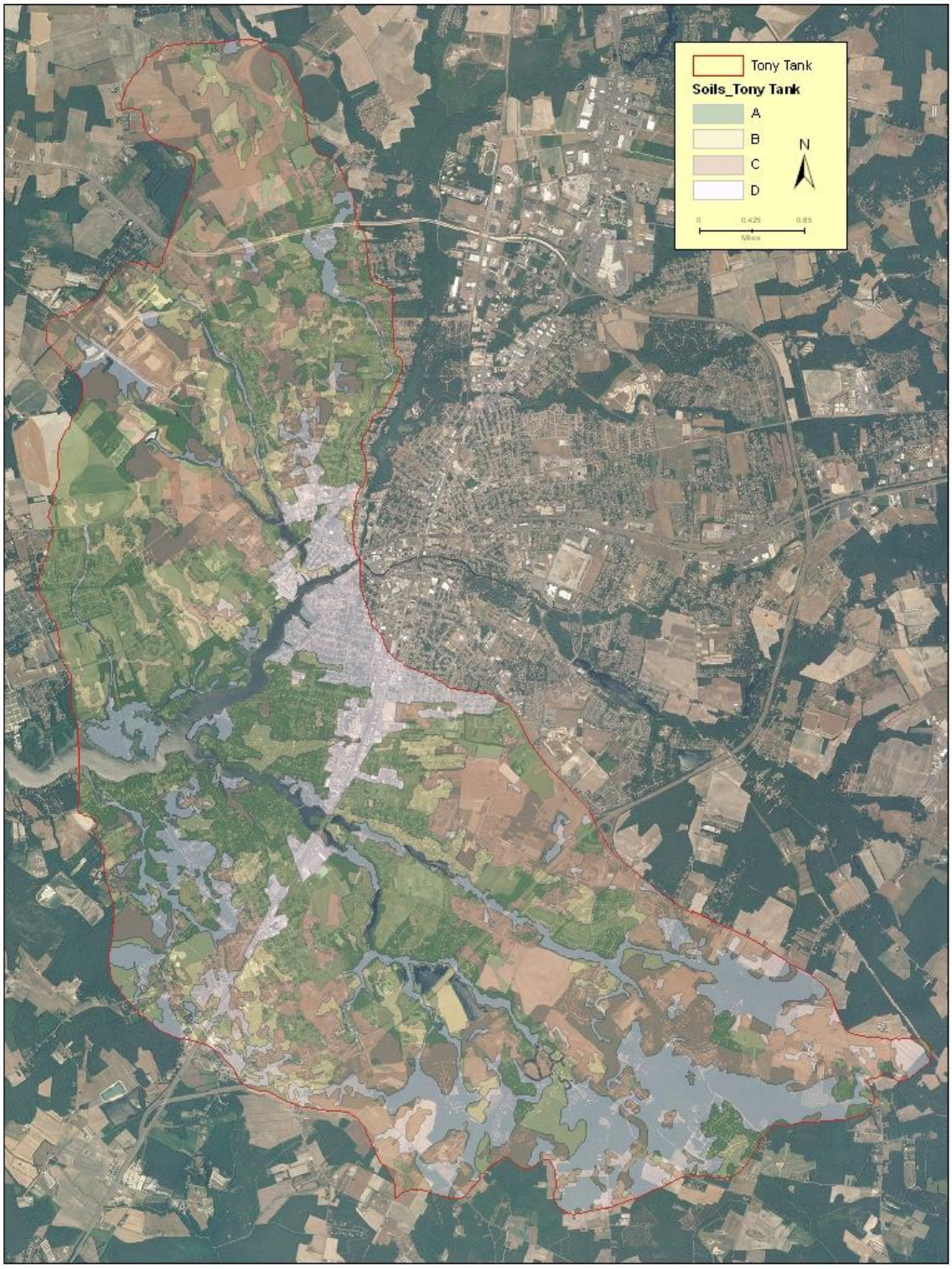

Figure 4. 13. Soil Distribution across the Tony Tank subwatershed

4.3.2 Field Assessments

On October 16-17, 2012, field work was conducted in the 29 square mile Tony Tank subwatershed of the Wicomico River. The watershed field assessment strategy aimed to meet initial watershed restoration and protection goals outlined by the watershed planning Core Team and watershed stakeholders. These general watershed goals were to:

- Improve water quality;
- Protect existing resources; and
- Restore watershed function

During these field assessments, the field crew teams, consisting of one Center staff and volunteers from the Wicomico Environmental Trust, Cities of Fruitland and Salisbury, Wicomico County, the Coast Guard, and other interested individuals, visited over 168 locations in the watershed and used one of four field assessment methodologies to evaluate the feasibility of implementing a management or restoration practice. Approximately 54 potential stormwater retrofit sites, 19 potential hotspot locations, 24 residential neighborhoods, and 5.0 miles of stream (22 stream reaches) were assessed in the Tony Tank subwatershed. Table 4. 15 provides a summary of general findings from the field assessments.

Table 4. 15. General Findings from Tony Tank Field Assessments

Task	General Findings
Stormwater Retrofit Inventory	• 54 sites visited • 35 potential stormwater retrofits identified for 27 sites • Focus on water quality treatment • Identified 2 high priority projects and 23 medium priority projects • Types of retrofits include bioretention areas, regenerative stormwater conveyance, infiltration, dry swales, existing stormwater pond retrofits, and impervious cover removal
Hotspot Site Investigation	• 19 potential hotspot sites investigated • 18 sites identified as potential, confirmed or severe hotspots
Neighborhood Source Assessment	• 24 neighborhoods assessed • Pollution severity index: 21 moderate, 3 high • Neighborhood restoration potential: 4 low, 19 moderate and 1 high • Types of recommendations include street sweeping or leaf pick-up, rain barrels, demonstration rain gardens, stormwater pond maintenance, free community trainings, storm drain stenciling, tree planting, buffer management, and nutrient/lawn homeowner management outreach
Unified Stream Assessment	• Assessed (via walking and boating) 5.0 miles of stream • Assessed 22 stream reaches • Completed site impact evaluations at 11 stream crossings, 1 modified channels, 3 erosion sites, 14 outfalls, 14 impacted buffers, 2 trash sites and 4 dams • Identified 32 project, including 7 high priority riparian corridor projects • Major findings include reaches are hydrologically disrupted throughout the subwatershed by dams and stream crossings. Areas of good habitat exist in lower tidal reaches and where buffers are wide with mature forest. Shoreline and lakeside shores have impacted buffers. Some areas of erosion and channel modification were noted.

Stormwater Retrofit Inventory

A total of 54 stormwater retrofit sites were visited by field crews throughout the Tony Tank subwatershed and a total of 35 preliminary retrofit concepts were developed at 27 of the sites (Appendix E). Multiple concepts were developed for several of the sites and are indicated by a letter after the site number (i.e., TT-RRI-41B). There were no concepts developed for 27 sites that either had adequate stormwater management or significant site constraints such as access or feasibility. A map of the RRI sites visited is found in Appendix C.

Several stormwater retrofit opportunities identified in the watershed were identified on publicly-owned land in highly visible locations, such as public schools, parks, and municipal facilities. Some retrofit opportunities were identified on privately-owned land, in neighborhoods and commercial areas. Two high priority retrofit projects were identified throughout the subwatershed (Table 4. 16). These were located in Pemberton Park and include a regenerative stormwater conveyance and bioretention facility (Figure 4. 14). Both projects would serve as excellent demonstration sites due to their location. Many opportunities for providing stormwater treatment through bioretention practices were identified in several neighborhoods such as Pinebluff Village, Canal Park and Nutters Crossing. Opportunities for water quality treatment were also identified at municipal facilities such as the Wicomico Solid Waste Division, Wicomico County Roads Division Headquarters and Salisbury Municipal Yard. Several projects were identified at schools such as Fruitland Primary and Salisbury Middle School. These projects provide ample opportunity for student and public engagement, education and outreach regarding stormwater management and efforts to improve local water quality. A full list of the retrofit opportunities identified in the Tony Tank can be found in Appendix E.

(a) (b) (c)

Figure 4. 14. (a) Location for regenerative stormwater conveyance at RRI_41a; (b) wooden box pipe to be removed at RRI_41a; (c) location for bioretention facility to treat parking lot runoff at RRI_41b

Table 4. 16. Priority Stormwater Retrofit Opportunities in the Tony Tank subwatershed

Site ID	Location	Retrofit Concept	Drainage Area (ac)	Impervious Cover (%)	Cost	TN Removal (lb/yr)	TP Removal (lb/yr)	TSS Removal (lb/yr)	Priority
TT_RRI_41A	Permberton Park	Regenerative Stormwater Conveyance	0.56	95	$ 11,294	1.99	0.23	64.05	High
TT_RRI_41B	Permberton Park	Bioretention	0.71	95	$ 96,159	7.14	0.83	230.25	High
TT_NSA_22B	Georgia Avenue Apartments	Bioretention	0.90	10	$ 10,805	1.16	0.14	37.55	Medium
TT_NSA_23	Playground - Riverside and Pennsylvania Ave	Bioretention	0.61	25	$ 83,424	2.29	0.27	73.76	Medium
TT_NSA_32	Nutters Crossing (Golf Course Club House)	Bioretention	0.22	90	$ 14,094	1.65	0.19	53.12	Medium
TT_RRI_32A	Pinebluff Village	Bioretention	0.52	25	$ 6,715	1.05	0.12	33.75	Medium
TT_RRI_32B	Pinebluff Village	Bioretention	0.32	5	$ 3,990	0.33	0.04	10.53	Medium
TT_RRI_32C	Pinebluff Village	Bioretention	0.20	85	$ 17,654	1.62	0.19	52.31	Medium
TT_RRI_38	Fruitland Primary	Bioretention	0.32	100	$ 11,316	1.99	0.23	64.25	Medium
TT_RRI_75B	Canal Park	Regenerative Stormwater Conveyance	0.34	90	$ 37,318	2.81	0.33	90.53	Medium
TT_RRI_76	Fruitland Water Treatment Plant	Bioretention	0.30	100	$ 47,684	3.29	0.38	106.10	Medium
TT_RRI_31HSI	Seven Eleven (Nanticoke Road and South Salisbury Boulevard)	Infiltration	0.29	100	$ 30,028	3.02	0.45	117.14	Medium
TT_RRI_53A	Wicomico Solid Waste Division	Wet Pond	2.67	100	$ 79,959	13.41	3.02	659.46	Medium

Table 4. 16. Priority Stormwater Retrofit Opportunities in the Tony Tank subwatershed

Site ID	Location	Retrofit Concept	Drainage Area (ac)	Impervious Cover (%)	Cost	TN Removal (lb/yr)	TP Removal (lb/yr)	TSS Removal (lb/yr)	Priority
TT_RRI_53B	Wicomico Solid Waste Division	Dry Swale	3.64	95	$ 54,623	20.75	2.65	723.29	Medium
TT_RRI_55	Salisbury Marina	Bioretention	1.35	100	$ 207,304	14.57	1.69	470.10	Medium
TT_RRI_48	Salisbury Middle School	Impervious Cover Removal	0.22	100	$ 21,172	2.66	0.36	78.37	Medium
TT_RRI_54B	Salisbury Plaza	Impervious Cover Removal	0.14	0.14	$ 727	0.09	0.01	2.69	Medium
TT_RRI_44	Wicomico Nursing Home	Bioretention	0.98	95	$ 70,966	8.02	0.93	258.66	Medium
TT_RRI_51	Wicomico County Roads Division HQ	Filtering Practice	3.33	100	$ 25,360	5.90	1.59	348.14	Medium
TT_RRI_52A	Lower Shore Enterprise	Extended Detention Pond	3.10	85	$ 881,441	5.36	1.09	791.33	Medium
TT_RRI_74	Maryland Food Bank of Eastern Shore	Dry Swale	0.75	90	$ 20,219	5.23	0.67	182.25	Medium
TT_RRI_29_1a	405 Camden Ave	Bioretention	0.19	100	$ 13,102	1.57	0.18	50.77	Medium
TT_RRI_29_1b	405 Camden Ave	Bioretention	0.20	100	$ 17,805	1.82	0.21	58.61	Medium
TT_RRI_4_1	Lakewood and Arbutus Dr	Regenerative Stormwater Conveyance	1.68	25	$ 22,770	8.11	1.09	239.11	Medium

Neighborhood Source Assessment

A total of 24 neighborhoods were visited by the field crews. A list of the assessed neighborhoods can be found in Appendix E. The assessed neighborhoods were predominantly a mix of older and newer single family homes, as in the South Prong, but also contained student housing associated with Salisbury University, as well as some subsidized (Section 8) housing. The Tony Tank neighborhoods assessed tended to rate as moderate in terms of pollution severity. Three neighborhoods received a rating of high for pollution severity, mostly due to high amount of grass cover in yards and lawns, highly managed turf lawns, evidence of sediment/organic matter in the curb and gutter, and field observed pollution indicators.

Neighborhoods generally rated moderate for restoration potential, with one rating high and four rating low. Opportunities identified in moderate neighborhoods included rain barrels, rain gardens, tree planting, nutrient and lawn management education and storm drain stenciling. Restoration opportunities in the neighborhoods rated low for restoration potential were limited in opportunity primarily because they were multi-family homes with less opportunity per lot, they were brand new homes where landowners may not be anxious for change, or they had high tree canopy cover that may impede projects such as rain gardens because of low light levels. One neighborhood was identified in the Tony Tank subwatershed with high priority restoration actions (Table 4. 17). Restoration opportunities in this neighborhood include stormwater pond maintenance, tree planting, street sweeping, ditch restoration, storm drain stenciling and outreach regarding lawn maintenance.

Table 4. 17. Neighborhood Source Control Opportunities in Tony Tank

Site_ID	Location	Pollution Severity	Restoration Potential	Opportunity	Cost	Priority
TT_NSA_22	River Oak, Oak Hills, Riverside Homes - River Oak Court, Alabama Ave, Georgia Ave	Moderate	Moderate	Rain gardens or bioswale between Oak Hills Townhome buildings, retrofit concrete channel that drains parking lot directly to river or add buffering along river, tree planting in open area at River Oak, stencil storm drain inlets, highly maintained lawns.	$	High
TT_NSA_29	Village at Tony Tank Creek - Village Oak Drive, Sandy Bottom Court	Moderate	Moderate	Rain barrels, over manicured lawns, tree planting or rain garden in large traffic circle (currently just lawn), downspouts to pervious, buffering and trash clean up in storm water ponds, stencil storm drain inlets, non-target irrigation	$	High

Table 4. 17. Neighborhood Source Control Opportunities in Tony Tank						
Site_ID	**Location**	**Pollution Severity**	**Restoration Potential**	**Opportunity**	**Cost**	**Priority**
TT_NSA_37	Willow Creek - Willow Creek Drive, Oxbridge Drive	High	High	Neighborhood stormwater pond needs maintenance at inlets and could use more buffering/tree planting, rain barrels, septic maintenance, better irrigation practices, street sweeping, ditches have concrete bottoms (retrofit opportunity), large church property drains to pond - retrofits/buffering opportunities, church trash/dumping in back of property, tree planting	$$	High
TT_NSA_42	Village at Mitchell Pond - Parsons Road	Moderate	Moderate	Some bare soil - rehab walkways or redirect pedestrian traffic - precipitation erodes the soil to storm water inlets, better parking lot maintenance/long term parking, dumpsters are not covered and drain to storm water inlet	$	High
TT_NSA_44-A	Duke Drive, Esquire Drive, Duchess Drive	Moderate	Moderate	Rain barrels, tree planting, downspouts to pervious, stencil storm drain inlets, septic maintenance, street sweeping	$	High
TT_NSA_44-B	Sassafras Meadows - Marquis Avenue	Moderate	Moderate	Tree planting, rain barrels, rain gardens, move downspouts to pervious/landscaping, stencil storm drain inlets	$$	High

(a) (b) (c)

Figure 4. 15. (a) Opportunity for outreach regarding lawn maintenance at TT_NSA_37; (b) dirty parking lots at TT_NSA_39; and (c) ample opportunity for tree planting at TT_NSA_22

Hotspot Site Investigation

A total of 19 hotspot sites were assessed in the Tony Tank subwatershed. Six sites were identified as severe hotspots, 10 sites were identified as confirmed hotspots, two sites were identified as potential hotspots and one site was not a hotspot. Pollution producing behaviors that were noted include: storage of outdoor materials in unlabeled containers without containment, poor trash management, uncovered materials, stains and other evidence of leakage and illegal dumping. Priority hotspot sites are shown in and a full list of all sites assessed can be found in Appendix E.

(a) **(b)** **(c)**

Figure 4. 16. (a) Municipal vehicle washing on impervious surface (TT_HSI_67); (b) batteries stored outside without cover or containment (TT_HSI_22b); and (c) poor trash management (TT_HSI_22a)

Table 4. 18. Priority Hotspot Sites in the Tony Tank Subwatershed

Site_ID	Location	Type of Hotspot	Description	Recommended Actions	Status	Cost	Priority
TT_HSI_68	Wicomico Co. Roads Division HQ	Vehicle Operations, Outdoor Material Storage	County's Road Division Headquarters, where equipment and trucks are stored and maintained, also contains covered fueling station	Schedule a review of the SWPPP, pollution prevention training for employees, provide additional cover for outdoor materials, implement retrofit project.	Potential	$	High
TT_HSI_67	Wicomico Co. Solid Waste Recycling Yard	Vehicle Operations, Waste Management	County transfer station for household recyclable materials as well as the depot for organic waste.	Check on NPDES status, schedule a review of the SWPPP; Pollution prevention training for employees; Implement wash pond retrofit	Confirmed	$$$	High
TT_HSI_66	Salisbury Municipal Yard	Vehicle Operations/Waste Management	City's municipal yard where they store trucks and equipment. They also store construction materials and bulk waste that they collect from the ROW	Check on NPDES status, schedule a review of the SWPPP, suggest follow-up inspection; Pollution prevention training for employees	Confirmed	$$	High
TT_HSI_22B	PASCO (1121 South Salisbury Boulevard)	Outdoor Material, Waste Management	Storing car batteries outside on wooden pallets	Suggest follow-up on-site inspection and discuss proper car battery storage	Confirmed	$	High
TT_HSI_22A	1147 University Square	Outdoor Material Storage, Waste Management	Poor trash management at the site; trash on the ground around dumpster; two dumpsters in standing water; 50 gallon drum was full, with open top, unlabeled, and rusting	Schedule a review of stormwater pollution prevention plan; follow up site inspection; discuss proper waste management and potential to move dumpsters out of standing water or move water away from area	Severe	$	High
TT_HSI_21	Salisbury University	Outdoor Material Storage	Compost/mulch pile is uncovered and drains to storm drain	Schedule a review of stormwater pollution prevention plan; follow up site inspection; discuss using berm to manage storm flows	Confirmed	$	High

Unified Stream Assessment

Twenty-two stream reaches were assessed in the Tony Tank subwatershed. Field crews were only able to assess streams from public properties and right-of-ways so assessments are not complete or necessarily indicative of the entire stream reach. In addition, assessments were limited amount by the amount of time available vs the size of the subwatershed and total lengths of streams. Contrary to the South Prong assessment however, a boat was made available by the Coast Guard Auxiliary group and the entire Tony Tank portion of the Wicomico mainstem was able to be assessed in this manner.

Five reaches that were assessed had no observable baseflow. These reaches were mostly in the headwaters and were marked as blue line streams in the GIS system, however, they appear to be intermittent streams. These dry stream reaches were not assessed using the USA protocol due to time constraints. In addition, one identified blue line stream was actually a wetland and not assessed using the USA protocols.

An overall quantitative score for each reach was assigned based on average physical condition of various in-stream and riparian parameters (i.e. diversity of instream habitat, floodplain connectivity, vegetative buffer width, etc.). These scores were used to classify stream reaches into condition categories ranging from *excellent* to *very poor* (Table 4. 19).

The best reach score in the study area was TT_RCH18, which scored 143 points. This can be considered a representative score for the best attainable condition for a reach within the watershed. A score of at least 89% or greater than this number (≥127) is considered comparable to the reference condition and represents excellent stream conditions for the watershed. A score less than 19% (≤65 pts) of the reference score is considered very poor. Between these two extremes, 46% of the reference score (66≥101 pts) represents poor stream conditions, 71% of the reference score (102≥115 pts) represents fair stream conditions, and 81% of the reference score (116≥126 pts) represents good stream conditions.

Table 4. 19. Stream Reach Scoring Criteria

Classification	Percentile	Point Threshold
Excellent	89%	≥127
Good	81%	116 ≥126
Fair	71%	102 ≥115
Poor	46%	66 ≥ 101
Very Poor	19%	≤ 65

While these criteria serve to place the assessed reaches in context, they are somewhat subjective. A reach scoring a few points higher than another may be placed in a higher category, but the qualitative aspects of the method make differences of a few points insignificant. Maps of the stream reaches assessed and the observed impacts can be found in Appendix C.

(a) (b) (c)

Figure 4. 17. (a) RCH_33 - "excellent reach;" (b) trash in RCH_37 - "poor" reach; and (c) "fair" tidal RCH_26

A total of 22 stream reaches were assessed in the Tony Tank subwatershed. Three reaches were assessed as excellent, three were assessed as good, three were assessed as fair, six were assessed as poor and one was assessed as very poor. Stream reaches scoring low had problems with buffer encroachment, eutrophication, sedimentation, and trash. Reach 46 begins in downtown Salisbury at the confluence of the North and South Prongs. This reach is in very poor condition with significant impacts from industry, a marina, parking lots, commercial and residential development. Chesapeake Shipbuilders is a significant hotspot and no buffer is provided between their operations and the river. Stream reaches scoring higher had favorable habitat conditions, large, intact buffers, wetland habitat and river access to the floodplain.

A summary of notable restoration opportunities and stream impacts observed in the stream reaches are presented in Table 4. 20. A complete list of the stream reaches assessed and the stream impacts observed can be found in Appendix E. Five high priority and seventeen medium priority opportunities to restore the riparian corridor in the Tony Tank subwatershed were identified. Specific techniques prescribed to these locations include buffer planting, invasive plant removal, fish barrier removal and discharge inspection.

Table 4. 20. Summary of Noted Stream Improvement Opportunities and Impacts

Impact Type	Site Description
Stream Buffer Restoration	• Impacted buffer identified along 30,866 linear feet of stream (5.8 miles) • Widespread invasives impacting buffer (TTIB36_1) • Wetland restoration through removal of invasive Phragmites at Pemberton Park (TTIB48_1) could be coupled with high priority stormwater retrofit projects (TT_RRI41A and TT_RRI_41B) • Conservation landscaping and / or living shoreline opportunities identified throughout
Channel Modification	• One channel modification identified (TTCM13_1) near Canal Woods development. Area requires further study to determine if relief points can be added to deter localized flooding.

Table 4. 20. Summary of Noted Stream Improvement Opportunities and Impacts	
Impact Type	**Site Description**
Stream Crossing	• Under-sized culverts acting as grade control and partial to full fish barriers[7] (TTSC36_1, TTSC30_1, TTSC43_1 and TTSC44_1). Four dams identified but more noted on aerial photography.
Discharge Investigation	• TTOT39_1B[8], TTOT39_1a and poor pool quality at TTOT36_1c (may indicate an intermittent discharge)
Trash	• Trash clean-up (TTTR36_1 and TTTR40_1)
Other	• Poor water quality at Colbourne Mill Pond. Deliver workshops to local residents on septic maintenance. Consider opportunities for fountains/aeration and/or floating treatment wetlands to absorb nutrients.

As noted above, five high priority stream opportunities were identified (Table 4. 21). On the Wicomico mainstem, Chesapeake Shipbuilders is a severe hotspot (see *Hotspot site Investigation* above) that drains to the critical area as well as high priority protection areas. Residential areas on the opposite bank have managed lawns to the edge of the bank and opportunities for adding buffer and/or living shorelines should be explored with these landowners. The Canal Woods Park development is surrounded by the river on three sides and flooding has been noted by the City in this area. Opportunities to reduce flooding in this development were beyond the scope of this study by the City and neighborhood may wish to explore the potential to offer relief points either upstream of the development or under Route 13. Other restoration opportunities noted in the development include buffer enhancement on the north and south sides of the development. In addition, wetland benches could be added instream on the south side of the development to add complexity, refugia and nutrient absorption. A stormwater retrofit was identified as well (TT_RRI_75b). Several stream opportunities were noted near the intersection of Rose St and Delaware Ave. The stream in this location is degraded and ample opportunities are present to involve the local neighbors in trash clean up and buffer restoration. In addition, erosion was noted around an outfall and an outfall stabilization project could be added to the overall effort.

Table 4. 21. Priority Stream Opportunities in the Tony Tank Subwatershed						
Reach ID	**Site ID**	**Location**	**Impact**	**Opportunity**	**Cost**	**Priority**
TT_RCH46	TTIB46_1	Mainstem Wicomico from downtown Salisbury to edge of natural gas facility	Impacted Buffer	Buffer enhancement / hotspot management	$$$	High
TT_RCH13	TTIB13_1	Canal Woods Park	Impacted Buffer	Buffer enhancement / wetland benches	$$	High

[7] Additional research is needed to determine what fish species of concern may, if at all, be impacted by these barriers. Maryland Department of Natural Resources should be contacted for more information.
[8] Reported to the City of Salisbury on 10/24/2012. Resolution unknown.

Table 4. 21. Priority Stream Opportunities in the Tony Tank Subwatershed						
Reach ID	**Site ID**	**Location**	**Impact**	**Opportunity**	**Cost**	**Priority**
TT_RCH36	TTIB36_1	Rose St and south	Impacted Buffer	Buffer enhancement	$	High
TT_RCH5	TTIB5_1	Colbourne Mill Pond	Impacted Buffer	Buffer enhancement	$$	High
TT_RCH36	TTTR36_1	Rose St	Trash	Trash clean-up	$	High

(a) **(b)** **(c)**

Figure 4. 18. (a) Hotspot operation and impacted buffer (IB46-1); (b) impacted buffer in Canal Woods development (IBI3_1) and (c) opportunity to engage local neighbors in a volunteer trash clean-up (TR36_1)

Protection Opportunities in Tony Tank Subwatershed

Using the process identified above in Section 4.1.5, several high priority areas (1,535 acres) were identified for protection; these areas are shown in Figure 4. 19. Two large areas were identified as high priority protection areas (#1 and #2) and two smaller areas (#3 and #4; 2,291 acres). Area # 1 is in the vicinity of Pemberton Park, a County park where a number of projects were identified above. These projects are particularly important because they will help to area maintain overall ecological integrity. 2,921 acres were identified as priority protection areas.

GIS was used to identify the acres of protection area that are not currently protected via the State, municipalities, easements or other means. This analysis identified 1,305 acres of high priority land (85% of the originally identified area) to be protected and 2,125 acres of priority land (73% of the originally identified area) to be protected.

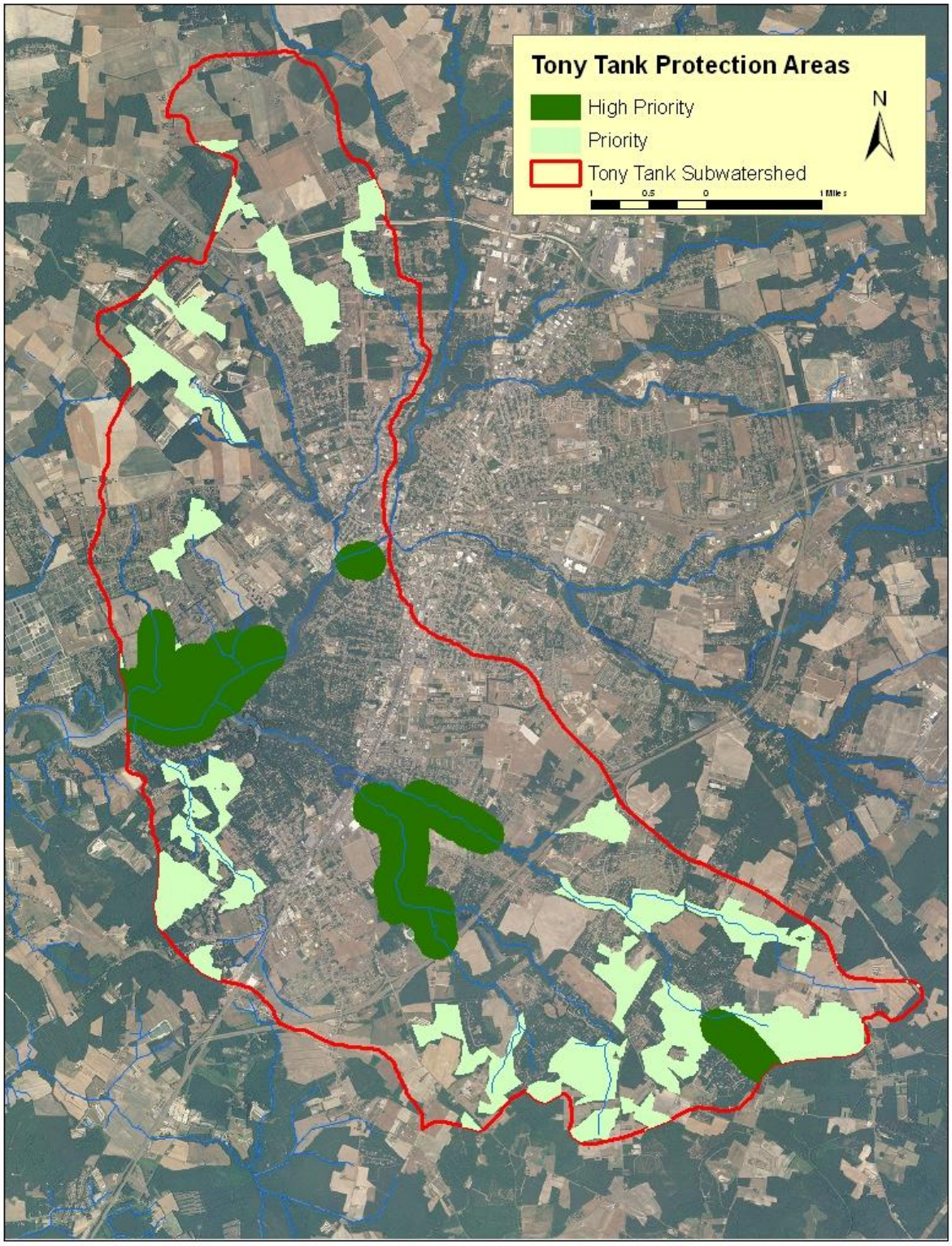

Figure 4. 19. Priority areas for protection in the Tony Tank subwatershed

SECTION 5. ACTION PLAN

5.1. Watershed Restoration Action Strategies

Watershed restoration strategies for the South Prong and Tony Tank Subwatersheds are presented below:

1. *Transition the Core Team into a long term management structure*.

During the planning process, the Core Team served as a means of providing input into the watershed planning process that includes input on goals, objectives, assessing watershed conditions and determining watershed priorities. As the focus moves towards implementation, the Core Team should shift towards a role of long term implementation of the plan. As a group, the Core Team should encourage formal adoption of the watershed plan by each jurisdiction. In addition, the Core Team should consider hiring a full-time staff person who would oversee implementation of the plan. This staff person would most likely be employed by Wicomico County, the Wicomico Environmental Trust or the City of Salisbury, as determined most appropriate by the Core Team and hosting agency/organization.

2. Prevent further degradation in the subwatersheds by implementing protection efforts.

Priority protection areas were identified through a desktop assessment and field checked with stream assessments. To prevent further degradation of the subwatersheds and downstream water quality, it is important that these areas remain protected from development and urban/suburban encroachment. These priority areas were identified due to the presence of important ecological areas that support sensitive species and their location near existing protected areas. The Lower Shore Land Trust (LSLT) is a local organization that works with landowners to identify the best means to protect properties and can be contacted to assist in protection of these priority areas. Three high priority areas were identified for protection (1,558 acres) in the South Prong and several high priority areas (1,535 acres) were identified in Tony Tank. Protecting these areas will help to maintain connectivity and important ecological "hubs" such as the Nassawango Creek preserve owned by The Nature Conservancy and Pemberton Park. For agricultural preservation efforts, the County should become re-certified with the Maryland Agricultural Land Preservation Foundation.

The County and City should consider passing a 100 foot stream buffer regulation to protect the existing intact stream buffers on both intermittent and perennial streams. Currently only a 50 foot stream buffer on blue line perennial streams is provided through a level of review under the Forest Conservation Act. Stream buffers function to reduce the impacts from land development including stabilizing banks, providing organic matter for aquatic life, filtering nutrients, providing habitat and attenuating flood water (Wenger, 1999).

The Wicomico Watershed is located in the critical sea level rise area as identified in the Maryland Sea Level rise plan. Wicomico County has 34.3 square miles of vulnerable land and Somerset has 126.8 square miles (Nuckols et al., 2010). Two-foot and two-to-five inundation levels were reviewed for this study. Two-foot inundations were negligible for the South Prong and indicated 7 acres for Tony Tank. Two-to-five foot inundations indicated 24 acres of

inundation for the South Prong and 166 acres for Tony Tank. To mitigate these effects, a large amount of wetland and stream buffers should be protected as they will recede inland gradually as the sea level rises.

3. *Implement pollution prevention measures at municipal and private sites, including employee training.*

During the hotspot assessment, forty-four hotspot sites were assessed in the subwatersheds. Eights sites were identified as severe hotspots, twelve as confirmed hotspots and three as potential hotspots. Stormwater pollution prevention plans should be reviewed, enforced and updated at severe sites. Some hotspot sites were municipal sites and employee training should be conducted to ensure compliance with the MS4 permit. The City should also review the illicit discharge ordinance to ensure adequate enforcement measures are in place for staff. Pollution prevention education should be conducted at hotspot sites to focus on: municipal pollution prevention and good housekeeping procedures, outdoor commercial vehicle washing, lack of secondary containment, leaking dumpsters and the zoo exhibit that has direct interaction with the water. Appendices D & E identify the hotspot locations.

4. *Encourage pollution prevention practices as well as tree planting and landscape management in residential neighborhoods.*

Stormdrain inlet marking or stenciling was noted as absent in the majority of neighborhoods. In addition, organic matter and sediment was observed in the street and storm drain network in several neighborhoods. Opportunities exist in neighborhoods to educate homeowners on removing debris from roadways. In addition, the City and County should consider increasing the frequency of leaf pick up and street sweeping. Highly fertilized lawns were mainly identified in the multifamily neighborhoods. Education should be provided to the maintenance company on proper lawn fertilization. In addition, very little tree canopy was observed in several neighborhoods presenting an opportunity for increased tree plantings. Appendices D & E identify high priority neighborhoods.

5. *Plant trees watershed-wide to increase tree canopy*

Trees improve water and air quality, provide recreational opportunities, wildlife habitat, strengthen local economies, and are a cost effective nutrient reduction strategy. In addition, this recommendation will assist with meeting the urban tree canopy goal and can be implemented in the urban tree canopy implementation plan. This strategy will help meet the tree planting goals in the current City and County Watershed Implementation Plans (WIPs) of 50,000 and 250,000 trees, respectively. Several opportunities for tree planting were identified in neighborhoods (strategy 6), schools, and along streams as buffers. Tree planting is a very cost effective restoration action that provides multiple benefits, including ecological, economic and quality of life benefits – protecting air and water quality, reducing energy costs, increasing property values and beautifying neighborhoods and highways. Altogether, 174.6 acres of tree planting opportunities were identified in the subwatersheds. Location of tree planting opportunities can be found in Appendices B & C.

6. Implement high priority stormwater retrofit practices, particularly educational/demonstration projects.

Stormwater retrofits targeting nutrient and pathogen removal are priorities. Retrofits designed to control volume and protect channels from erosive flows are also critical in the watershed. Many opportunities for providing stormwater treatment through various practices were identified in the South Prong at the Parkside High School, Ward Museum, Wicomico Middle School, Prince Street School, public lots in downtown Salisbury and at other parks and public places such as the Salisbury Zoo and Courthouse. Many opportunities for providing stormwater treatment through bioretention and other practices were identified in the Tony Tank at Pemberton Park, Salisbury Middle School, municipally-owned sites and neighborhoods such as Georgia Ave Apartments, Pinebluff Village, etc. High priority retrofit projects were identified (Table 4. 16).

Municipal owned parks and County schools are great places for demonstration stormwater retrofit practices because of the educational component associated with the projects. There is an opportunity to incorporate stormwater and the environment into the school science curriculum that will teach students about water quality. Several opportunities were present at parks and schools to disconnect downspouts or treat rooftop runoff into a rain garden or bioretention system (Appendix D & E). The Wicomico Environmental Trust is engaging schools in environmental activities and restoration.

Staff from the City of Salisbury noted that several municipal parking lots near downtown will be redeveloped. These parking lots present stormwater management opportunities during the redevelopment process as required in the Maryland stormwater design manual. Table x provides a list of parking lots where projects were identified.

7. Implement priority stream improvement projects.

A number of buffer planting, invasive plant removal of Japanese knotweed (*Fallopia japonica),* natural channel design and discharge inspection projects were identified throughout the subwatersheds to help stabilize eroding stream channels, enhance vegetated riparian buffers, and remove polluted discharges from entering the streams. In the South Prong, 18,057 linear feet of impacted buffer, 5,987 linear feet of channel modification, 54 linear feet of erosion and one illicit discharges to investigate. In the Tony Tank, 30,866 linear feet of impacted buffer, 342 linear feet of channel modification, 202 linear feet of erosion, and three illicit discharges to investigate.

Buffer planting and invasive plant species management projects (knotweed and Phragmites) require planning prior to implementation and stream repair projects will require additional design work and potential coordination with upstream retrofits. Due to the prevalence of invasive plants throughout the watershed, integrating their management with priority buffer reforestation projects will be critical to success. In addition, a feasibility study for a large water quality demonstration project is recommended to determine the most effective options at SC301, located west of the zoo on the mainstem of the South Prong. This location is very visible, providing for ample education opportunities, and has the potential to treat a portion of

the entire South Prong subwatershed. Priority stream projects are identified in Table Appendix D & E.

Living shorelines are a natural bank stabilization technique that utilize a variety of structural and organic materials, such as wetland plants, submerged aquatic vegetation, oyster reefs, coir fiber logs, sand fill and stone. They provide multiple benefits such as stabilization, habitat, protection and filtering of upland runoff. Many opportunities for implementing living shorelines were apparent along the lakes as well as along the Wicomico River mainstem such as at the Cherry Hill development (IB48_1).

8. Investigate strategies for pond management

Nine impoundments were identified in the subwatersheds, five in the South Prong and four in Tony Tank[9]. Some of the more prominent ponds in the subwatersheds include Parker Pond, Schumaker Pond, Tony Tank Lake and Colbourne Mill Pond, among others. The ponds exhibit eutrophication most likely from phosphorus loading from failing septics, geese and stormwater runoff. The ponds are typically dominated by aquatic weeds due to the shallow depth. Further investigation should be conducted on the ecological factors that sustain and reinforce dense populations of aquatic weeds. Efforts for pond management should be coordinated with septic efforts (Strategy 10). Several pond management approaches are outlined in Section 2.2.3.

9. Minimize the creation of impervious surfaces during the development review process

The County and City subdivision and land development ordinances dictate the creation of impervious surfaces and the protection of natural resources during the development process. The County and City should provide a review of their development codes and ordinances to encourage the use of innovative stormwater management practices (e.g. cisterns, bioretention), reduce the amount of impervious cover created (e.g. parking lot requirements) and protect natural resources (e.g. require tree protection standards). This review can be accomplished using the Code and Ordinance Worksheet available for free at www.cwp.org.

10. Educate homeowners regarding advanced nutrient removal septic systems and connect failing septic systems to the sewer system as per the County's Water and Sewerage Plan (2010).

Although, septic systems were not assessed as part of this study, according to the MAST, there are approximately 23,200 individual on-site sewerage disposal systems (OSDSs) within the County systems. Septic systems are problematic as they do not provide adequate removal of nitrogen and are often not properly maintained or pumped out. The County currently uses Bay Restoration Funds to upgrade ~50 OSDSs per year to the best available technology that provides enhanced nitrogen removal. This program should be continued, and increased if additional funding is made available through the State. Proper maintenance of septic systems, particularly pumping every 3-5 years, can result in water quality benefits. Finally, failing septic systems should be connected to the sewer system where possible to be treated at the wastewater treatment plant.

[9] More impoundments in the Tony Tank are visible from aerial photography but there were not assessed in the field.

11. Track and monitor the implementation progress

The Core Team should develop an approach to monitoring implementation activities that includes project monitoring, sentinel station monitoring, and project tracking. Project monitoring should be geared towards quantitative measures of success for both structural and non-structural management and restoration practices (i.e., stormwater retrofits, stream repair projects, etc.). Monitoring methods will depend upon the project, but can involve pre and post biological sampling and cross sections at stream repair projects, and simple accounting of disconnections performed as part of a discharge prevention program.

Continued monitoring through the Creekwatchers program should continue at existing stations throughout the watershed to investigate water quality conditions, the impact of potential barriers on in-stream biology, and long term trends. Trend monitoring is the best way to determine if stream conditions are improving, watershed goals are being met, and progress towards meeting regulatory requirements is being made.

Managing the delivery of a large group of restoration projects within the watershed can be a complex enterprise. Therefore, it is a good idea to create a master project spreadsheet linked to a GIS system that tracks the status of individual projects through final design, permitting, construction, inspection, maintenance and performance monitoring. By tracking the delivery of restoration projects, lessons learned can be identified and implementation progress over time can be assessed, which in turn, helps explain future changes in water resource quality. Project tracking can also improve the delivery of future projects, and creates reports that can document implementation progress for key funders and stakeholders. The tracking system should account for all restoration practices undertaken in the watershed regardless of their type or size. The Core Team should determine a central entity for coordinating overall implementation; this will be linked to Strategy 1.

5.2 Implementation Planning and Costs

Implementation is by far the longest and most expensive step in the watershed management process. In fact, restoration and protection costs for a single suburban subwatershed can easily range in the million dollars depending on the extent of restoration and protection activities, number of jurisdictions involved, land costs, and other factors. Salaries, land acquisition and construction of projects often account for a majority of these costs. A minimum of twenty years is usually needed to design and construct all the necessary projects, which are normally handled in several annual "batches." Sustaining progress over time and adopting the plan as more experience is gained are vital aspects of implementation.

Presented below are planning partners, planning level costs, and phasing and resources for implementing watershed strategies. Table 5.3 provides a matrix of partners and their capacity and potential role for implementation of the plan. It should be noted that although the matrix indicates that Salisbury, Fruitland and County have the capacity for much of the project contract administration, they have limited staff resources available. In addition, to date there is an overall lack of resources available by the partners to fully implement the plan. Final determination of responsible parties for each strategy should be a discussion item at future Core Team meetings. Table 5. 1 provides the goals and objectives met and interim milestones for implementation of

each strategy. Table 5. 2 provides a draft implementation schedule and associated costs for implementing each short term, mid-term and long term actions. Table 5. 3 identifies the implementation parties and roles and capacity best suited for each party as identified at Core Team meeting 3.

The cumulative estimate for implementing the 11 strategies is approximately $1.7 million dollars over the short and mid-term (Table 5. 2). The largest component of these cost results from the estimated cost of acquiring conservation easements (Strategy 2) and implementing stormwater retrofit and stream projects (Strategy 6 & 7). Additional costs are associated with hiring a watershed coordinator and implementing pollution prevention measures and municipal and private sites. Costs associated with watershed strategy 2 alone are estimated at over $600,000 for the mid-term, which assume costs for conservation easements on 250 acres of land and will require the County to become re-certified with the state for the preservation of agricultural land.

Project costs represent only planning level estimates and were determined based on guidance provided in Schueler et al. (2007), Wright et al. (2005), Kitchell and Schueler (2004), King and Hagan (2011) and personal communication with Kate Patton of the Lower Shore Land Trust. These estimates should be adapted to include more appropriate local cost estimates where available. These cost estimates should be used to guide the County, the City, and other project partners in estimating annual operation and implementation budgets for the South Prong and Tony Tank subwatersheds. The implementation costs should be distributed across implementation partners, existing programs, and responsible property owners (i.e., the County, City, institutions, businesses, and landowners). Project costs and cost ranges associated with 177 individual watershed projects and 47 neighborhoods can be found in Appendices D and E. Some individual projects from these lists are incorporated into the implementation plan as examples. Project partners should consult the appendices to begin implementation of high priority projects and factor costs from the most feasible projects into the overall implementation strategy.

Table 5. 1. South Prong Implementation Strategy

Goals Met	Objectives Met	Strategy	Interim Milestones
All	All	1. Transition the Core Team into a long term management structure	• Each jurisdiction to formally adopt the plan • Hire a watershed coordinator • Meet monthly to discuss progress on strategies
1 2 3	1, 2 1-4 2, 3, 5	2. Prevent further degradation in the subwatershed by implementing protection efforts	• Work with the LSLT to protect parcels within the identified high priority areas • Establish a buffer protection ordinance • Enact protection measures for buffers and wetlands that will be inundated due to sea level rise
1	1,3,5	3. Implement pollution prevention measures at municipal and private sites, including employee training.	• Stormwater pollution prevention plans at potential, confirmed and severe hotspot sites enacted, reviewed and/or enforced • Pollution prevention and good housekeeping training provided to municipal employees

Table 5. 1. South Prong Implementation Strategy			
Goals Met	**Objectives Met**	**Strategy**	**Interim Milestones**
			• Illicit discharge ordinance reviewed and enforcement measures established, if needed • Commercial outdoor vehicle washing ceased • Secondary containment provided for outdoor and waste materials • Determine feasibility of moving zoo exhibits that have direct contact with the river
1 3	1,3 4	4. Encourage pollution prevention practices as well as tree planting and landscape management in residential neighborhoods	• Conduct 4 homeowner education events on pollution prevention • Conduct stormdrain marking in half of the neighborhoods • Conduct 4 educational events on proper maintenance of lawns as well as conservation landscaping • Hold 2 tree planting giveaways
1 3 4	1,2,3 2,4,5 1,2	5. Plant trees watershed-wide to increase tree canopy	• Develop a plan to meet tree canopy goal (see strategy 4, 7) • Plant trees along the stream where encroachment was noted
1 3 4	1,3,6 1,2 1,2	6. Implement high priority stormwater retrofit practices, particularly education/demonstration projects	• Install 2 retrofit projects • Install 2 projects at schools or parks
1 3	1,2 1,2,5	7. Implement priority stream improvement projects	• Continue to sample for potential illicit discharges as reported in CWP, 2011 • Implement feasibility study SP_SC301 • Implement top 2 projects
1 4	4 4	8. Investigate strategies for pond management	• Study the ecological factors that sustain and reinforce dense populations of aquatic weeds in priority ponds • Encourage the implementation of strategies to reduce nutrient inputs to the ponds (strategy 10)
1	5,6	9. Minimize the creation of impervious surfaces during the development review process	• Review the City and County development codes using the Codes and Ordinances Worksheet (CWP, 1998)
1 4	1,3	10. Educate homeowners regarding	• Provide septic maintenance workshops around ponds / lakes with dense weeds and

Table 5. 1. South Prong Implementation Strategy			
Goals Met	**Objectives Met**	**Strategy**	**Interim Milestones**
	1	advanced nutrient removal septic systems and connect failing septic systems to the sewer system as per the County's Water and Sewerage Plan (2010).	eutrophication • Lobby state for additional BRF funds
All	All	11. Track and monitor the implementation progress	• Continue to analyze Creekwatcher data to show annual trends. • Provide an annual report on the state of the river.

Table 5. 2. Implementation Actions and Costs*			
Strategy	**Short-Term Action (year 1)**	**Mid-Term Action (year 2-4)[1]**	**Long-Term Action (year 5+)[2]**
1. Transition the Core Team into a long term management structure	Assign responsible parties for each restoration strategy using this table as well as **Error! Reference source not found.** (20 hrs)	Find funding for support of Watershed Coordinator staff position (80 hrs =$2400).	Develop long-term work plan for Watershed Coordinator
	Determine most logical entity to host a Watershed Coordinator staff position (20 hrs)	Hire Watershed Coordinator ($35,000/yr/3 yrs)	Ensure that Coordinator actions are effectively directed to meet water quality and watershed restoration goals, which may change over time
	Determine specific roles and responsibilities for Watershed Coordinator (20 hrs)		Annual salary for Watershed coordinator
Strategy 1 Costs	$3,300	$109,400	$$$
2. Prevent further degradation in the subwatershed by implementing protection efforts	Consider passing a 100 foot stream buffer regulation for perennial, intermittent and ephemeral streams (200 hrs)	Adjust restoration and protection planning efforts to account for wetland and buffer migration (100 hrs).	Conduct outreach to landownersof high priority protection areas
	Promote the County's Rural Legacy program through outreach and eductaion to landowners, which can support conservation easements on forested and agricultural parcels (100 hrs)	Conduct outreach to landownersof high priority protection areas (200hr/yr/3 yrs)	Protect 50% of remaining high priority protection areas (1,132 total acres) and 10% of priority protection areas (403 total acres)[3]
	Promote sustainable management of forests through outreach and education to landowners (100 hrs)	Protect 10% of high priority protection areas (251 total acres)[3]	
	County to become re-certified with the MALPH program (40 hours)		
Strategy 2 Costs	$24,200	$615,549	$$$$

Table 5. 2. Implementation Actions and Costs*			
Strategy	**Short-Term Action (year 1)**	**Mid-Term Action (year 2-4)[1]**	**Long-Term Action (year 5+)[2]**
3. Implement pollution prevention measures at municipal and private sites, including employee training.	Conduct a full hotspot assessment of all municipal facilities (5 days for field work, 3 days to post process)	Provide education on pollution prevention to targeted businesses and implement stormwater retrofits and pollution source control measures (4 trainings/yr at 32 hrs/training/3 yrs)	Develop a *Business Stewardship Outreach Program* that engages the business community in watershed restoration
	Provide internal employee training to municipal employees regarding pollution prevention and good housekeeping practices (4 trainings/yr at 32 hrs/training)	Continue to provide employee training to municipal employees regarding pollution prevention and good housekeeping practices (2 trainings/yr at 15 hrs/training/3 yrs)	Implement BMPs on private facilities (TT_RRI_31, TT_RRI100c, SP_RRI_101)
	Ensure that an enforceable stormwater ordinance for preventing illicit discharges to the storm drain system is in place (320 hrs)	Implement 2 innovative BMPs on municipal properties as demonstration of good stewardship to the community (TT_RRI_55 & SP_RRI_1)	
Strategy 3 Costs	$28,160	$288,070	$$
4. Encourage pollution prevention practices as well as tree planting and landscape management in residential neighborhoods	Identify neighborhood leaders for community stewardship (12 hrs)	Expand the storm drain marking program into older neighborhood (6 trainings at 32 hrs/3 yrs)	Increase neighborhood tree canopy and encourage natural buffer regeneration at residences along stream corridors
	Develop educational materials for pollution prevention and source control (40 hrs)	Disconnect residential downspouts to allow for treatment and volume reduction of rooftop runoff (100 downspouts @ $50/downspout)	
	Encourage tree planting and landscape management in residential neighborhoods (40 hrs + 100 trees at $19/tree)	Develop a targeted residential education program to encompass the proper application of fertilizer and use of alternatives to grass lawns, trash education and promotion of recycling, stream buffer eductaion and conservation landscaping (3/4 FTE staff person)	

Table 5. 2. Implementation Actions and Costs*			
Strategy	**Short-Term Action (year 1)**	**Mid-Term Action (year 2-4)[1]**	**Long-Term Action (year 5+)[2]**
		Assess ditch restoration opportunities in neighborhoods as strategy to meet water quality goals (100 hrs)	
Strategy 4 Costs	$6,960	$63,680	$$
5. Plant trees watershed-wide to increase tree canopy	Determine responsible entities for implementing and maintaining tree planting projects (20 hours)	Establish a means of supporting community groups and schools to implement their own tree planting projects, including guidance on maintenance (60 hrs)	Assess status of meeting urban tree planting goals and revise implementation as needed
	Align tree planting projects identified in plan with urban tree canopy goals (20 hours)		
	Install some tree planting demonstration projects in highly visible areas (40 hrs each + 100 trees at $19/tree)		
		Plant 10% of identified tree planting projects (18 acres @ 100 trees/acre @ $19/tree)	Plant 60% of remaining tree planting projects
Strategy 5 Costs	$6,300	$37,500	$$$
6. Implement high priority stormwater retrofit practices, particularly educational / demonstration stormwater retrofit practices	Identify funding sources for retrofits (80 hrs)	Install educational/demonstration stormwater retrofit projects at schools and parks (SP_RRI_15a, SP_RRI_15b:, TT_RRI_48)	Expand the green school program to include additional institutions
	Modify, repair, and/or maintain existing stormwater management facilities to improve water quality performance[4]	Develop a green school program that includes reforestation, stormwater retrofits and pollution prevention (300 hrs)	Implement additional high priority stormwater retrofits (TT_RRI_41a, TT_RRI_41b, TT_RRI_74, SP_RRI_102b, SP_RRI_11)
	Engage the public through implementation of highly visible, low cost demonstration projects (SP_RRI_8b, SP_RRI_24)	Implement stormwater management into existing municipal parking lots during redevelopment (code changes: 200 hrs)	Continue to identify retrofit opportunities at schools, neighborhoods, commercial areas, and outfalls that do not

Table 5. 2. Implementation Actions and Costs*			
Strategy	**Short-Term Action (year 1)**	**Mid-Term Action (year 2-4)[1]**	**Long-Term Action (year 5+)[2]**
	Engage neighborhood residents in buffer planting project (TT_IB36_1)	Further assess opportunities in neighborhoods with little or no existing stormwater management (72 hrs)	have existing BMPs
Strategy 6 Costs	$21,900	$91,460	$$$
7. Implement priority stream improvement projects	Conduct quarterly stream clean-ups. (4 events/yr)	Implement additional high-priority stream projects, such as buffer restoration (SP_IB2101 and TT_IB36_1).	Incorporate new stream, data into GIS layers and use the data during development plan reviews
	Continue use of bag filters on outfalls and consider expansion of program ($20,000/net@5 nets + $5,000 maintenance costs)[5]	Update watershed mapping to account for and differentiate between perennial and intermittent streams. (40 hrs)	Continue to implement additional high-priority stream projects (SP_IB2601; TT_IB5_1; SP_IB_301).
	Continue implementation of illicit discharge outfall screening program ($25,000/year)[6]	Determine potential for Coast Guard auxiliary to assist with trash clean-ups in the lower watershed that can only be accessed by boat. (40 hrs)	Implement large demonstration project at SP_SC301
	Obtain grant funding to conduct feasibility study of large-scale water quality improvement project at SP_SC_301 (25 hrs)	Hold regular living shoreline and conservation landscape workshops. (4 events at 32 hrs/3yrs)	
	Educate the citizenry regarding invasive species like Japanese knotweed and their control (4 events at 15 hrs each)	Implement 1-2 fish barrier projects (TT_SC26_1)	
	Control Japanese knotweed invasion in the headwaters (SP_IB1701)	Implement feasibility study at SP_SC_301 ($35,000)	
	Conduct outreach to landowners on the river for living shoreline projects (4 events at 32 hrs each)		
Strategy 7 Costs	$149,315	$73,020	$$

Table 5. 2. Implementation Actions and Costs*			
Strategy	**Short-Term Action (year 1)**	**Mid-Term Action (year 2-4)[1]**	**Long-Term Action (year 5+)[2]**
8. Investigate strategies for pond management	Provide educational workshops to lakeside homeowners regarding neighborhood source control practices, septic system maintenance (strategy 9) and benefits of shoreline buffers. (4 events at 32 hrs each) Foster opportunities for residents to interact with lake systems where pollution problems are less of a concern. (4 events at 32 hrs each)	Comprehensive assessment of lakes in the watershed for future action based on pollution, aquatic weeds, flooding and other concerns (1200 hrs)	Implement actions identified in lake restoration assessments. (unknown cost)
Strategy 8 Costs	$14,080	$66,000	$$$$
9. Minimize the creation of impervious surfaces during the development review process.	Review the City and County development codes using the Codes and Ordinances Worksheet (COW) (60 hrs)	Implemented needed code revisions as determined by the COW (400 hrs)	Where possible, remove excess or unused impervious cover (SP_RRI_22; SP_RRI_100a; TT_RRI_48; TT_RRI_54b).
Strategy 9 Costs	$3,300	$22,000	$$
10. Educate homeowners regarding advanced nutrient removal septic systems and connect failing septic systems to the sewer system as per the County's Water and Sewerage Plan (2010).	Provide educational workshops on septic system maintenance (strategy 7) (4 events at 32 hrs each)	Provide educational workshops on septic system maintenance (strategy 7) (14 events at 32 hrs each)	Extend sanitary infrastructure to high priority lakes with adjacent septic systems
Strategy 10 Costs	$7,040	$24,640	$$$$
11. Track and monitor the implementation progress	Determine capacity limitations of local partners identified in Table X for implementation and identify ways to build capacity in needed areas (e.g. specific training) (40 hrs)	Revisit watershed plan and assess status (40 hrs)	Revise this plan as needed to reflect changes in watershed conditions and new priorities.

Table 5. 2. Implementation Actions and Costs*			
Strategy	**Short-Term Action (year 1)**	**Mid-Term Action (year 2-4)[1]**	**Long-Term Action (year 5+)[2]**
	Expand a Creekwatcher monitoring program by adding Total suspended solids as parameter (450 samples @ $15/sample = $6,750); conduct detailed synoptic survey of Tony Tank and South Prong ($2500); establish new station in Monie Bay and use as a reference site (40 hrs)	Provide continuing education regarding project maintenance to homeowners, HOAs, schools, municipalities, etc. (4 trainings at 32 hrs each/3 yrs)	
	Develop project tracking database in GIS and spreadsheets (40 hrs)		
Strategy 11 Costs	$15,850	$23,320	$
Sub Totals	**$280,405**	**$1,414,639**	
Grand Total (Short & Mid Term Only)	**$1,695,044**		

*Note: These cost estimates include staff time, materials, supplies, and construction costs where applicable. A $55 hourly rate was assumed in all calculations. Best professional judgment was used for staff time estimates, projects costs are from Appendices D and E. Other cost assumptions are documented with footnotes.

[1]Costs are calculated for three years within this category where noted, otherwise for one year. A range of 50-150% of estimated costs is provided to account for uncertainty.

[2]Costs are calculated for 10 years within this category where noted, otherwise for one year. Since these costs are so unpredictable for the long-term, and likely to change based on inflation and other unknown factors, best professional judgment was used to assign a relative value as such: "$"=$1,000-$10,000; "$$"=$10,000-$100,000; "$$$"=$100,000-$500,000; and "$$$$"=>$500,000.

[3]Protection costs based on $2,200/acre, 3% administrative fee to sponsor the project and 1.5% compliance fee.

[4]Funding a stormwater post-construction program depends on many factors. See "Managing Stormwater in Your Community: A Guide for Building an Effective Post-Construction Program" (Hirschman and Kosco, 2008) for more information and guidance on developing a budget.

[5]Costs from ongoing CWP Gross Solids project in Talbot County.

[6] Brown et al (2004).

Table 5. 3. Wicomico Watershed Restoration Implementation Parties															
	City / County Plan Dept.	County Public Works	City Public Works	County Schools	SU green groups	HOAs	Churches / Civic Assns	Business	Master Gardeners	WET	CBF	Creek watchers	LSLT	Exten-sion	DNR
Overall Organizational Assessment															
Financing	x	Through utility / grants	x					small amounts		x			x	x	funder
Design		x	x					x	small scale				small scale	x	
Construction		x	x					x							funder
Maintenance		Depends	x	x		x	x							Educa-tion regard-ing mainten -ance	
Monitoring		x	x							x		x			
Education & Outreach		x	x	x	x	x	x			x	x	x	x	x	
Technical Capacity Assessment															
Contract management		x	x							if needed				may help with	
Grant management		x	x							if needed			x	may help with	
BMP design		x	x										limited		x
BMP construction		x	x												funder
Tree planting & /or reforestation	Assess/ plan, not actual planting		x	x	x		x			x			x		

Table 5. 3. Wicomico Watershed Restoration Implementation Parties															
	City / County Plan Dept.	County Public Works	City Public Works	County Schools	SU green groups	HOAs	Churches / Civic Assns	Business	Master Gardeners	WET	CBF	Creek watchers	LSLT	Exten-sion	DNR
Land conservation	x												x		
GIS	x		x		x								x		
Volunteer recruitment						x				x	x		x		x
Development of educational materials (paper, social media other)					x					x	x			x	x
Provide volunteers				x	x	x	x	x		x		x			
Geographic Assessment															
Identify any geographic limitations		Public lands	Within City limits	Schools				Sites for projects							
Other Notes															
		Intereste d in projects that treat large drainage areas													

5.3 Monitoring Plan

The City, County, Wicomico Environmental Trust, and other watershed partners have a vested interest in measuring whether the projects they implement are successful. Success can be measured in a number of ways including direct improvements in watershed indicators (e.g. reduced pollutant loading or improved aquatic insect communities) or indirectly (e.g. number of rain gardens installed, number of volunteers, acres preserved).

The monitoring plan includes the assessment of individual watershed projects and the monitoring of stream indicators at sentinel monitoring stations in the Creekwatcher water quality monitoring program. Guidance on developing monitoring studies is provided in Law et al. (2008). Information can be input to a tracking system and then used to revise or improve the watershed plan over a five to ten year cycle. Each part of the monitoring plan is described below:

- *Project monitoring* at a small scale (reach or smaller) to illustrate benefits of individual restoration efforts. As stormwater retrofits, neighborhood and business pollution prevention and education strategies are implemented monitoring should be conducted to show effectiveness.

- *Sentinel station monitoring* to track long-term health and water quality trends. Sentinel monitoring stations are fixed, long-term monitoring stations which are established to measure trends in key indicators over many years. Sentinel monitoring is perhaps the best way to determine if conditions are changing in a subwatershed or watershed. The Creekwatcher program is an example of a sentinel monitoring program. Expansion of the Creekwatcher program to assess progress towards meeting goals identified in this Plan, may include: 1) adding total suspended solids to the list of parameters analyzed; 2) adding a Creekwatcher station in Monie Bay as reference site and because this is only subwatershed in the Wicomico without a representative station.

- *Repeat synoptic survey for the South Prong and add Tony Tank*. Maryland Department of the Environment conducted synoptic sampling of the South prong and North Prong subwatersheds in May, 2012. The data, however, seemed incomplete but it is recognized that this would be a useful approach to identifying nutrient hotspots in the watershed. The survey should be repeated and, once nutrient hotspot reaches are identified, actions and projects can be targeted for these areas.

- *Source Tracking* to better identify watershed pollutant loads. To date, no detailed sourcing studies have been completed in the watershed, so it is difficult to quantify load reductions that should be targeted. Project partners should conduct research to better identify sources of watershed impairment and target future watershed actions to address these sources.

5.4 Project Tracking

Managing the delivery of a large group of restoration projects within a subwatershed can be a complex task. Creating a master project spreadsheet linked to a GIS system can help track the status of individual projects through final design, permitting, construction, inspection, maintenance and any performance monitoring. For non-structural efforts, tracking systems will include measures such as number of stream clean-ups, residents educated, green schools and businesses created, acres of natural resources preserved, or number of dedicated volunteers. By tracking the delivery of watershed projects, implementation progress can be assessed over time, which in turn, helps explain future changes in stream quality. Project tracking can also improve the delivery of future projects, and creates reports that can document implementation progress for key funders and stakeholders.

The watershed coordinator will manage implementation tracking. This person will setup project information in spreadsheet/GIS format, and report on the status of implementation quarterly to the Core Team. The tracking system will account for all watershed practices undertaken in the subwatershed plan regardless of their type or size, and track the progress of outlined milestones.

5.5 Long Term Goals

Long-term goals have been set in the implementation strategy to mark progress to ensure the implementation of the *Plan* adheres to a schedule to meet the defined outcomes.

- Meet interim milestones from Table 5.2 for each strategy
- Reduce baseflow concentrations of nitrogen, phosphorus and bacteria at Creekwatcher monitoring stations to meet local and Chesapeake Bay TMDL reductions. Additional information is needed to better quantify bacteria loading and to develop implementation plans to address bacteria impairments.
- Track improvements in the stream water quality using the existing Creekwatcher monitoring sites. Evaluate at five years any improvements in trends that may have occurred due to implementation efforts.

After 5 years time, this *Plan* should be updated to include recent watershed developments and monitoring results.

REFERENCES

Brown, E., D. Caraco and R. Pitt. 2004. *Illicit Discharge Detection and Elimination: a guidance manual for program development and technical assessments*. Center for Watershed Protection and University of Alabama. EPA X-82907801-0.U.S. EPA Office of Wastewater Management, Washington, D.C.

Caraco, D. 2001. "Evaluating the Impact of Watershed Treatment." *Watershed Protection Techniques*. 3(4): 791-796.

Caraco, D. 2002. *The Watershed Treatment Model: Version 3.1*. U.S. Environmental Protection Agency, Region V. Center for Watershed Protection. Ellicott City, MD.

Center for Watershed Protection. 1998. Better Site Design: A Handbook for Changing Development Rules in Your Community. Center for Watershed Protection. Ellicott City, MD.

Center for Watershed Protection. 2011. Field Findings: Pollution Detection and Elimination in Salisbury, MD. Center for Watershed Protection, Ellicott City, MD.

Davenport, T. and Susan Kaynor. 2001. "In-Lake Treatment to Restore Urban Lakes." *Watershed Protection Techniques*. 3(4): 813-820.

Hall, Keith. "RE: Draft Characterization Report." E-mail to Lori Lilly. July 31, 2012.
Johnson, Zoe. 2000. Sea level rise response strategy for the state of Maryland. Maryland Department of Natural Resources, Annapolis, MD.

Hirschman, D. Collins, K., and Schueler, T. 2008. *Technical Memorandum: The Runoff Reduction Method*. Center for Watershed Protection. Ellicott City, MD.

Hirschman, D., and J. Kosco. 2008. *Managing Stormwater in Your Community. A Guide for Building an Effective Post-Construction Program.* EPA Publication No 833-R-08-001. Center for Watershed Protection, Ellicott City, MD.

Johnson, Zoe Pfahl. 2000. A Sea Level Response Strategy for the State of Maryland. Maryland Department of Natural Resources, Coastal Management Division, Annapolis, MD

King, D. and Hagan, P. 2011. Costs of Stormwater Management Practices In Maryland Counties. Technical Report Series No. TS-626-11. University of Maryland Center for Environmental Science Chesapeake Biological Laboratory. Solomons, MD.

Kitchell, A. and T. Schueler. 2004. *Unified Stream Assessment: A User's manual. Manual 10 in the Urban Subwatershed Restoration Manual Series.* Center for Watershed Protection. Ellicott City, MD.

Law, N. L., Fraley-McNeal, L., Cappiella, K., and R. Pitt. 2008. *Monitoring to Demonstrate Environmental Results: Guidance to Develop Local Stormwater Monitoring Studies Using Six Example Study Designs.* Center for Watershed Protection, Ellicott City, MD.

Leatherman, S.P., R. Chalfont, E.C. Pendletong, T.L. McCandless, and S. Funderburk. 1995. Vanishing lands: Sea level, society and Chesapeake Bay. University of Maryland, Laboratory for Coastal Research, and the US Fish and Wildlife Service, Chesapeake Bay Field Office, Annapolis, MD.

Maryland Department of Natural Resources (MD DNR) Accessed April 2012a. Geospatial Data. http://dnrweb.dnr.state.md.us/gis/data/data.asp

Maryland Department of Natural Resources (MD DNR) Accessed May 2012c. BioNet – Biodiversity Conservation Network Metadata. ftp://dnrftp.dnr.state.md.us/public/SpatialData/LivingResources/Terrestrial/BioNet/BioNet.htm

Maryland Department of Business and Economic Development (MD BED). Brief Economic Facts: Wicomico County, Maryland. Accessed April 2012. http://choosemaryland.org/factsstats/Documents/briefeconomicfacts/WicomicoBef11.pdf

Maryland Department of the Environment (MDE). 2010. *Total Maximum Daily Loads of Fecal Coliform for the Restricted Shellfish Harvesting Area in Monie Bay in Somerset County, Maryland.* Submitted to USEPA, Region III.

Maryland Department of the Environment (MDE) Water Management Administration. 2009. *Maryland Stormwater Design Manual.* Baltimore, MD.

Maryland Department of the Environment (MDE). 2008. *Total Maximum Daily Loads of Fecal Coliform for the Restricted Shellfish Harvesting Area in the Lower Wicomico River Basin in Wicomico and Somerset Counties, Maryland.* Submitted to USEPA, Region III.

Maryland Department of the Environment (MDE). 2007. *Maryland Biological Stream Survey. Sampling Manual: Field Protocols.* Annapolis, Maryland.

Maryland Department of the Environment (MDE). 2006. *Total Maximum Daily Loads of Fecal Coliform for the Non-Tidal Wicomico River Headwaters Basin in Wicomico County, Maryland.* Submitted to USEPA, Region III.

Maryland Department of the Environment (MDE). 2004. *Water Quality Analyses of Fecal Coliform for Eight Basins in Maryland: Assawoman Bay, Sinepuxent Bay, Newport Bay, and Chincoteague Bay in Worcester County; Monie Bay in Somerset County; Kent Island Bay in Queen Anne's County; Rock Creek in Anne Arundel County; and Langford Creek in Kent County.* Submitted to USEPA, Region III.

Maryland Department of the Environment (MDE). 2001. *Total Maximum Daily Loads of Phosphorus and Sediments to Johnson Pond in the Upper Wicomico Watershed Wicomico County, Maryland.* Submitted to USEPA, Region III.

Maryland Department of the Environment (MDE). 2000a. *Total Maximum Daily Loads of Nitrogen and Phosphorus for the Wicomico Creek, Wicomico and Somerset Counties, Maryland.* Submitted to USEPA, Region III.

Maryland Department of the Environment (MDE). 2000b. *Total Maximum Daily Loads of Nitrogen and Phosphorus and Biochemical Oxygen Demand for the Lower Wicomico River, Wicomico and Somerset Counties, Maryland.* Submitted to USEPA, Region III.

Maryland Department of the Environment (MDE). 1999. *Total Maximum Daily Loads of Phosphorus and Sediments to Tony Tank Lake, Wicomico County, MD Maryland.* Submitted to USEPA, Region III.

National Estuarine Research Reserve System (NERRS). Accessed April 2012. http://www.nerrs.noaa.gov/NERRSReserve.aspx?ID=94&ResID=CBM
Salisbury University. Accessed April 2012. http://www.salisbury.edu/wicomicocreekwatchers/

Nuckols, W.H., P. Johnston, D. Hudgens, and J.G. Titus. 2010. "Maryland." In James G. Titus and Daniel Hudgens (editors). The Likelihood of Shore Protection along the Atlantic Coast of the United States. Volume 1: Mid-Atlantic. Report to the U.S. Environmental Protection Agency. Washington, D.C.

Schueler, T., Hirschman, D., Novotney, M., and J. Zielinski. 2007. *Urban Stormwater Retrofit Practices Version 1.0. Manual 3 in the Urban Subwatershed Restoration Manual Series*. Center for Watershed Protection. Ellicott City, MD.

Schueler, T. And Jon Simpson. 2001. "Why Urban Lakes Are Different." *Watershed Protection Techniques*. 3(4): 747-750.

Wenger, Seth. 1999. A Review of the Scientific Literature on Riparian Buffer Width, Extent, and Vegetation. Office of Publication Service and Outreach, Institute of Ecology, University of Georgia, Athens.

Wright, T., C. Swann, K. Cappiella, T. Schueler. 2005. *Unified Subwatershed and Site Reconnaissance: A User's Manual-Version 2.0. Manual 11 in the Urban Subwatershed Restoration Manual Series*. Center for Watershed Protection. Ellicott City, MD.

Appendix A – Watershed Characterization Report Appendices

A-A – Indices of Biological Integrity for the Wicomico Watershed

Table A1. Fish Index of Biological Integrity

Stream Name	Site ID	Year Sampled	BIBI Score	BIBI Ranking
Lower Wicomico River Watershed				
BEAVERADAM CREEK	WI-S-016-209-95	1995	ND	ND
[1]	WI-S-041-222-97	1997	ND	ND
BEAVERDAM CREEK	LOWI-113-R-2000	2000	2.00	Poor
BEAVERDAM CREEK	LOWI-205-B-2008	2008	2.00	Poor
BEAVERDAM CREEK	LOWI-209-B-2008	2008	1.67	Very Poor
COX BRANCH	WI-S-064-121-95	1995	ND	ND
HALLOWAY BRANCH	WI-S-041-202-97	1997	ND	ND
HORSEBRIDGE CREEK	LOWI-104-B-2008	2008	1.00	Very Poor
HORSEBRIDGE CREEK	LOWI-115-R-2009	2009	2.67	Poor
LEONARD POND RUN	WI-S-063-220-95	1995	3.33	Fair
LEONARD POND RUN	WI-S-075-206-95	1995	3.67	Fair
LITTLE BURNT BRANCH	WI-S-082-113-95	1995	4.00	Good
OWENS BRANCH	WI-S-073-114-95	1995	4.00	Good
OWENS BRANCH	WI-S-073-116-95	1995	ND	ND
ROCKAWALKIN CREEK	LOWI-103-R-2000	2000	2.67	Poor
SOUTH PRONG BEAVERDAM	LOWI-314-R-2009	2009	ND	ND
SOUTH PRONG WICOMICO RIVER	WI-S-016-211-95	1995	3.67	Fair
TONY TANK POND UT1	LOWI-104-R-2000	2000	4.00	Good
WARD BRANCH UT1	WI-S-017-119-95	1995	2.00	Poor

Stream Name	Site ID	Year Sampled	BIBI Score	BIBI Ranking
WHITE MARSH CREEK	LOWI-102-R-2000	2000	2.67	Poor
Wicomico Creek Watershed				
PASSERDYKE CREEK	SO-S-005-109-95	1995	3.00	Fair
Wicomico River Headwaters Watershed				
COMELLY MILL BRANCH	WIRH-220-S-2010	2010	3.67	Fair
FIGGS DITCH	WIRH-103-B-2009	2009	1.00	Very Poor
LEONARD POND RUN	WIRH-109-R-2000	2000	1.00	Very Poor
LEONARD POND RUN	WIRH-111-R-2000	2000	3.00	Fair
LITTLE BURNT BRANCH	WIRH-108-R-2000	2000	1.67	Very Poor
LEONARD POND RUN	WIRH-220-S-2000	2000	4.00	Good
LEONARD POND RUN	WIRH-220-S-2001	2001	3.67	Fair
LEONARD POND RUN	WIRH-220-S-2002	2002	3.67	Fair
LEONARD POND RUN	WIRH-220-S-2003	2003	3.33	Fair
LEONARD POND RUN	WIRH-220-S-2004	2004	3.33	Fair
LEONARD POND RUN	WIRH-220-S-2005	2005	3.33	Fair
LEONARD POND RUN	WIRH-220-S-2006	2006	3.67	Fair
LEONARD POND RUN	WIRH-220-S-2007	2007	4.00	Good
LEONARD POND RUN	WIRH-220-S-2008	2008	3.00	Fair
LEONARD POND RUN	WIRH-220-S-2009	2009	3.67	Fair
LEONARD POND RUN	WIRH-220-S-2011	2011	4.33	Good
MIDDLE NECK BRANCH	WIRH-215-R-2000	2000	3.33	Fair
MORRIS BRANCH	WIRH-114-R-2000	2000	1.86	Very Poor

Stream Name	Site ID	Year Sampled	BIBI Score	BIBI Ranking
MORRIS BRANCH	WIRH-104-B-2009	2009	1.33	Very Poor
PEGGY BRANCH	WIRH-102-B-2009	2009	3.33	Fair
PEGGY BRANCH	WIRH-102-B-2009	2009	3.33	Fair

[1] Stream name was not identified.

ND is defined as no data was available due to a dry stream.

Table A2. Index of Biological Integrity

Stream Name	Site ID	Year Sampled	BIBI Score	BIBI Ranking
Lower Wicomico River Watershed				
[1]	WI-S-041-222-97	1997	ND	ND
BEAVERDAM CREEK	WI-S-016-209-95	1995	ND	ND
BEAVERDAM CREEK	LOWI-113-R-2000	2000	1.57	Very Poor
BEAVERDAM CREEK	LOWI-205-B-2008	2008	2.14	Poor
BEAVERDAM CREEK	LOWI-209-B-2008	2008	3.57	Fair
COX BRANCH	WI-S-064-121-95	1995	ND	ND
HALLOWAY BRANCH	WI-S-041-202-97	1997	2.43	Poor
HORSEBRIDGE CREEK	LOWI-104-B-2008	2008	1.57	Very Poor
HORSEBRIDGE CREEK	LOWI-115-R-2009	2009	2.43	Poor
LEONARD POND RUN	WI-S-063-220-95	1995	4.43	Good
LEONARD POND RUN	WI-S-075-206-95	1995	2.43	Poor
LITTLE BURNT BRANCH	WI-S-082-113-95	1995	5.00	Good
OWENS BRANCH	WI-S-073-116-95	1995	ND	ND

Stream Name	Site ID	Year Sampled	BIBI Score	BIBI Ranking
OWENS BRANCH	WI-S-073-114-95	1995	2.43	Poor
ROCKAWALKIN CREEK	LOWI-103-R-2000	2000	2.43	Poor
SOUTH PRONG BEAVERDAM CREEK	LOWI-314-R-2009	2009	3.57	Fair
SOUTH PRONG WICOMICO RIVER	WI-S-016-211-95	1995	3.86	Fair
TONY TANK POND UT1	LOWI-104-R-2000	2000	3.86	Fair
WARD BRANCH UT1	WI-S-017-119-95	1995	1.86	Very Poor
WHITE MARSH CREEK	LOWI-102-R-2000	2000	2.43	Poor
Wicomico Creek				
PASSERDYKE CREEK	SO-S-005-109-95	1995	2.43	Poor
Wicomico River Headwaters				
[1]	WIRH-108-R-2000	2000	3.00	Fair
COMELLY MILL BRANCH	WIRH-220-S-2010	2010	3.57	Fair
FIGGS DITCH	WIRH-103-B-2009	2009	2.14	Poor
LEONARD POND RUN	WIRH-109-R-2000	2000	1.86	Very Poor
LEONARD POND RUN	WIRH-111-R-2000	2000	1.86	Very Poor
LEONARD POND RUN	WIRH-220-S-2000	2000	4.14	Good
LEONARD POND RUN	WIRH-220-S-2001	2001	4.71	Good
LEONARD POND RUN	WIRH-220-S-2002	2002	4.43	Good
LEONARD POND RUN	WIRH-220-S-2003	2003	4.14	Good
LEONARD POND RUN	WIRH-220-S-2004	2004	4.43	Good
LEONARD POND RUN	WIRH-220-S-2005	2005	4.71	Good

Stream Name	Site ID	Year Sampled	BIBI Score	BIBI Ranking
LEONARD POND RUN	WIRH-220-S-2006	2006	4.43	Good
LEONARD POND RUN	WIRH-220-S-2007	2007	4.71	Good
LEONARD POND RUN	WIRH-220-S-2008	2008	3.86	Fair
LEONARD POND RUN	WIRH-220-S-2009	2009	2.43	Poor
LEONARD POND RUN	WIRH-220-S-2011	2011	3.57	Fair
MIDDLE NECK BRANCH	WIRH-215-R-2000	2000	3.29	Fair
MORRIS BRANCH	WIRH-114-R-2000	2000	1.86	Very Poor
MORRIS BRANCH	WIRH-104-B-2009	2009	2.71	Poor
PEGGY BRANCH	WIRH-102-B-2009	2009	3.00	Fair

[1] Stream name was not identified.
ND is defined as no data was available due to a dry stream.

Appendix A – Watershed Characterization Report Appendices

A-B – Point Sources in the Wicomico Watershed

Jurisdiction	Facility Name	Type
Salisbury, MD	A G Atlantic Investments	Minor, General Permit Covered Facility
	Brick Kiln	Minor, General Permit Covered Facility
	Canal Woods Pools	Minor, General Permit Covered Facility
	Cato, Inc.	Minor, General Permit Covered Facility
	City of Salisbury Wastewater Treatment Plant	Minor, Associated Permit Record & Major, NPDES Individual Permit
	Delmarva Oil	Minor (Not Fed. Rep.), General Permit Covered Facility, NPDES Individual Permit
	Exxon Service Station #2-2288	Minor, General Permit Covered Facility
	Former Buddies Shell	Minor, General Permit Covered Facility
	Former Dresser Salisbury Facility	Minor, NPDES Individual Permit
	Herman's Arco-State Lead Site	Minor, General Permit Covered Facility
	Holly Center	Minor (Not Fed. Rep.), NPDES Individual Permit
	Lake Street Bulk Plant	Minor, General Permit Covered Facility
	Lewis Steel Property	Minor, General Permit Covered Facility
	Mid-Shore Family YMCA	Minor, General Permit Covered Facility
	Naylor Mill Road Regional Lift Station	Minor, NPDES Individual Permit
	Newland Park Landfill Borrow P	Minor, General Permit Covered Facility
	Nustar Terminals Operations Partnership L.P.	Minor, NPDES Individual Permit
	Oak Hill Townhouses	Minor, General Permit Covered Facility
	Paleo Well 2	Minor, General Permit Covered Facility
	Parkside Apartments Pool	Minor, General Permit Covered Facility
	Pemberton Manor Apartments	Minor, General Permit Covered Facility
	Perdue Farms	Major (Fed. Rep.), Major, NPDES Individual Permit, SQG
	Price Buick Pontiac	Minor, General Permit Covered Facility, SQG
	Salisbury Aggregate Terminal	Minor, General Permit Covered Facility
	Salisbury Christian School	Minor, General Permit Covered Facility
	Salisbury Elks Club #817	Minor, General Permit Covered Facility

Jurisdiction	Facility Name	Type
	Salisbury Portable Water Storage Tank	Minor, NPDES Individual Permit
	Sherwood Ford Lincoln Mercury	Minor, NPDES Individual Permit
	Sherwood of Salisbury Appearance Center	Minor, General Permit Covered Facility
	Sleep Inn	Minor, General Permit Covered Facility
	Steeplechase Water Works	Minor, General Permit Covered Facility
	Support Terminals OP.Partnersh	Minor, General Permit Covered Facility
	The Newland Park Municipal Solid Waste Landfill	Minor, NPDES Individual Permit
	Thoro Goods Concrete Co., Inc.	Minor, General Permit Covered Facility
	Village Down River Subdivision	Minor, General Permit Covered Facility
Fruitland, MD	Fruitland WWTP	Minor, NPDES Individual Permit
	Hearne-Meadow, LLC	Minor, NPDES Individual Permit
Delmar, MD	Delmar WWTP	Minor, NPDES Individual Permit
Eden, MD	Wicomico Yacht Club	Minor, General Permit Covered Facility
	Wikander Yacht Yard	Minor, General Permit Covered Facility

Appendix A – Watershed Characterization Report Appendices

A-C – Protection and Restoration Subwatershed Metric and Scoring Rules

Metric	Core Team Rank (Weight)[1]	Scoring Rules	Notes
Protection Subwatersheds			
%Impervious cover	2	>10%= 0 points 2-10%= 5 points <2% = 10 points	Indicates stream condition. Used quartiles from the NLCD impervious cover data to determine range.
% Forests and wetlands	2	>60%= 10 points 40-60%= 5 points 30-40%= 2 points <30%= 0 points	Used quartiles of the forests and wetlands from NLCD to determine range.
% important ecological areas	3	>80%= 10 points 60-80%= 5 points 40-60%= 2 points <40%= 0 points	Includes sensitive species areas, targeted ecological areas, forest interior dwelling species potential habitat, biodiversity conservation network, wetlands of special state concern, green infrastructure hubs and corridors, and critical areas.
Water quality monitoring exceedances	3	<2 samples>threshold= 10 points 2-10 samples>threshold = 5 points >10 samples>threshold = 0 points	From Creekwatcher Data
Development pressure	1	High = 10 points Moderate = 5 points Low or Very Low = 0 points	From CBP Vulnerability Analysis.
% Agricultural land	2	>35%= 10 points 30-35%= 5 points 25-30%= 2 points <25%= 0 points	Used quartiles of the crop and pasture land from NLCD to determine range.
% Protected land	1	>25% = 10 points 15-25%= 5 points 5-15%= 2 points <5%= 0 points	Protected land calculated from MD DNR protected land layers. Range determine from quartiles.

Restoration Subwatersheds			
%Impervious Cover	2	>10%= 10 points 2-10%= 5 points <2%= 0 points	Indicates retrofit potential.
Water quality monitoring exceedances	3	>10 samples>threshold= 10 points 2-10 samples>threshold = 5 points <2 samples>threshold = 0 points	From Creekwatcher Data
% public land (or institutional + parkland if ownership not available)	1	>20%= 10 points 10-20%= 5 points 5-10%= 2 points <5%= 0 points	Indicator of available space for projects. Determine based on quartiles.
Stream density	2	>2.5 miles/mi^2= 10 points 2.0-2.5 miles mi^2= 5 points 1.5-2.0 miles/mi^2 = 2 points <1.5 miles/mi^2= 0 points	Calculated from NHD - perennial, intermittent, artificial paths, canals/ditches Determined based on quartiles.
Stormwater BMP density	3	>2 ponds/mi^2= 10 points 1-2 ponds mi^2= 5 points <1 BMP/mi^2= 0 points	Indicator of stormwater retrofit opportunity. Determined based on quartiles.
Density of point sources	1	>0.3 PS/mi^2= 10 points 0.1-0.3 PS/mi^2 = 5 points <0.1 PS /mi^2= 0 points	Determined based on quartiles.

[1]The weights have been determined with input from the Core Team, and reflect how confident we are that a particular metric is a good indicator of protection or restoration status.

Appendix A – Watershed Characterization Report Appendices

A-D – Subwatershed Restoration and Protection Final Scores

		Monie Bay[2]	Wicomico Creek	South Prong Wicomico River	Ellis Bay Wicomico River	Shiles Creek Wicomico River	Tonytank Creek Wicomico River	North Prong Wicomico River
Metric	Weight	Score	Score	Score	Score	Score	Score	Score
Impervious Cover[1]	2	10	10	0	10	10	0	5
% Forests and Wetlands[1]	2	10	5	2	10	5	0	2
% Important Ecological Areas[1]	3	10	10	0	10	5	0	2
Water Quality Monitoring Exceedences	3	10	10	0	10	10	5	0
Development Pressure	1	5	10	10	0	10	10	10
% Agricultural Land[1]	2	0	5	5	0	10	5	5
% Protected Land[1]	1	10	5	0	10	2	0	2
Total Protection Score		**115**	**115**	**24**	**110**	**107**	**35**	**42**
% Impervious Cover[1]	2	0	0	10	0	0	10	5
Water Quality Monitoring Exceedences	3	0	0	10	0	0	5	10
% Public Land	1	10	0	5	10	0	2	0
Stream Density	2	10	10	0	10	5	0	0
Stormwater BMP Density[3]	3	0	0	10	0	5	10	10
Density of Point Sources	1	0	0	10	0	0	10	5
Total Restoration Score		**30**	**20**	**95**	**30**	**25**	**77**	**75**

Appendix B – South Prong Subwatershed Site Location Maps

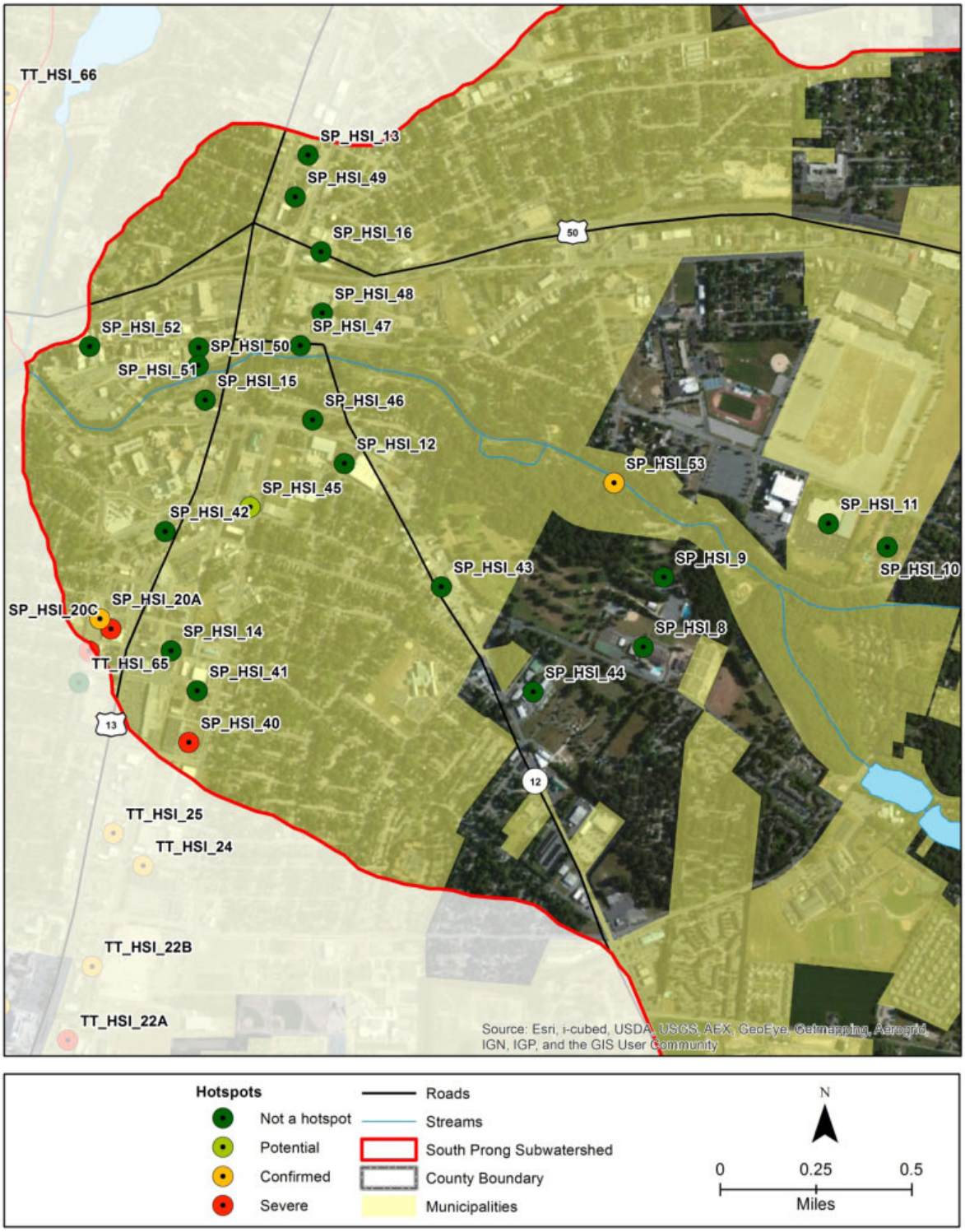

Figure B-1. Hotspot sites in the South Prong subwatershed

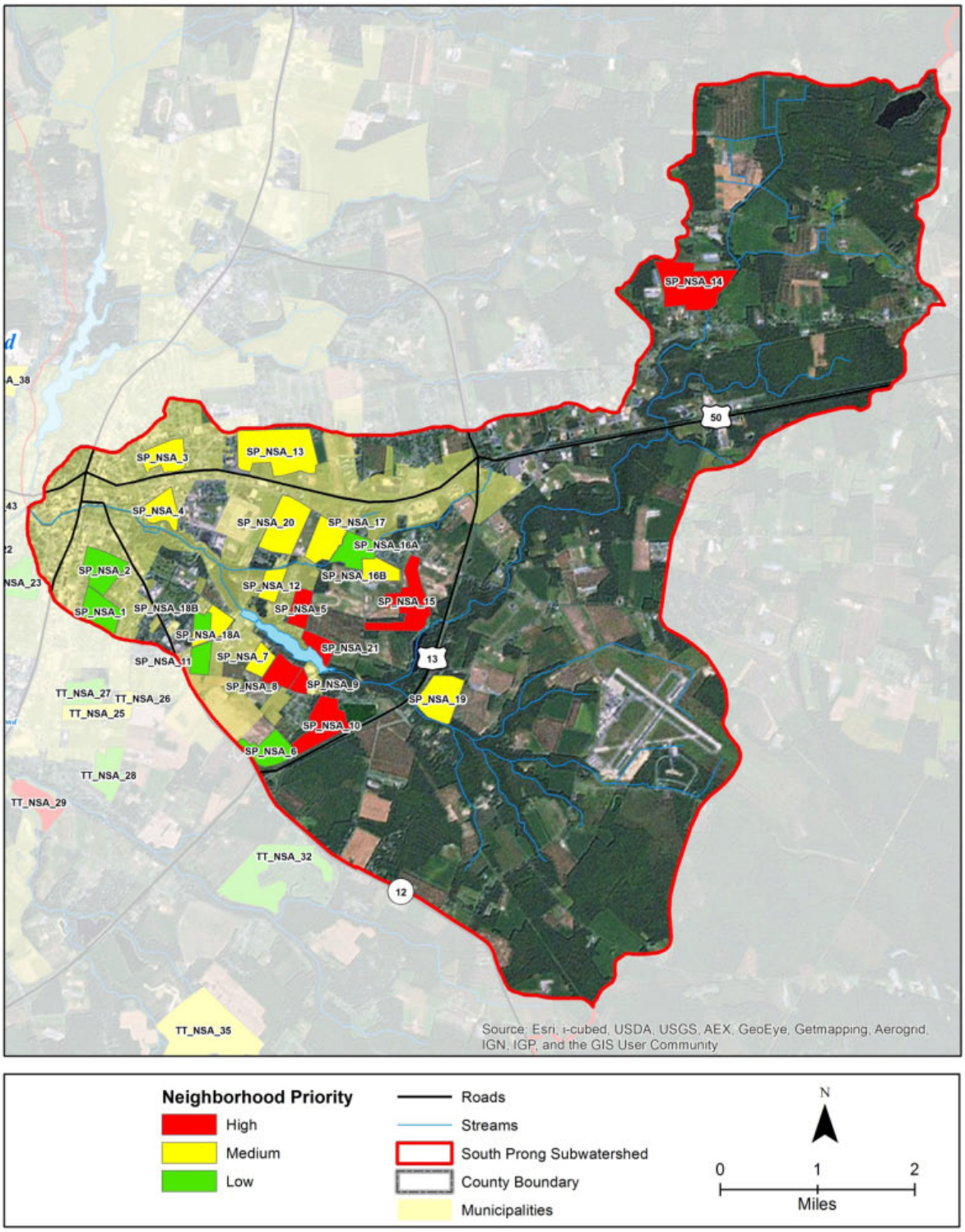

Figure B-2. Neighborhood source control opportunities in the South Prong subwatershed

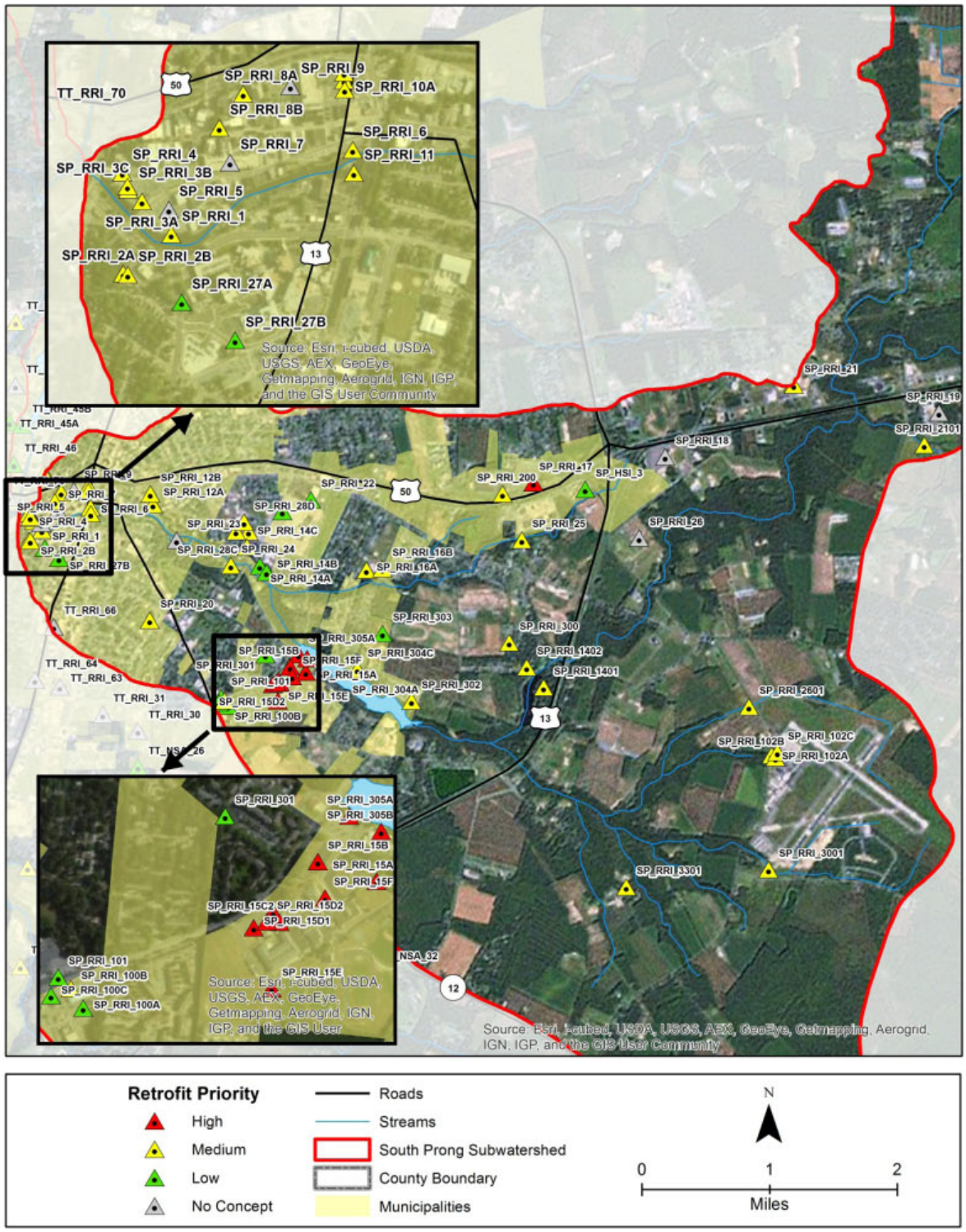

Figure B-3. Stormwater retrofit opportunities in the South Prong subwatershed

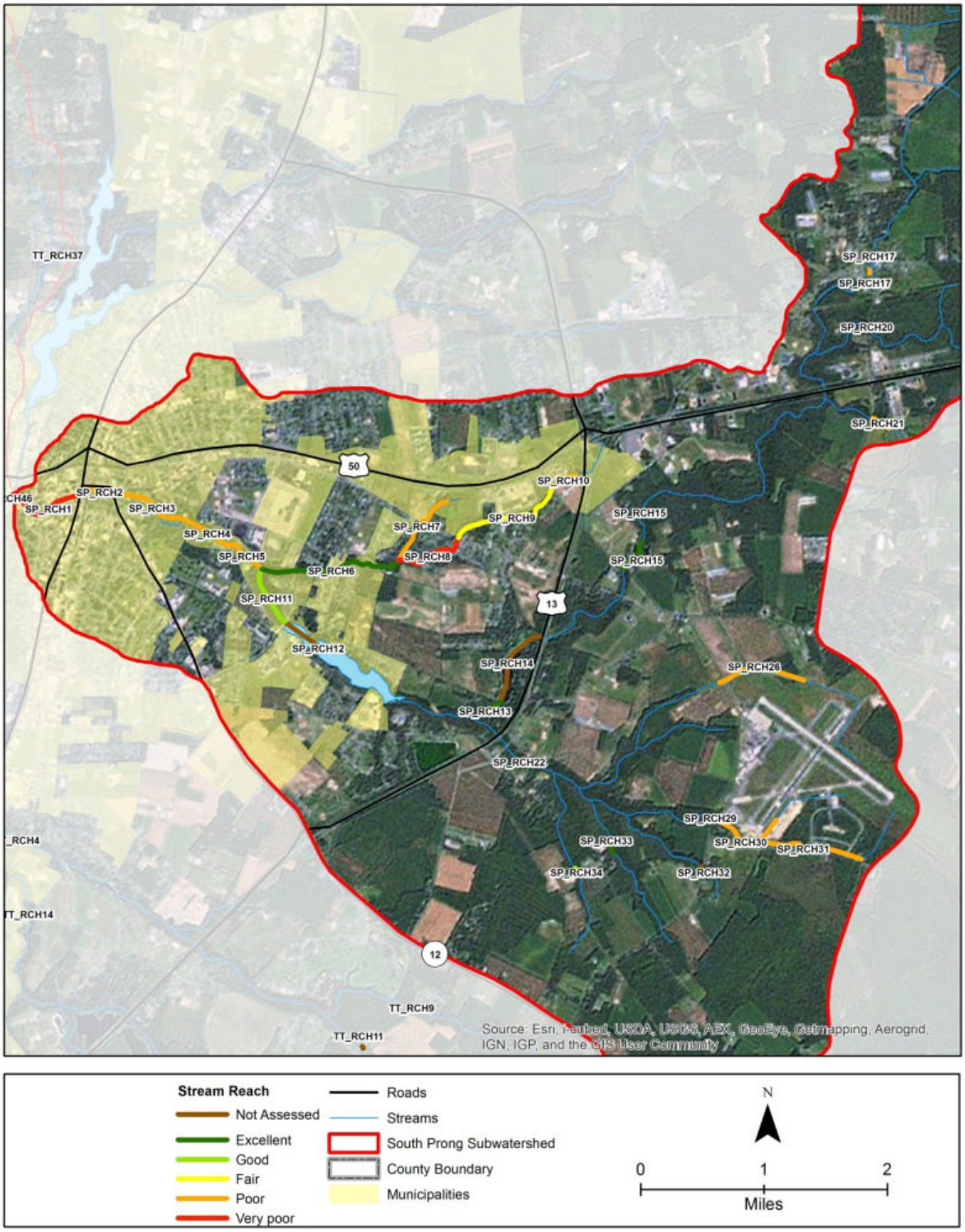

Figure B-4. Stream reaches assessed in the South Prong subwatershed

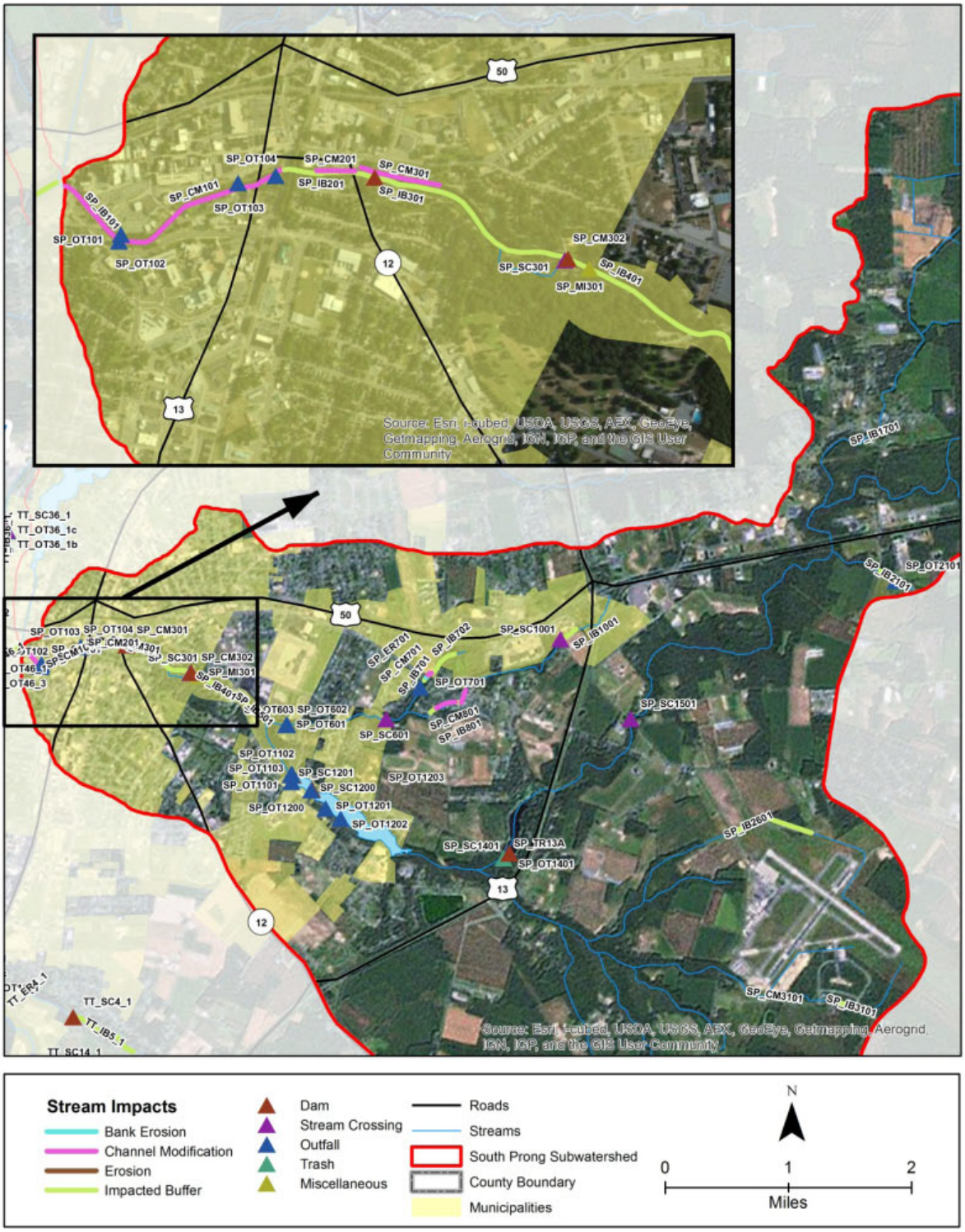

Figure B-5. Stream impacts in the South Prong subwatershed

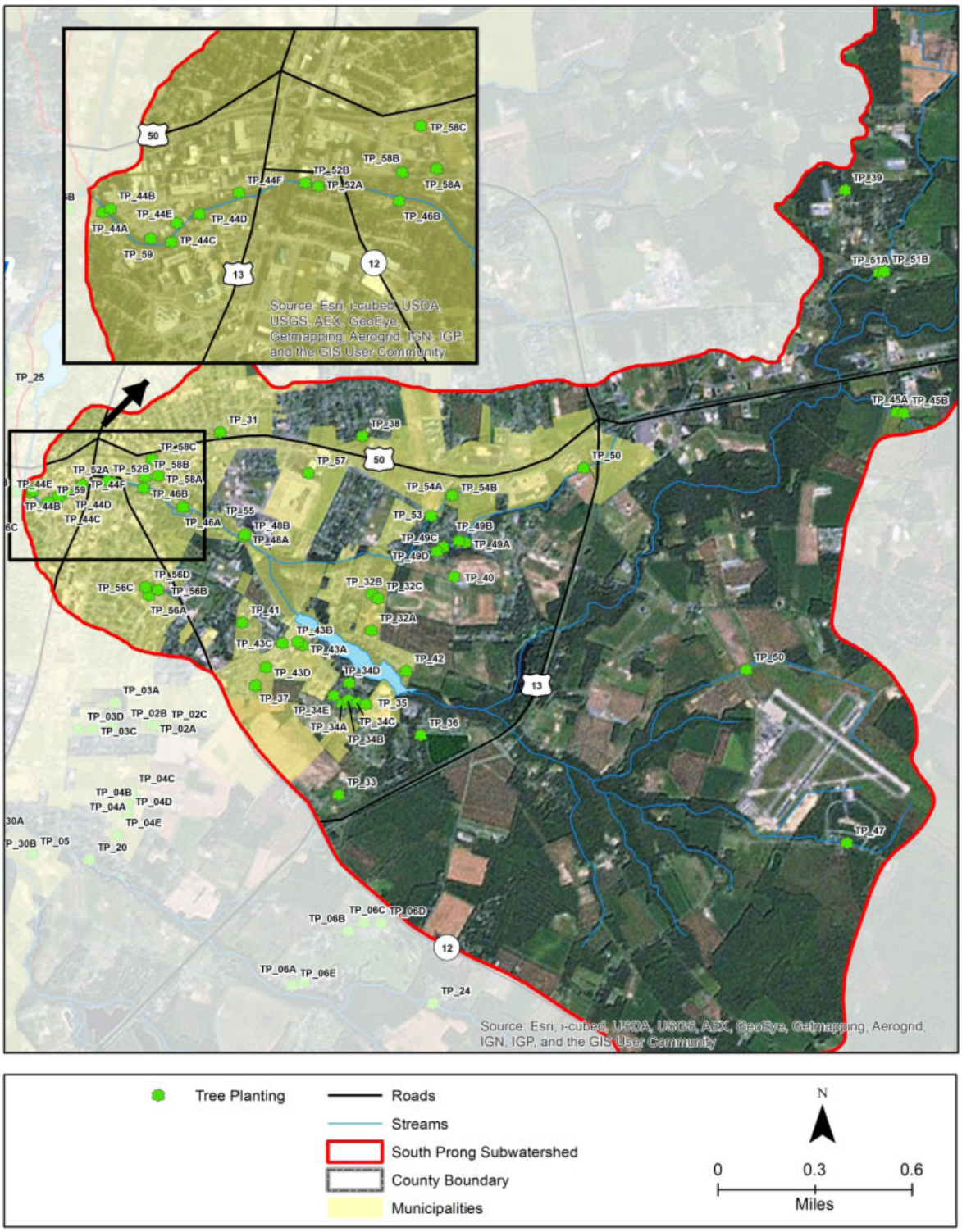

Figure B-6. Tree planting opportunities in the South Prong subwatershed

Appendix C– Tony Tank Subwatershed Site Location Maps

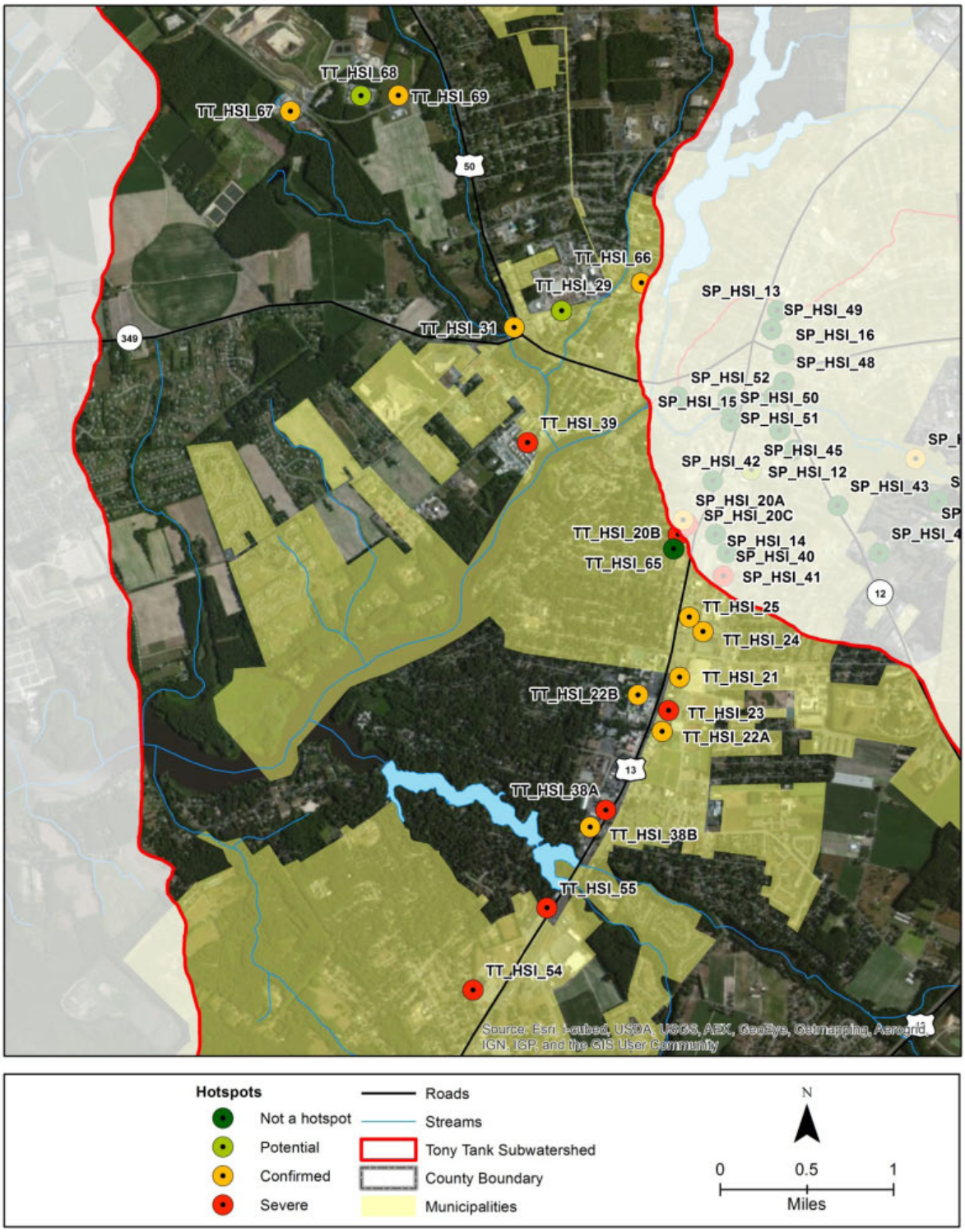

Figure C-1. Hotspot sites in the Tony Tank subwatershed

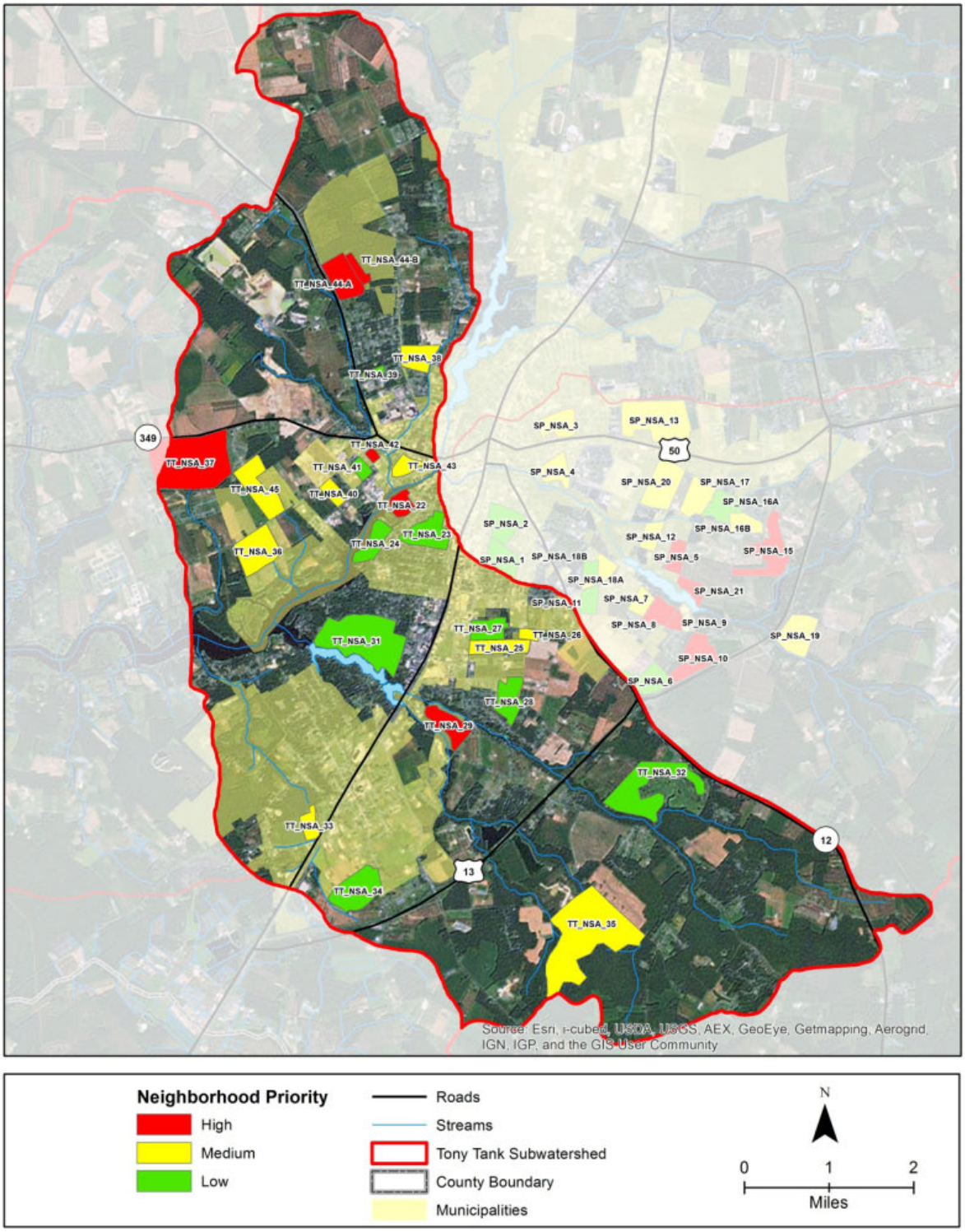

Figure C-2. Neighborhood source control opportunities in the Tony Tank subwatershed

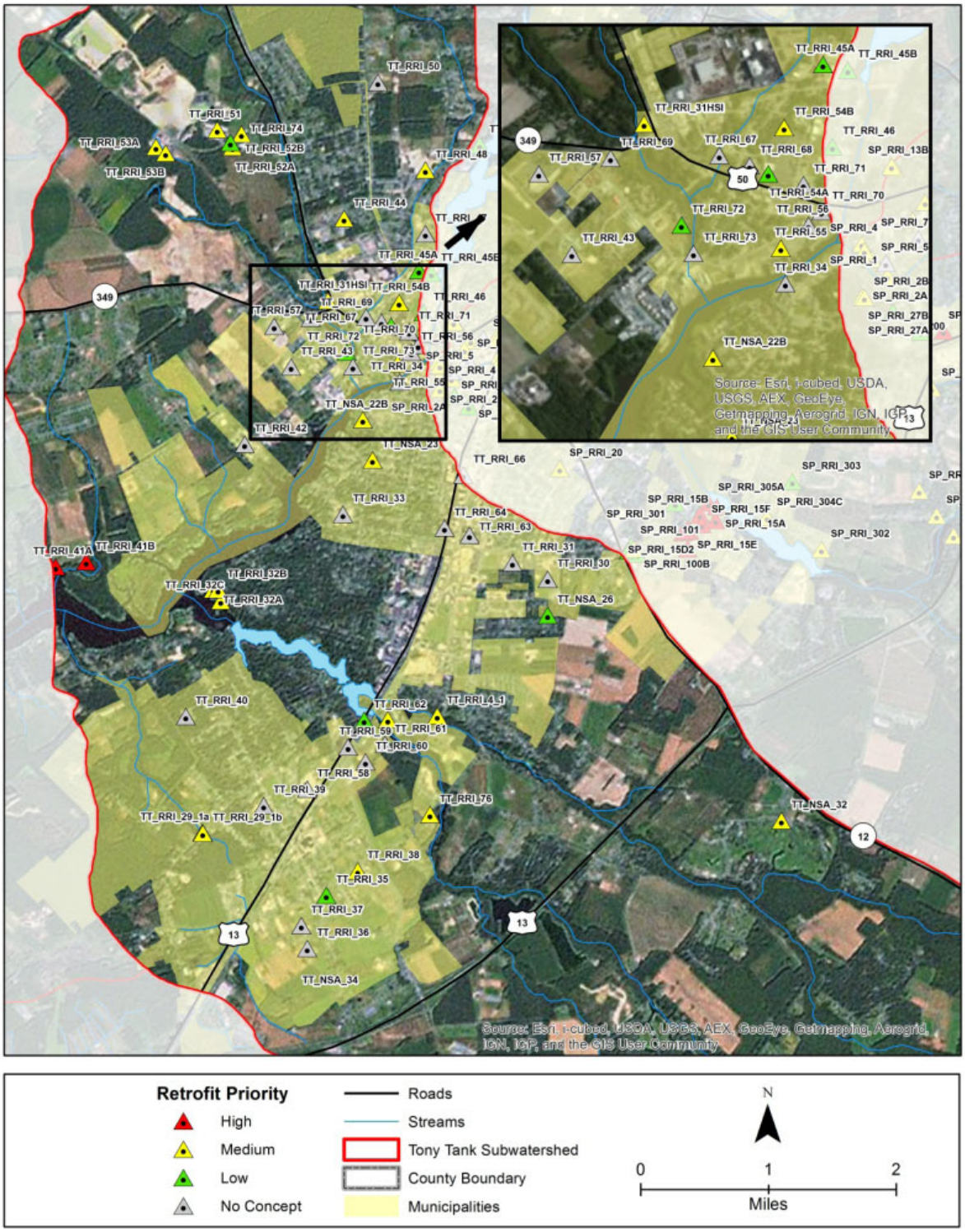

Figure C-3. Stormwater retrofit opportunities in the Tony Tank subwatershed

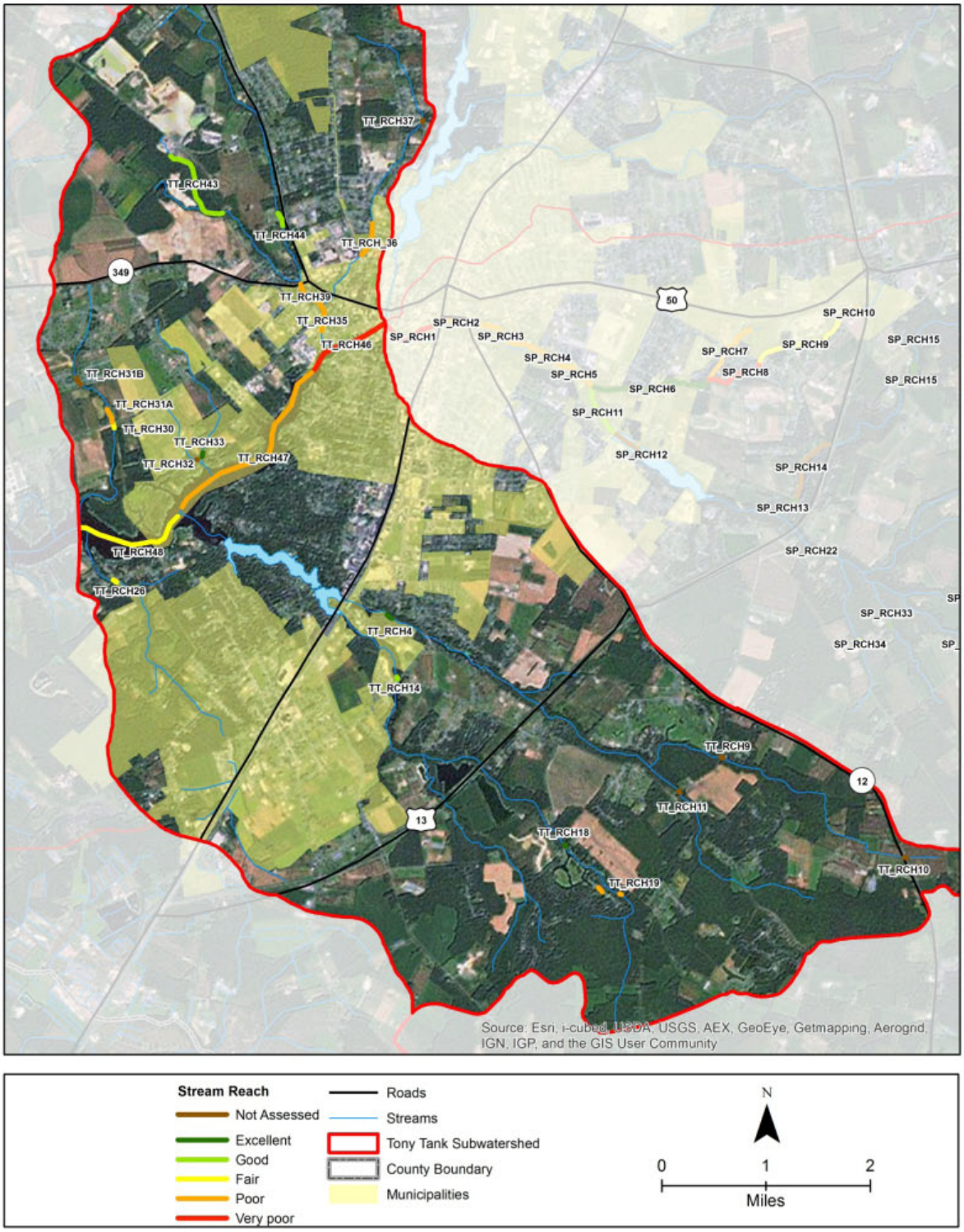

Figure C-4. Stream reaches assessed in the Tony Tank subwatershed

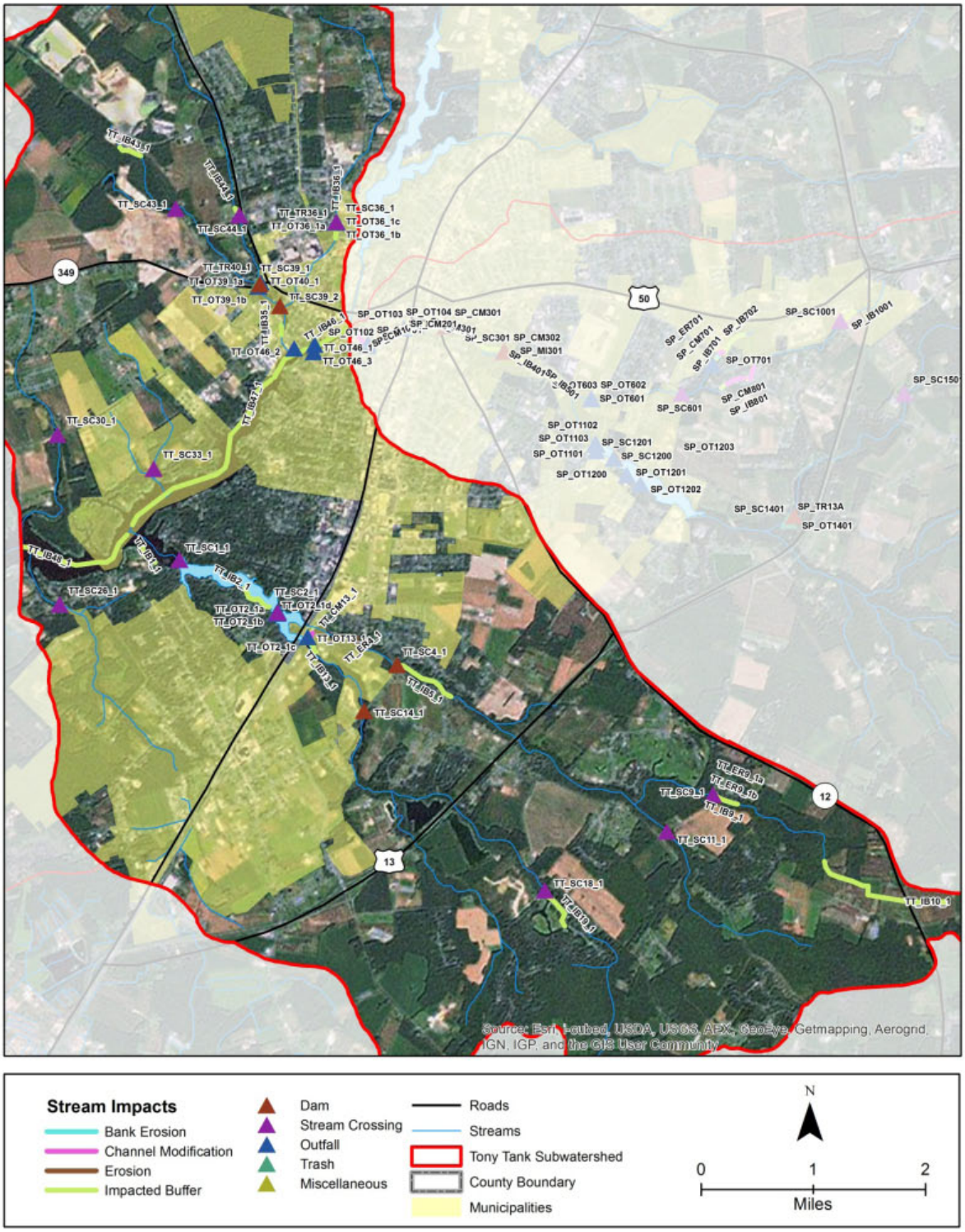

Figure C-5. Stream impacts in the Tony Tank subwatershed

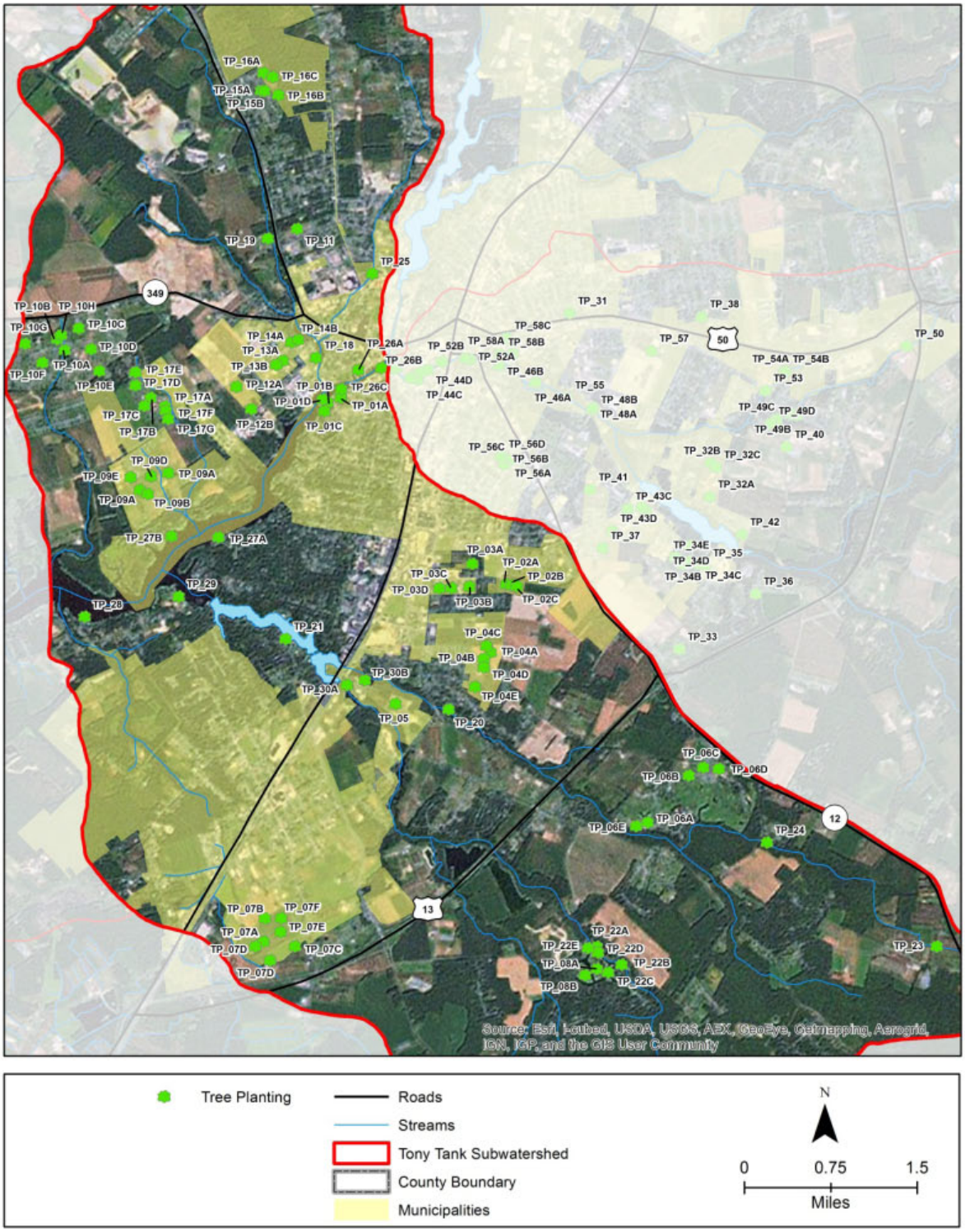

Figure C-6. Tree planting opportunities in the Tony Tank subwatershed

Appendix D– Summary of Projects in the South Prong Subwatershed

A key to the nomenclature used by field teams during the assessment work is provided in Table D-1. The naming convention was designed to be flexible for multiple field teams and to immediately impart key information about the site. Identifiers consist of three parts: 1) the abbreviation of the subwatershed in which the site or reach is located, in this case "SP" for South Prong and "TT" for Tony Tank; 2) the type of assessment conducted, and 3) a unique identifier that is employed as a team evaluates a site, reach or project. In the case of unified stream assessment projects, the unique identifier references the stream reach ID as well.

Table D-1. Site Naming Nomenclature

Assessment Type	Abbreviation
Retrofit	RRI
Hotspot	HSI
Neighborhood	NSA
Stream Reach	RCH
Outfall	OT
Stream Crossing	SC
Trash and Debris	TR
Impacted Buffer	IB
Eroded Bank	ER
Channel Modification	CM
Miscellaneous	MI

Project costs represent only planning level estimates and were determined based on guidance provided in Schueler et al. (2007), Wright et al. (2005), Kitchell and Schueler (2004), King and Hagan, 2011 and best professional judgment. Neighborhood, hotspot and stream project costs are expressed as a range. High, medium and low thresholds differ among project types and these are defined below.

Neighborhood Projects

$: Estimated Planning Level Cost < $5,000
$$: Estimated Planning Level Cost $5,000-$20,000
$$$: Estimated Planning Level Cost > $20,000

Stream Projects

$: Estimated Planning Level Cost < $2,000
$$: Estimated Planning Level Cost $2,000-$8,000
$$$: Estimated Planning Level Cost > $8,000

Hotspot Projects

$: Estimated Planning Level Cost < $5,000
$$: Estimated Planning Level Cost $5,000-$10,000
$$$: Estimated Planning Level Cost > $10,000

Table D-1. Hotspot Sites in the South Prong Subwatershed

Site_ID	Location	Jurisdiction	Type of Hotspot	Description	Recommended Actions	Status	Cost	Priority
SP_HSI_53	Salisbury Zoo	Salisbury	Waste Management/Turf Landscaping	Animal exhibits have direct interaction with the river. Direct pollution source and contributor of bacteria. Large mammals and birds in exhibits	Exhibit should be moved if possible. Consideration could be given for treatment such as with floating wetlands.	Confirmed	$$$	High
SP_HSI_40	Center of Hope (Harvest Baptist Church at 119 South Blvd # A)	Salisbury	Outdoor Material Storage, Waste Management	Garbage on the ground; 50 gallon drum w/out secondary containment; evidence of dumpsters leaking; bulk material outside dumpster on ground	Suggest follow-up on-site inspection and discuss proper trash management; determine contents of 50 gallon drum & discuss proper management/storage	Severe	$	High
SP_HSI_20C	Restaurants & Businesses near Hazel Avenue and South Salisbury Boulevard	Salisbury	Outdoor Material Storage, Waste Management	Dumpsters with broken lids, cooking oil in plastic container w/ lid down but evidence of oil spills and empty 5 gallon buckets with cooking oil residue; trash on ground around dumpster area	Schedule a review of stormwater pollution prevention plan; Suggest follow-up on-site inspection; discuss proper cooking oil and waste management; check out the pipe that has flow and algae to the right of dumpsters	Confirmed	$	Medium
SP_HSI_20A	Inside Out Car Care (726 South Salisbury Boulevard # G)	Salisbury	Vehicle Operations	Outdoor car wash that conveys the waste water to the parking lot storm drain (also visible from Google Earth view)	Schedule a review of stormwater pollution prevention plan; Suggest follow-up on-site inspection; divert water from storm drain and provide education	Confirmed	$	Medium
SP_HSI_45	Pacific Pride Commercial Fueling (corner of East Vine Street & Eastern Shore Drive across from Salvation Army Thrift Store)	Salisbury	Vehicle Operations	Uncovered gas pump at gas station	Schedule a review of stormwater pollution prevention plan; Suggest follow-up on-site inspection	Potential	$	Low

Table D-2. Neighborhood Source Control Opportunities in the South Prong Subwatershed

Site_ID	Location	Jurisdiction	Pollution Severity	Restoration Potential	Opportunity	Cost	Ranking
SP_NSA_15	South Kaywood Community	County	Moderate	Low	Rain barrels, storm drain stenciling, homeowner education for lawn and tree management (reduce organics in street & storm drain); RRI-300 Amended Soils in green space median	$	High
SP_NSA_21	New Bedford Way and Long Warf Road	Salisbury	Moderate	Moderate	Homeowner lawn management outreach, back yard buffers for homes adjacent to pond, storm drain stenciling; See RRI-302 pond retrofit	$	High
SP_NSA_8	Highland Park	County	Moderate	Moderate	Tree planting or retrofit for islands with BMP (no retrofit proposed during field visit)	$	High
SP_NSA_9	Mallard Landing Lakeside	Salisbury	Moderate	High	Tree planting at community park, storm drain stenciling, nutrient & lawn mgt outreach/education	$	High
SP_NSA_10	East Lake Subdivision	County	High	Moderate	Nutrient management outreach, septic education, buffer at Riden Court, better management for pond trail at Riden Court	$	High
SP_NSA_14	Walston Switch	County	Moderate	Moderate	Rain barrels, buffer management & education, storm drain stenciling, tree planting in green space; Many geese and droppings near pond.	$	High
SP_NSA_5	Stonegate	Salisbury	Moderate	Moderate	Plant trees at BMP sites (ponds), storm drain stenciling	$	High
SP_NSA_1	Springfield Circle and East Lincoln Avenue	Salisbury	Moderate	Low	Rain barrels, free community training and free rain barrel give away, storm drain stenciling	$	Low

Table D-2. Neighborhood Source Control Opportunities in the South Prong Subwatershed

Site_ID	Location	Jurisdiction	Pollution Severity	Restoration Potential	Opportunity	Cost	Ranking
SP_NSA_11	Beaglin Park Drive	Salisbury	Moderate	Moderate	Pond/bioswale alongside of development, amended soils, remove dry pond vegetation, remove curb along swale and plant vegetation, storm drain stenciling	$	Low
SP_NSA_16A	Gunbys Mill Drive and Woodbridge Drive	County	High	Moderate	Rain barrels, buffer and shoreline protection/homeowner education, storm drain stenciling	$	Low
SP_NSA_18B	Green and Shumaker Pond	Salisbury	Moderate	Low	Lawn management oureach, conservation landscaping, cistern use for landscaping, storm drain stenciling	$	Low
SP_NSA_2	Roger Street and Venton Place	Salisbury	Moderate	Low	Rain barrels, free community training and free rain barrel give away, storm drain stenciling	$	Low
SP_NSA_6	Twelve South	County	Moderate	High	Conservation landscaping, pond retrofit (e.g., soil amendment and/or tree planting), ditch restoration, storm drain stenciling	$	Low
SP_NSA_12	Shumaker Glen	Salisbury	Moderate	Moderate	Rain gardens, rain barrels, storm drain stenciling	$$	Medium
SP_NSA_13	Old Ocean City Road and Shamrock Drive	County	Moderate	Low	Tree planting at Fairfield Park (perimeter), ditch restoration, rain barrels	$	Medium
SP_NSA_16B	Gunbys Mill Drive and Grand View Court	County	High	Moderate	Lawn management outreach, buffer around pond needed, storm drain stencils; Geese near pond	$	Medium
SP_NSA_17	Valleywood Drive and Mouth Hermon Road	Salisbury/County	Moderate	Moderate	Rain barrels, homeowner education for lawn and tree management (reduce organics in street & storm drain), storm drain stenciling	$	Medium

Table D-2. Neighborhood Source Control Opportunities in the South Prong Subwatershed

Site_ID	Location	Jurisdiction	Pollution Severity	Restoration Potential	Opportunity	Cost	Ranking
SP_NSA_18A	Parkwood Apartments	Salisbury/County	Moderate	High	Lawn management outreach, reduce the grass and fertilizer use in BMP, storm drain stencils; See RRI-301 pond retrofit	$	Medium
SP_NSA_19	Ward Road and Nutters Cross Road	County	Moderate	Moderate	Rain barrels, homeowner education for lawn management, storm inlet stenciling; potential pond retrofit for amended soils or other retrofit (no retrofit proposed during field visit)	$	Medium
SP_NSA_20	Glen Avenue and Calvin Drive	County	Moderate	Moderate	Rain barrels, homeowner education for lawn and tree management (reduce organic in street & storm drain), storm drain stenciling	$	Medium
SP_NSA_3	Truitt Street and East Isabella Street	Salisbury	Moderate	Low	Plant trees in area North of Hwy 50 (East Salisbury Parkway) at the south end of neighborhood, storm drain stenciling	$	Medium
SP_NSA_4	Monument Street and Parkway Avenue	Salisbury	High	Low	Rain gardens, rain barrels, storm drain stenciling	$$	Medium
SP_NSA_7	Schumaker Manor	Salisbury	Moderate	Moderate	Better management for common space (e.g., native plants), lawn management outreach, storm drain stenciling	$	Medium

Table D-3. Stormwater Retrofit Opportunities in the South Prong

Site ID	Location	Jurisdiction	Retrofit Concept	Drainage Area (ac)	Impervious Cover (%)	% WQv Treated	Cost	TN Removal (lb/yr)	TP Removal (lb/yr)	TSS Removal (lb/yr)	Priority
SP_RRI_15A	Parkside High School	Salisbury	Bioretention	0.32	90	47%	$16,328	2.22	0.26	71.49	High
SP_RRI_15B	Parkside High School	Salisbury	Bioretention	1.24	90	17%	$22,680	4.97	0.58	160.50	High
SP_RRI_15C1	Parkside High School	Salisbury	Bioretention	0.45	90	13%	$6,573	1.41	0.17	48.98	High
SP_RRI_15C2	Parkside High School	Salisbury	Bioretention	0.43	90	14%	$6,418	1.37	0.16	47.65	High
SP_RRI_15D1	Parkside High School	Salisbury	Bioretention	0.50	90	16%	$8,783	1.81	0.22	62.87	High
SP_RRI_15D2	Parkside High School	Salisbury	Bioretention	0.40	90	9%	$4,074	0.87	0.10	30.32	High
SP_RRI_15E	Parkside High School	Salisbury	Bioretention	4.00	25	17%	$23,573	5.16	0.60	166.45	High
SP_RRI_15F	Parkside High School	Salisbury	Bioretention	0.30	100	65%	$23,511	2.60	0.30	84.05	High
SP_RRI_17	MVA	Salisbury	Constructed Wetland	2.51	85	42%	$21,930	6.17	1.67	364.08	High
SP_RRI_304A	1008 S Schumaker Woods	Salisbury	Infiltration	2.00	30	137%	$56,320	6.61	0.99	256.49	High
SP_RRI_305A	Ward Museum of Waterfowl	Salisbury	Infiltration	1.23	100	38%	$28,529	7.66	1.14	297.32	High
SP_RRI_305B	Ward Museum of Waterfowl	Salisbury	Bioretention	0.05	95	74%	$4,232	0.43	0.05	13.95	High
SP_RRI_1	Lot No. 12	Salisbury	Bioretention	0.50	100	104%	$62,528	5.06	0.59	163.38	Medium
SP_RRI_102A	Wicomico Regional Airport	County	Wet Pond	10.20	85	144%	$304,566	42.68	9.94	2256.38	Medium

Table D-3. Stormwater Retrofit Opportunities in the South Prong

Site ID	Location	Jurisdiction	Retrofit Concept	Drainage Area (ac)	Impervious Cover (%)	% WQv Treated	Cost	TN Removal (lb/yr)	TP Removal (lb/yr)	TSS Removal (lb/yr)	Priority
SP_RRI_102B	Wicomico Regional Airport	County	Bioretention	2.75	85	32%	$89,933	15.15	1.76	488.88	Medium
SP_RRI_102C	Wicomico Regional Airport	County	Impervious Cover Removal	0.07	100	100%	$6,737	0.85	0.11	24.94	Medium
SP_RRI_10A	Lot No. 10	Salisbury	Bioretention	0.38	100	213%	$98,721	4.77	0.55	153.89	Medium
SP_RRI_10B	Lot No. 10	Salisbury	Bioretention	0.48	95	180%	$98,721	5.39	0.63	173.89	Medium
SP_RRI_10C	Lot No. 10	Salisbury	Bioretention	0.59	95	146%	$98,721	6.27	0.73	202.40	Medium
SP_RRI_11	Philip C Cooper Park	Salisbury	Bioretention	0.38	80	37%	$13,580	2.12	0.25	68.36	Medium
SP_RRI_12A	Wicomico Middle School	Salisbury	Bioretention	2.18	20	123%	$77,994	5.62	0.65	181.49	Medium
SP_RRI_12B	Wicomico Middle School	Salisbury	Bioretention	0.39	90	119%	$50,408	3.71	0.43	119.66	Medium
SP_RRI_13A	Lot No. 7 & 13	Salisbury	Infiltration	0.38	100	65%	$14,864	2.90	0.43	112.67	Medium
SP_RRI_13B	Lot No. 7 & 13	Salisbury	Infiltration	0.31	100	79%	$14,864	2.54	0.38	98.40	Medium
SP_RRI_1401	Colony and Sylvan Rd	County	Bioretention	4.90	25	9%	$14,640	3.30	0.38	106.40	Medium
SP_RRI_14C	Civic Center Parking Lot Section A3-D3	County	Bioretention	2.37	100	104%	$296,793	24.07	2.79	776.69	Medium
SP_RRI_16A	Glen Avenue School	County	Infiltration	0.31	95	48%	$8,684	2.02	0.30	78.55	Medium
SP_RRI_16B	Glen Avenue School	County	Infiltration	1.11	60	89%	$37,293	5.91	0.88	229.54	Medium
SP_RRI_20	Prince Street School	Salisbury	Bioretention	0.31	70	162%	$43,514	2.56	0.30	82.76	Medium
SP_RRI_200	Food Lion	Salisbury	Constructed Wetland	3.72	100	83%	$74,065	13.71	3.70	808.94	Medium

Table D-3. Stormwater Retrofit Opportunities in the South Prong

Site ID	Location	Jurisdiction	Retrofit Concept	Drainage Area (ac)	Impervious Cover (%)	% WQv Treated	Cost	TN Removal (lb/yr)	TP Removal (lb/yr)	TSS Removal (lb/yr)	Priority
SP_RRI_21	East Wicomico Little League	County	Infiltration	10.98	30	136%	$307,262	36.22	5.40	1405.80	Medium
SP_RRI_2101	WorWic Community College	County	Wet Pond	4.20	40	113%	$49,209	8.84	1.99	434.84	Medium
SP_RRI_24	Salisbury Zoo	Salisbury	Bioretention	0.28	80	50%	$13,615	1.78	0.21	57.44	Medium
SP_RRI_25	Calvary Baptist Tabernacle	County	Bioretention	1.55	70	39%	$52,868	7.90	0.92	254.96	Medium
SP_RRI_2601	Airport Rd and Walston Switch Rd	County	Constructed Wetland	326.80	8	47%	$476,133	125.78	33.96	7421.27	Medium
SP_RRI_28B	Wicomico County Stadium Parking Lot	County	Bioretention	1.78	100	34%	$73,763	11.90	1.38	383.86	Medium
SP_RRI_28C	Wicomico High School	County	Bioretention	1.29	95	76%	$113,384	11.32	1.31	365.29	Medium
SP_RRI_28D	Wicomico High School	County	Bioretention	1.28	90	41%	$57,908	8.42	0.98	271.58	Medium
SP_RRI_2A	Salisbury Health Center Fritz Building	Salisbury	Infiltration	0.48	85	28%	$6,363	2.20	0.33	85.40	Medium
SP_RRI_2B	Salisbury Health Center Fritz Building	Salisbury	Infiltration	0.47	90	18%	$4,353	1.78	0.27	69.23	Medium
SP_RRI_300	Belvedere Terrace and Somers Drive	County	Infiltration	10.10	30	21%	$43,726	15.58	2.32	604.59	Medium
SP_RRI_3001	SW Airport, near Harpar Ct	County	Constructed Wetland	284.50	15	23%	$308,188	117.68	31.77	6942.91	Medium

Table D-3. Stormwater Retrofit Opportunities in the South Prong											
Site ID	**Location**	**Jurisdiction**	**Retrofit Concept**	**Drainage Area (ac)**	**Impervious Cover (%)**	**% WQv Treated**	**Cost**	**TN Removal (lb/yr)**	**TP Removal (lb/yr)**	**TSS Removal (lb/yr)**	**Priority**
SP_RRI_302	New Bedford Way	Salisbury	Infiltration	13.90	70	12%	$70,559	29.03	4.33	1126.72	Medium
SP_RRI_304B	1008 S Schumaker Woods	Salisbury	Bioretention	1.87	40	18%	$17,805	3.80	0.44	122.58	Medium
SP_RRI_304C	1008 S Schumaker Woods	Salisbury	Bioretention	2.97	40	12%	$17,805	4.17	0.48	134.67	Medium
SP_RRI_3301	Woodland Nursery	County	Rain Garden	0.62	25	29%	$2,406	1.10	0.13	35.39	Medium
SP_RRI_3A	Lot No. 1	Salisbury	Bioretention	0.14	100	50%	$8,752	1.14	0.13	36.67	Medium
SP_RRI_3B	Lot No. 1	Salisbury	Bioretention	0.13	100	96%	$15,593	1.33	0.15	43.02	Medium
SP_RRI_3C	Lot No. 1	Salisbury	Bioretention	0.19	100	135%	$31,343	2.11	0.25	68.22	Medium
SP_RRI_4	Lot No. 15	Salisbury	Bioretention	0.53	100	25%	$15,918	3.00	0.35	96.73	Medium
SP_RRI_6	Parking Lot Adjacent to Lot No. 16	Salisbury	Bioretention	0.57	75	25%	$13,073	2.47	0.29	79.68	Medium
SP_RRI_8A	Lot No. 9	Salisbury	Infiltration	0.12	95	47%	$3,193	0.76	0.11	29.33	Medium
SP_RRI_8B	Old Courthouse	Salisbury	Rain Garden	0.02	50	177%	$673	0.10	0.01	3.09	Medium
SP_RRI_1402	near 713 S. Kaywood Dr	County	Bioretention	6.33	30	2%	$6,190	0.00	0.00	0.00	Medium
SP_RRI_100B	810 Beaglin Park Drive and 901 Snow Hill Road	Salisbury	Infiltration	0.74	95	56%	$22,102	5.16	0.77	200.28	Medium
SP_HSI_3	Sleep inn	Salisbury	Bioretention	5.44	90	47%	$280,455	37.84	4.39	1220.79	Low
SP_RRI_100A	810 Beaglin Park Drive and 901 Snow Hill Road	Salisbury	Impervious Cover Removal	0.24	100	100%	$23,097	2.90	0.39	85.50	Low

Table D-3. Stormwater Retrofit Opportunities in the South Prong

Site ID	Location	Jurisdiction	Retrofit Concept	Drainage Area (ac)	Impervious Cover (%)	% WQv Treated	Cost	TN Removal (lb/yr)	TP Removal (lb/yr)	TSS Removal (lb/yr)	Priority
SP_RRI_100C	810 Beaglin Park Drive and 901 Snow Hill Road	Salisbury	Infiltration	0.45	95	31%	$7,367	2.42	0.36	93.85	Low
SP_RRI_101	Moose Lodge Parking Lot and PNC Bank Corner of Beaglin Park and Snow Hill	County	Bioretention	2.37	90	21%	$53,445	10.92	1.27	352.23	Low
SP_RRI_14A	Civic Center Parking Lot Section E2	County	Bioretention	0.55	100	186%	$122,969	6.55	0.76	211.43	Low
SP_RRI_14B	Civic Center Parking Lot Section F2 - H3	County	Bioretention	2.47	95	25%	$70,917	13.39	1.55	431.91	Low
SP_RRI_22	Twilley Center	Salisbury	Impervious Cover Removal	0.40	100	100%	$38,331	4.81	0.65	141.89	Low
SP_RRI_27A	Peninsula General Hospital Education Center Parking Lot	Salisbury	Bioretention	0.21	90	46%	$10,579	1.45	0.17	46.67	Low
SP_RRI_27B	Peninsula General Hospital ER Trauma Parking Lot	Salisbury	Bioretention	0.27	90	28%	$8,211	1.47	0.17	47.52	Low
SP_RRI_28A	Former Mall Property	Salisbury	Impervious Cover Removal	24.82	100	100%	$2,388,204	299.68	40.46	8840.44	Low
SP_RRI_301	Parkwood Apartments	County	Infiltration	14.40	75	46%	$308,477	74.29	11.09	2883.70	Low

Table D-3. Stormwater Retrofit Opportunities in the South Prong

Site ID	Location	Jurisdiction	Retrofit Concept	Drainage Area (ac)	Impervious Cover (%)	% WQv Treated	Cost	TN Removal (lb/yr)	TP Removal (lb/yr)	TSS Removal (lb/yr)	Priority
SP_RRI_303	Stonegate	Salisbury	Bioretention	8.21	60	99%	$607,964	50.98	5.91	1644.99	Low

Table D-4. Stream Impacts in the South Prong Subwatershed

Site ID	Location	Jurisdiction	Impacts	Opportunity	Cost	Priority
SP_IB2101	Southwest of WorWic Community College	County	Impacted Buffer	Buffer Enhancement	$	High
SP_IB2601	Walston Switch Rd and Airport Rd	County	Impacted Buffer	Buffer Enhancement	$	High
SP_IB301	Between Snow Hill Rd and plastic fencing marking the downstream boundary of the zoo.	Salisbury	Impacted Buffer	Buffer Enhancement	$$	High
SP_IB3101	Along Fooks Rd	County	Impacted Buffer	Buffer Enhancement	$$	High
SP_IB501	Upstream of Memorial Plz	Salisbury	Impacted Buffer	Buffer Enhancement	$$	High
SP_OT1102	E College Ave	Salisbury	Outfall	Illicit discharge investigation	$	High
SP_TR1301	Downstream of Parker Pond on small tributary of RCH13	County	Trash	Trash clean-up	$	High
SP_CM701	Mt Hermon Rd and Phillip Morris Dr	Salisbury	Channel Modification	Natural channel design	$$	Medium
SP_IB101	Between Mill St and S Salisbury Blvd	Salisbury	Impacted Buffer	Buffer Enhancement	$	Medium
SP_IB1701	Walston Switch Rd, just South of Rt 50	County	Impacted Buffer	Buffer Enhancement	$$	Medium
SP_IB701	Downstream of Mt Hermon Rd	County	Impacted Buffer	Buffer Enhancement	$	Medium

Table D-4. Stream Impacts in the South Prong Subwatershed

Site ID	Location	Jurisdiction	Impacts	Opportunity	Cost	Priority
SP_IB702	Downstream of Woodbrooke Dr Shopping Center	Salisbury	Impacted Buffer	Buffer Enhancement	$	Medium
SP_IB801	Between Mt Hermon Rd and Woodridge Dr	County	Impacted Buffer	Buffer Enhancement	$	Medium
SP_OT1201	East of SP_OT1200	County	Outfall	Outfall repair	$	Medium
SP_OT1203	East of SP_SC1201 in Schuemaker Pond near Beaglin Park Drive	Salisbury	Outfall	Outfall stabilization	$	Medium
SP_CM3101	Aiport, near Fooks Rd	County	Channel Modification	Natural channel design	$$$	Medium
SP_CM801	Between Mt Hermon Rd and Woodridge Dr	County	Channel Modification	Natural channel design	$$	Low
SP_SC1001	Autumn Grove Ct	County	Stream Crossing	Fish barrier restoration	$$	Low
SP_SC601	Glen Ave	County	Stream Crossing	Fish barrier restoration	$$	Low
SP_CM101	Between Mill St and S Salisbury Blvd	Salisbury	Channel Modification	n/a	n/a	n/a
SP_CM201	Along right bank of RCH1 behind commercial area	Salisbury	Channel Modification	n/a	n/a	n/a
SP_CM301	Upstream of Snow Hill Rd	Salisbury	Channel Modification	n/a	n/a	n/a
SP_CM302	Beaverdam Dr	Salisbury	Channel Modification	n/a	n/a	n/a
SP_ER701	Downstream of Mt Hermon Rd	County	Bank Erosion	n/a	n/a	n/a

Table D-4. Stream Impacts in the South Prong Subwatershed

Site ID	Location	Jurisdiction	Impacts	Opportunity	Cost	Priority
SP_IB1001	Between Autumn Grove Ct and Salisbury Byp Ram	Salisbury	Impacted Buffer	n/a	n/a	n/a
SP_IB201	Between S Salisbury Blvd and Snow Hill Rd	Salisbury	Impacted Buffer	n/a	n/a	n/a
SP_IB401	Salisbury Zoo	Salisbury	Impacted Buffer	n/a	n/a	n/a
SP_MI301	Downstream boundary of the zoo.	Salisbury	Miscellaneous	n/a	n/a	n/a
SP_OT101	Off of parking lot on W Market St just upstream of Circle Ave	Salisbury	Outfall	n/a	n/a	n/a
SP_OT102	Off of W Carroll St, between Mill St and Waverly Dr	Salisbury	Outfall	n/a	n/a	n/a
SP_OT103	Off of parking lot on E Market St, just downstream of S Salisbury Blvd	Salisbury	Outfall	n/a	n/a	n/a
SP_OT104	Salisbury Blvd on left bank	Salisbury	Outfall	n/a	n/a	n/a
SP_OT1101	E College Ave	Salisbury	Outfall	n/a	n/a	n/a
SP_OT1103	E College Ave	Salisbury	Outfall	n/a	n/a	n/a
SP_OT1200	On South side of Dam near the Warm Museum of Waterfowl	Salisbury	Outfall	n/a	n/a	n/a
SP_OT1202	East of SP_OT1201 near the pier in the park	County	Outfall	n/a	n/a	n/a
SP_OT1401	Parker Pond and N. Schumaker Dr.	County	Outfall	n/a	n/a	n/a
SP_OT2101	WorWic Community College maintenance yard	County	Outfall	n/a	n/a	n/a
SP_OT601	N Park Dr	Salisbury	Outfall	n/a	n/a	n/a

Table D-4. Stream Impacts in the South Prong Subwatershed

Site ID	Location	Jurisdiction	Impacts	Opportunity	Cost	Priority
SP_OT602	N Park Dr	Salisbury	Outfall	n/a	n/a	n/a
SP_OT603	N Park Dr	Salisbury	Outfall	n/a	n/a	n/a
SP_OT701	Downstream of Mt Hermon Rd	County	Outfall	n/a	n/a	n/a
SP_SC1200	Dam on Beaglin Park Drive	Salisbury	Dam	n/a	n/a	n/a
SP_SC1201	Dam East of SP_SC1200	Salisbury	Dam	n/a	n/a	n/a
SP_SC1501	Near intersection of Hobbs and Shavox Rd	County	Stream Crossing	n/a	n/a	n/a
SP_SC301	Beaverdam Dr	Salisbury	Stream Crossing	n/a	n/a	n/a

$: Estimated Planning Level Cost < $2,000
$$: Estimated Planning Level Cost $2,000-$8,000
$$$: Estimated Planning Level Cost > $8,000

Table D-5. Tree Planting Opportunities in the South Prong Subwatershed

Site_ID	Subwatershed	Latitude	Longitude	Related Assessment	Area (acres)	Notes
TP_31	South Prong	38.36950046270	-75.58174220250	NSA	1.9	NSA_3 - Common area
TP_32A	South Prong	38.35128289710	-75.56370362480	NSA	0.5	NSA_5 - Stormwater pond
TP_32B	South Prong	38.35497694260	-75.56392373960	NSA	0.5	NSA_5 - Stormwater pond
TP_33	South Prong	38.33667457880	-75.56759015890	NSA	0.7	NSA_6 - Stormwater pond
TP_34A	South Prong	38.34476153160	-75.56718633150	NSA	0.0	NSA_8 - Cul de sac islands
TP_34B	South Prong	38.34507119440	-75.56650570940	NSA	0.0	NSA_8 - Cul de sac islands
TP_34C	South Prong	38.34484605770	-75.56542235230	NSA	0.0	NSA_8 - Cul de sac islands
TP_34D	South Prong	38.34663519680	-75.56636554680	NSA	0.0	NSA_8 - Cul de sac islands
TP_34E	South Prong	38.34545682600	-75.56816328670	NSA	0.0	NSA_8 - Cul de sac islands
TP_35	South Prong	38.34467936820	-75.56442786100	NSA	0.9	NSA_9 - Common area
TP_36	South Prong	38.34185924170	-75.55804585660	NSA	0.2	NSA_10 - Common area
TP_37	South Prong	38.34638314410	-75.57730521720	NSA	0.2	NSA_11 - Common area
TP_38	South Prong	38.36956354380	-75.56461610460	NSA	1.1	NSA_13 - Fairfield Park
TP_39	South Prong	38.39131839630	-75.50924627710	NSA	1.8	NSA_14 - Stormwater pond
TP_40	South Prong	38.35665091230	-75.55385914200	NSA	1.0	NSA_16B - Stormwater pond
TP_41	South Prong	38.35214396510	-75.57882476160	NSA	0.2	NSA_18B - Common area
TP_42	South Prong	38.34792241430	-75.55975733320	NSA	0.4	NSA_21 - Stormwater pond
TP_43A	South Prong	38.35008205970	-75.57184121420	RRI	1.1	Parkside High School
TP_43B	South Prong	38.35059373320	-75.57246851560	RRI	0.9	Parkside High School
TP_43C	South Prong	38.35018855970	-75.57442323960	RRI	0.9	Parkside High School
TP_43D	South Prong	38.34806392590	-75.57605981300	RRI	8.0	Parkside High School
TP_32C	South Prong	38.35399849630	-75.56276604280	NSA	0.6	NSA_5 - Stormwater pond
TP_45A	South Prong	38.37112280430	-75.50189041760	USA	1.2	SW of WorWic Comm College
TP_45B	South Prong	38.37112449680	-75.50119648980	USA	1.0	SW of WorWic Comm College
TP_46A	South Prong	38.36362084120	-75.58774026400	USA	1.2	Between zoo and Snow Hill Rd
TP_46B	South Prong	38.36323714350	-75.58761022780	USA	1.1	Between zoo and Snow Hill Rd
TP_47	South Prong	38.33174967640	-75.50826039530	USA	0.5	Fooks Rd

Table D-5. Tree Planting Opportunities in the South Prong Subwatershed

Site_ID	Subwatershed	Latitude	Longitude	Related Assessment	Area (acres)	Notes
TP_48A	South Prong	38.35935551940	-75.57780122100	USA	0.7	Upstream of Memorial Plaza
TP_48B	South Prong	38.35947313500	-75.57760119430	USA	0.8	Upstream of Memorial Plaza
TP_49A	South Prong	38.35998215290	-75.55257657050	USA	0.7	Between Mt Hermon Rd and Woodridge Dr
TP_49B	South Prong	38.35962881440	-75.55392242510	USA	0.4	Between Mt Hermon Rd and Woodridge Dr
TP_49C	South Prong	38.35925462590	-75.55519804630	USA	0.3	Between Mt Hermon Rd and Woodridge Dr
TP_50	South Prong	38.34809740090	-75.51958306760	USA	0.4	Walston Switch Rd and Airport Rd
TP_21	Tony Tank	38.33733386250	-75.61648209540	USA	0.3	Camden Ave
TP_22D	Tony Tank	38.30602179620	-75.57735178000	USA	0.5	Grosse Pointe Dr
TP_22E	Tony Tank	38.30723193630	-75.57915938050	USA	0.3	Grosse Pointe Dr
TP_25	Tony Tank	38.37397582970	-75.60617107390	USA	1.1	Rose St
TP_51A	South Prong	38.38419681840	-75.50471308550	USA	0.3	Walston Switch Rd - South of Rte 50
TP_51B	South Prong	38.38439240900	-75.50386682980	USA	0.5	Walston Switch Rd - South of Rte 50
TP_44A	South Prong	38.36381541760	-75.60333942520	USA	0.4	Between Mill St and S. Salisbury Blvd
TP_44B	South Prong	38.36396458220	-75.60302425340	USA	0.2	Between Mill St and S. Salisbury Blvd
TP_44C	South Prong	38.36304619850	-75.60099140560	USA	0.9	Between Mill St and S. Salisbury Blvd
TP_44D	South Prong	38.36405232720	-75.59888853010	USA	0.2	Between Mill St and S. Salisbury Blvd
TP_44E	South Prong	38.36354099380	-75.60039572690	USA	0.2	Between Mill St and S. Salisbury Blvd
TP_44F	South Prong	38.36447575110	-75.59828507060	USA	0.5	Between Mill St and S. Salisbury Blvd
TP_52A	South Prong	38.36495257090	-75.59392190230	USA	0.3	Between S. Salisbury and Snow Hill Rd
TP_52B	South Prong	38.36508120560	-75.59413191390	USA	0.2	Between S. Salisbury and Snow Hill Rd
TP_53	South Prong	38.36188263790	-75.55683306170	USA	0.2	Downstream of Mt Hermon Rd
TP_54A	South Prong	38.36325843620	-75.55510877580	USA	0.2	Downstream of Woodbrooke Dr Shopping Center
TP_54B	South Prong	38.36325699610	-75.55500731540	USA	0.2	Downstream of Woodbrooke Dr Shopping Center
TP_49D	South Prong	38.35883035260	-75.55612647370	USA	0.4	Between Mt Hermon Rd and Woodridge Dr
TP_50	South Prong	38.36600207860	-75.53991739370	USA	1.1	Between Autumn Grove Ct and Salisbury Byp Ram
TP_55	South Prong	38.36128039330	-75.58216751690	USA	0.2	Salisbury Zoo
TP_24	South Prong	38.31713645100	-75.55588509550	USA	0.3	NuTony Tankers Cross Rd, south of Waycroft Dr.

Table D-5. Tree Planting Opportunities in the South Prong Subwatershed

Site_ID	Subwatershed	Latitude	Longitude	Related Assessment	Area (acres)	Notes
TP_56A	South Prong	38.35510311650	-75.58934987090	RRI	0.1	RRI_20 - Prince Street School
TP_56B	South Prong	38.35461998280	-75.58967646980	RRI	0.1	RRI_20 - Prince Street School
TP_56C	South Prong	38.35556589180	-75.58877205640	RRI	0.5	RRI_20 - Prince Street School
TP_56D	South Prong	38.35552932650	-75.58991776010	RRI	0.4	RRI_20 - Prince Street School
TP_57	South Prong	38.36579227660	-75.57113757870	RRI	0.4	RRI_22 - Back of Twilley Center
TP_58A	South Prong	38.36552514800	-75.58892417310	RRI	0.8	RRI12A - Wicomico Middle School
TP_58B	South Prong	38.36543762860	-75.59017467360	RRI	0.2	RRI12A - Wicomico Middle School
TP_58C	South Prong	38.36703866130	-75.58971593270	RRI	2.0	RRI12A - Wicomico Middle School
TP_59	South Prong	38.36311581660	-75.60143224320	RRI	0.1	RRI_1 - Lot No 12

Appendix E– Summary of Projects in the Tony Tank Subwatershed

Table E-1. Hotspot Sites in the Tony Tank Subwatershed

Site_ID	Location	Jurisdiction	Type of Hotspot	Description	Recommended Actions	Status	Cost	Priority
TT_HSI_68	Wicomico Co. Roads Division HQ	County	Vehicle Operations, Outdoor Material Storage	County's Road Division Headquarters, where equipment and trucks are stored and maintained, also contains covered fueling station	Schedule a review of the SWPPP, pollution prevention training for employees, provide additional cover for outdoor materials, implement retrofit project.	Potential	$	High
TT_HSI_67	Wicomico Co. Solid Waste Recycling Yard	County	Vehicle Operations, Waste Management	County transfer station for household recyclable materials as well as the depot for organic waste.	Check on NPDES status, schedule a review of the SWPPP; Pollution prevention training for employees; Implement wash pond retrofit	Confirmed	$$$	High
TT_HSI_66	Salisbury Municipal Yard	Salisbury	Vehicle Operations/Waste Management	City's municipal yard where they store trucks and equipment. They also store construction materials and bulk waste that they collect from the ROW	Check on NPDES status, schedule a review of the SWPPP, suggest follow-up inspection; Pollution prevention training for employees	Confirmed	$$	High
TT_HSI_22B	PASCO Electric (1121 South Salisbury Boulevard)	Salisbury	Outdoor Material Storage, Waste Management	Storing car batteries outside on wooden pallets	Suggest follow-up on-site inspection and discuss proper car battery storage	Confirmed	$	High
TT_HSI_22A	1147 University Square	Salisbury	Outdoor Material Storage, Waste Management	Poor trash management at the site; trash on the ground around dumpster; two dumpsters in standing water; 50 gallon drum was full, with open top, unlabeled, and rusting	Schedule a review of stormwater pollution prevention plan; follow up site inspection; discuss proper waste management and potential to move dumpsters out of standing water or move water away from area	Severe	$	High

Table E-1. Hotspot Sites in the Tony Tank Subwatershed

Site_ID	Location	Jurisdiction	Type of Hotspot	Description	Recommended Actions	Status	Cost	Priority
TT_HSI_21	Salisbury University	County	Outdoor Material Storage	Compost/mulch pile is uncovered and drains to storm drain	Schedule a review of stormwater pollution prevention plan; follow up site inspection; discuss using berm to manage storm flows	Confirmed	$	High
TT_HSI_69	Maryland Food Bank	County	Vehicle Operations, Outdoor Material Storage	Food bank warehouse for drop off and pick up of food products. Noticeable stains on pavement and in grass swale emanating from loading dock.	Schedule on-site inspection, pollution prevention training for staff, include in future education efforts, clean loading area, implement retrofit projects	Confirmed	$$	Medium
TT_HSI_55	Hunan Palace (418 North Fruitland Boulevard)	County	Waste Management	Restaurant with cooking oil in plastic receptacle but with evidence of oil stains on receptacle and on the ground (sediment & concrete); 50 gallon drum with unknown contents; illegal dumping of bulk trash (2 couches)	Schedule a review of stormwater pollution prevention plan; Suggest follow-up on-site inspection; discuss proper cooking oil waste management and deterring illegal dumping	Severe	$	Medium
TT_HSI_54	Fruitland Plaza (208 North Fruitland Boulevard)	Fruitland	Outdoor Material Storage, Waste Management	Restaurant with cooking oil stored in 50 gallon drum that has no secondary containment or cover; evidence of oil leaks on concrete; illegal dumping (mattress)	Schedule a review of stormwater pollution prevention plan; Suggest follow-up on-site inspection; discuss proper cooking oil waste management and deterring illegal dumping	Severe	$	Medium

Table E-1. Hotspot Sites in the Tony Tank Subwatershed

Site_ID	Location	Jurisdiction	Type of Hotspot	Description	Recommended Actions	Status	Cost	Priority
TT_HSI_39	DMO Energy & Chesapeake Shipbuilding Corporation (710 Fitzwater Street)	County	Vehicle Operations, Outdoor Material Storage, Waste Management	Very large area that is used for ship building, ship fueling, ship repair, vehicle gassing; DMO energy has an energy operation; evidence of ground disturbance	Schedule a review of stormwater pollution prevention plan; Suggest follow-up on-site inspection; Very large area that is hard to access. County said there are two small stormwater BMPs at the Shipbuilding site; Evidence of storing varying types of materials both under cover and without cover; 50 gallon drums present; uncovered fueling station; and this site is in the critical area/ on the river	Severe	$$$	Medium
TT_HSI_38B	Temple Hill Motel (1510 South Salisbury Boulevard)	County	Waste Management	Illegal dumping near the motel dumpster, both behind dumpster and down the hill (dumping) and bulk trash dumping behind motel (mattresses)	Suggest follow-up on-site inspection and discuss proper trash management; post no dumping signs	Confirmed	$	Medium
TT_HSI_38A	Court Plaza (1502 South Salisbury Boulevard)	County	Outdoor Material Storage, Waste Management	Garbage on the ground; garbage in receptacles without cover; paint cans on the ground; and cooking oil receptacle with lid open and garbage inside	Suggest follow-up on-site inspection and discuss proper trash and cooking oil management	Severe	$	Medium
TT_HSI_31	Seven Eleven (Nanticoke Road and South Salisbury Boulevard)	Salisbury	Waste Management	Illegal dumping area: 1) dumping over the hillside where there is a car access behind the building and 2) at the far end of the large parking lot near the commercial building	Schedule a review of stormwater pollution prevention plan; Suggest follow-up on-site inspection; discuss increasing fencing and/or a stormwater BMP w/ trash rack near dumping site #2	Confirmed	$	Medium

Table E-1. Hotspot Sites in the Tony Tank Subwatershed								
Site_ID	**Location**	**Jurisdiction**	**Type of Hotspot**	**Description**	**Recommended Actions**	**Status**	**Cost**	**Priority**
TT_HSI_25	Popeye's (917 Ocean Highway)	Salisbury	Waste Management	Cooking oil stored in 3 50 gallon drums & 1 lid askew; evidence of cooking oil on the concrete near the waste disposal area	Suggest follow-up on-site inspection and discuss proper cooking oil management	Confirmed	$	Medium
TT_HSI_24	Ace Hardware & old Super Fresh (121 Eastern Shore Drive)	Salisbury	Waste Management	Illegal dumping behind the Ace Hardware and old Super Fresh stores (mattresses)	Suggest follow-up on-site inspection and discuss proper trash management; post no dumping signs	Confirmed	$	Medium
TT_HSI_23	McDonalds (1305 South Salisbury Boulevard)	Salisbury	Waste Management	Dumpster juice leaking to curb cut leading to vegetative conveyance channel; evidence of oil/staining on the concrete wall containing the dumpster area; gas can visible in area	Suggest follow-up on-site inspection and discuss proper trash management	Confirmed	$	Medium
TT_HSI_20B	Viet Castle (corner of Hazel Avenue & Waverly Drive)	Salisbury	Outdoor Material Storage, Waste Management	Restaurant with cooking oil stored in 50 gallon drum that has no secondary containment or cover and lid is askew; other waste behind the building on the paved alley with staining evidence; drains to storm drain	Schedule a review of stormwater pollution prevention plan; Suggest follow-up on-site inspection; discuss proper cooking oil and waste management	Severe	$	Medium
TT_HSI_65	Behind the Fed Ex building complex (772 South Salisbury Blvd., Salisbury)	Salisbury	Waste Management	One Dumpster overflowing. Two dumpsters positioned right on top of a stormwater inlet.	Add an additional dumpsters where needed. Reposition dumpsters away from stormwater inlet (preferably near the building and under cover).	Not	$	Low
TT_HSI_29	Taylor Oil Company (~899 West Isabella Street)	Salisbury	Outdoor Material Storage	SealMaster ® big tank on gravel area that appears to be leaking a little of the black tar material	Suggest follow-up on-site inspection and determine if proper storage of the material is occurring, if not suggest proper storage	Potential	$	Low

Table E-2. Neighborhood Source Control Opportunities in Tony Tank

Site_ID	Location	Jurisdiction	Pollution Severity	Restoration Potential	Opportunity	Cost	Priority
TT_NSA_22	River Oak, Oak Hills, Riverside Homes - River Oak Court, Alabama Ave, Georgia Ave	Salisbury	Moderate	Moderate	Rain gardens or bioswale between Oak Hills Townhome buildings, retrofit concrete channel that drains parking lot directly to river or add buffering along river, tree planting in open area at River Oak, stencil storm drain inlets, highly maintained lawns, community pool - pool drainage education	$	High
TT_NSA_29	Village at Tony Tank Creek - Village Oak Drive, Sandy Bottom Court	Salisbury	Moderate	Moderate	Rain barrels, over manicured lawns, tree planting or rain garden in large traffic circle (currently just lawn), downspouts to pervious, buffering and trash clean up in storm water ponds, stencil storm drain inlets, non-target irrigation	$	High
TT_NSA_37	Willow Creek - Willow Creek Drive, Oxbridge Drive	County	High	High	Neighborhood stormwater pond needs maintenance at inlets and could use more buffering/tree planting, possible overgrown inlet/stream at south end of storm water pond, rain barrels, septic maintenance, better irrigation practices, street sweeping, ditches have concrete bottoms (retrofit opportunity), pool drainage education, large church property drains to pond - retrofits/buffering opportunities, church trash/dumping in back of property, tree planting, stencil storm drain inlets, rain gardens, highly maintained lawns	$$	High
TT_NSA_42	Village at Mitchell Pond - Parsons Road	Salisbury	Moderate	Moderate	Some bare soil - rehab walkways or redirect pedestrian traffic - precipitation erodes the soil to storm water inlets, better parking lot maintenance/long term parking, dumpsters are not covered and drain to storm water inlet, tree planting, stencil storm drain inlets, downspouts to pervious	$	High
TT_NSA_44-A	Duke Drive, Esquire Drive, Duchess Drive	County	Moderate	Moderate	Rain barrels, tree planting, downspouts to pervious, stencil storm drain inlets, septic maintenance, street sweeping	$	High

Table E-2. Neighborhood Source Control Opportunities in Tony Tank

Site_ID	Location	Jurisdiction	Pollution Severity	Restoration Potential	Opportunity	Cost	Priority
TT_NSA_44-B	Sassafras Meadows - Marquis Avenue	Salisbury	Moderate	Moderate	Tree planting, rain barrels, rain gardens, move downspouts to pervious/landscaping, stencil storm drain inlets	$$	High
TT_NSA_25	Francis Drive and Hall Drive	County	Moderate	Moderate	Rain barrels, street sweeping, landscaping, stencil storm drain inlets, septic maintenance	$	Medium
TT_NSA_26	University Village - Onley Road	Salisbury	Moderate	Moderate	Some tree planting, overgrown pond on east side, add buffering/landscaping at west storm water pond, connect downspouts to cisterns for irrigating, pervious pavers in parking lot, stencil storm drain inlets, highly maintained lawn	$	Medium
TT_NSA_33	Holiday Street, Liberty Way, Sandcastle Street	Fruitland	Moderate	Moderate	Street sweeping, change concrete swale to bioswale, stencil storm drain inlets	$	Medium
TT_NSA_35	Deer Harbour - Deer Harbour Drive, Five Friars Road, Devonshire Drive	County	High	Moderate	Disconnect downspouts, pool drainage education, storm drain outlets connect directly to streams, more buffering and tree planting in common area next to water, better lawn maintenance (highly manicured), stencil storm drain inlets, rain barrels	$	Medium
TT_NSA_36	Harbor Pointe - Harbor Pointe Drive, Anchors Way, Tressler Drive	Salisbury	Moderate	Moderate	Rain barrels, direct downspouts to pervious surfaces, rain gardens in street islands and front yards, overflow pond is overgrown, stencil storm drain inlets, tree planting, retrofit in dry swales, highly managed lawns	$$$	Medium
TT_NSA_38	Between Morris Street, West Road, Price Road, Booth Street	County	Moderate	Moderate	Rain barrels, street sweeping - plants are growing in gutters, area prone to flooding, roads are very wide (30-40 ft) - have potential for bioretention in streets	$	Medium
TT_NSA_40	The Cottages at River House - Riverhouse Drive	Salisbury	Moderate	Moderate	Fix one inlet to storm water pond - has scouring, add vegetation/buffering around pond - has geese problem, better lawn practice - highly manicured lawns, tree planting, rain barrels for irrigation, stencil storm drain inlets, downspouts to pervious	$	Medium

Table E-2. Neighborhood Source Control Opportunities in Tony Tank

Site_ID	Location	Jurisdiction	Pollution Severity	Restoration Potential	Opportunity	Cost	Priority
TT_NSA_43	Between Delaware Avenue, W Main Street, Fitzwater Street	Salisbury	Moderate	Moderate	Street sweeping, trash clean-up	$	Medium
TT_NSA_45	Pemberton Ponds - Strawberry Way	County	Moderate	Moderate	Rain barrels, tree planting, downspouts to pervious, add float wetlands in storm water pond due to large geese problem, stencil storm drain inlets, highly maintained lawns, septic system maintenance	$	Medium
TT_NSA_23	Between Maryland Ave, Waverly Drive, South Blvd, and Riverside Road	Salisbury	Moderate	Moderate	Rain barrels, street sweeping, stencil storm drain inlets, bioretention possible at Woodcock Park (see RRI volunteer form)	$	Low
TT_NSA_24	Ridge Road, N Pinehurst Drive, Manor Drive	Salisbury	Moderate	Low	Street sweeping, rain barrels, direct downspouts to landscaping, buffering opportunity along river, stencil storm drain inlets, irrigation education	$	Low
TT_NSA_27	Halsey Drive, Perry Drive, Spruell Drive, Cedar Crossing Road	Salisbury	Moderate	Moderate	Tree planting, rain barrels at single family homes, storm pond trash removal, stencil storm drain inlets, street sweeping, parking lot cleaning (car fluid leakage)	$	Low
TT_NSA_28	Aspen Hills, Eireann Mohr, Briarcliff - Aspend Drive, Ballindee Drive, Killarney Drive, Beckfort Court	Salisbury	Moderate	Low	Aspen Hills could use tree planting and landscaping and has open area for bioretention, Aspen Hills storm water pond needs buffering/potential for step pools, Eireann Mohr has concrete channels that could be changed to vegetated swales, stencil storm drain inlets, rain barrels, high maintenance turf, playground/park has ditch - potential retrofit opportunity	$	Low
TT_NSA_31	Between Riverside Drive, Elberta Avenue, and Camden Avenue	County	Moderate	Low	Street sweeping - lots of organic matter, rain gardens, downspouts to pervious, stencil storm drain inlets	$	Low

Table E-2. Neighborhood Source Control Opportunities in Tony Tank

Site_ID	Location	Jurisdiction	Pollution Severity	Restoration Potential	Opportunity	Cost	Priority
TT_NSA_32	Nutter's Crossing - Southampton Bridge Road and Stoneybrooke Drive	County	Moderate	Low	rain barrels, better lawn maintenance (highly groomed/maintained lawns), golf club house parking lot has retrofit potential, stencil storm drain inlets, tree planting, septic system maintenance, non-target irrigation	$	Low
TT_NSA_34	Eastfields - Nina Lane, Paddock Drive	Fruitland	High	Moderate	Rain barrels, lots of tree planting (there are few trees), street sweeping due to sediment in gutter, stencil storm drain inlets, buffering and tree planting around storm drain pond, geese problem around pond, better lawn maintenance, pool drainage education, downspouts to pervious	$	Low
TT_NSA_39	Booth Street Townhomes - Booth Street	County	Moderate	Moderate	Tree planting, landscaping, parking lot drains entirely to street, move downspouts to pervious, replace concrete swales with pervious, dumpster was overflowing, parking lot cleaning - organic matter and sediment	$	Low
TT_NSA_41	Pemberton Manor - Fairground Drive	Salisbury	Moderate	Moderate	Large open areas near tennis courts where water drains to could have rain garden/bioretention opportunity, tree planting in open areas, street sweeping for organic matter, unsure where some downspouts connect to - underground storage?, parking lot retrofit, stencil storm drain inlets, highly managed lawns, community pool - drainage education	$	Low

Table E-3. Stormwater Retrofit Opportunities in the Tony Tank Subwatershed

Site ID	Location	Jurisdiction	Retrofit Concept	Drainage Area (ac)	Impervious Cover (%)	% WQv Treated	Cost	TN Removal (lb/yr)	TP Removal (lb/yr)	TSS Removal (lb/yr)	Priority
TT_RRI_41A	Permberton Park	County	Regenerative Stormwater Conveyance	0.56	95	13%	$ 11,294	1.99	0.23	64.05	High
TT_RRI_41B	Permberton Park	County	Bioretention	0.71	95	118%	$ 96,159	7.14	0.83	230.25	High
TT_NSA_22B	Georgia Avenue Apartments	Salisbury	Bioretention	0.90	10	68%	$ 10,805	1.16	0.14	37.55	Medium
TT_NSA_23	Playground - Riverside and Pennsylvania Ave	Salisbury	Bioretention	0.61	25	250%	$ 83,424	2.29	0.27	73.76	Medium
TT_NSA_32	Nutters Crossing (Golf Course Club House)	County	Bioretention	0.22	90	60%	$ 14,094	1.65	0.19	53.12	Medium
TT_RRI_32A	Pinebluff Village	County	Bioretention	0.52	25	37%	$ 6,715	1.05	0.12	33.75	Medium
TT_RRI_32B	Pinebluff Village	County	Bioretention	0.32	5	102%	$ 3,990	0.33	0.04	10.53	Medium
TT_RRI_32C	Pinebluff Village	County	Bioretention	0.20	85	86%	$ 17,654	1.62	0.19	52.31	Medium
TT_RRI_38	Fruitland Primary	Fruitland	Bioretention	0.32	100	29%	$ 11,316	1.99	0.23	64.25	Medium
TT_RRI_75B	Canal Park	Salisbury	Regenerative Stormwater Conveyance	0.34	90	77%	$ 37,318	2.81	0.33	90.53	Medium
TT_RRI_76	Fruitland Water Treatment Plant	Fruitland	Bioretention	0.30	100	131%	$ 47,684	3.29	0.38	106.10	Medium
TT_RRI_31HSI	Seven Eleven (Nanticoke Road and South Salisbury Boulevard)	Salisbury	Infiltration	0.29	100	169%	$ 30,028	3.02	0.45	117.14	Medium
TT_RRI_53A	Wicomico Solid Waste Division	County	Wet Pond	2.67	100	124%	$ 79,959	13.41	3.02	659.46	Medium

Table E-3. Stormwater Retrofit Opportunities in the Tony Tank Subwatershed

Site ID	Location	Jurisdiction	Retrofit Concept	Drainage Area (ac)	Impervious Cover (%)	% WQv Treated	Cost	TN Removal (lb/yr)	TP Removal (lb/yr)	TSS Removal (lb/yr)	Priority
TT_RRI_53B	Wicomico Solid Waste Division	County	Dry Swale	3.64	95	38%	$ 54,623	20.75	2.65	723.29	Medium
TT_RRI_55	Salisbury Marina	Salisbury	Bioretention	1.35	100	127%	$ 207,304	14.57	1.69	470.10	Medium
TT_RRI_48	Salisbury Middle School	County	Impervious Cover Removal	0.22	100	100%	$ 21,172	2.66	0.36	78.37	Medium
TT_RRI_54B	Salisbury Plaza	Salisbury	Impervious Cover Removal	0.14	0.14	100%	$ 727	0.09	0.01	2.69	Medium
TT_RRI_44	Wicomico Nursing Home	County	Bioretention	0.98	95	63%	$ 70,966	8.02	0.93	258.66	Medium
TT_RRI_51	Wicomico County Roads Division HQ	County	Filtering Practice	3.33	100	14%	$ 25,360	5.90	1.59	348.14	Medium
TT_RRI_52A	Lower Shore Enterprise	County	Extended Detention Pond	3.10	85	250%	$ 881,441	5.36	1.09	791.33	Medium
TT_RRI_74	Maryland Food Bank of Eastern Shore	County	Dry Swale	0.75	90	71%	$ 20,219	5.23	0.67	182.25	Medium
TT_RRI_29_1a	405 Camden Ave	Fruitland	Bioretention	0.19	100	57%	$ 13,102	1.57	0.18	50.77	Medium
TT_RRI_29_1b	405 Camden Ave	Fruitland	Bioretention	0.20	100	74%	$ 17,805	1.82	0.21	58.61	Medium
TT_RRI_4_1	Lakewood and Arbutus Dr	County	Regenerative Stormwater Conveyance	1.68	25	30%	$ 22,770	8.11	1.09	239.11	Medium

Table E-3. Stormwater Retrofit Opportunities in the Tony Tank Subwatershed

Site ID	Location	Jurisdiction	Retrofit Concept	Drainage Area (ac)	Impervious Cover (%)	% WQv Treated	Cost	TN Removal (lb/yr)	TP Removal (lb/yr)	TSS Removal (lb/yr)	Priority
TT_RRI_49	Salvation Army	County	Regenerative Stormwater Conveyance	0.75	90	28%	$ 30,636	4.14	0.48	133.50	Low
TT_NSA_26	University Village	Salisbury	Infiltration	0.24	95	250%	$ 47,123	2.63	0.39	102.04	Low
TT_RRI_35	Fruitlamd City Office	Fruitland	Bioretention	0.19	100	50%	$ 11,222	1.46	0.17	47.07	Low
TT_RRI_62	Bowling Alley	County	Trash Rack	12.95	95	100%	$ 4,500	0.00	0.00	0.00	Low
TT_RRI_46	Salisbury Fire Department	Salisbury	Extended Detention Pond	4.75	95	140%	$ 247,060	7.84	1.59	1156.83	Low
TT_RRI_54A	Salisbury Plaza	Salisbury	Bioretention	2.38	100	181%	$ 520,958	28.33	3.29	914.13	Low
TT_RRI_72	Mitchell Landing Apt	Salisbury	Extended Detention Pond	0.95	80	116%	$ 34,712	1.26	0.26	186.19	Low
TT_RRI_45A	Salisbury Municipal Yard	Salisbury	Filtering Practice	1.00	100	7%	$ 3,653	0.69	0.19	40.83	Low
TT_RRI_45B	Salisbury Municipal Yard	Salisbury	Dry Swale	1.25	100	75%	$ 39,113	9.79	1.25	341.34	Low
TT_RRI_52B	Lower Shore Enterprise	County	Dry Swale	10.50	60	12%	$ 31,827	18.42	2.35	642.24	Low

Table E-4. Stream Impacts in the Tony Tank Subwatershed

Site ID	Location	Jurisdiction	Impact	Opportunity	Cost	Priority

Table E-4. Stream Impacts in the Tony Tank Subwatershed						
Site ID	**Location**	**Jurisdiction**	**Impact**	**Opportunity**	**Cost**	**Priority**
TTIB46_1	Mainstem Wicomico from downtown Salsibury to edge of natural gas facility	Salisbury	Impacted Buffer	Buffer enhancement / hotspot management	$$$	High
TTIB13_1	Canal Woods Park	Salisbury	Impacted Buffer	Buffer enhancement / wetland benches	$$	High
TTIB36_1	Rose St and south	Salisbury	Impacted Buffer	Buffer enhancement	$	High
TTIB5_1	Coulbourn Mill Pond	County	Impacted Buffer	Buffer enhancement	$$	High
TTTR36_1	Rose St	County/Salisbury	Trash	Trash clean-up	$	High
TTER9_1a	Nutters Cross Rd, south of Waycroft Dr.	County	Erosion	Erosion stabilization	$	Medium
TTIB1_1	Riverside Dr, downstream end of Tony Tank	County	Impacted Buffer	Living shorelines	$$$	Medium
TTIB47_1	Mainstem Wicomico from natural gas facility to confluence with Tony Tank creek	Salisbury	Impacted Buffer	Living shorelines	$$$	Medium
TTSC4_1	Division St	County	Stream Crossing / Dam	Pond treatment / education	$$	Medium
TTER9_1b	Nutters Cross Rd, south of Waycroft Dr.	County	Erosion	Erosion stabilization	$$	Medium

Table E-4. Stream Impacts in the Tony Tank Subwatershed						
Site ID	**Location**	**Jurisdiction**	**Impact**	**Opportunity**	**Cost**	**Priority**
TTSC30_1	South of Pemberton Drive and east of Pemberton Historical Park	County	Stream Crossing	Fish barrier removal	$$	Medium
TTIB19_1	Grosse Point Dr	County	Impacted Buffer	Buffer enhancement	$$	Medium
TTIB35_1	North of Fitzwater Street on the Right Bank of RCH35	Salisbury	Impacted Buffer	Buffer enhancement	$	Medium
TTIB48_1	Mainstem Wicomico from confluence with Tony Tank creek to edge of Tony Tank subwatershed boundary (just west of Sharps Point Rd)	County/Salisbury	Impacted Buffer	Buffer enhancement / wetland restoration	$$$	Medium
TTIB9_1	Nutters Cross Rd, south of Waycroft Dr.	County	Impacted Buffer	Buffer enhancement	$	Medium
TTOT36_1c	Rose St, left bank	County/Salisbury	Outfall	Discharge investigation	$	Medium
TTOT39_1b	South of Isabella St near coffe house	Salisbury	Outfall	Discharge investigation	$	Medium
TTTR40_1	North of Isabella St	Salisbury	Trash	Trash clean-up	$	Medium
TTIB10_1	Snow Hill Rd, north of Olde Fruitland Rd	County	Impacted Buffer	Buffer enhancement	$$	Medium

Table E-4. Stream Impacts in the Tony Tank Subwatershed						
Site ID	**Location**	**Jurisdiction**	**Impact**	**Opportunity**	**Cost**	**Priority**
TTIB44_1	American Legion Road	County	Impacted Buffer	Buffer enhancement	$	Medium
TTOT36_1b	Rose St, left bank	County/Salisbury	Outfall	Outfall stabilization / trash clean-up	$$	Medium
TTOT39_1a	South of Isabella St near coffe house	Salisbury	Outfall	Discharge investigation	$	Medium
TTOT2_1a	Camden Ave, upstream end of Tony Tank pond	County	Outfall	Outfall restoration	$$	Low
TTOT2_1b	Camden Ave, upstream end of Tony Tank pond	County	Outfall	Outfall restoration	$$	Low
TTOT2_1d	Camden Ave, upstream end of Tony Tank pond	County	Outfall	Outfall restoration	$$	Low
TTSC11_1	Nutters Cross Rd, just northeast of Coulbourn Mill Rd	County	Stream Crossing	Culvert replacement	$$	Low
TTSC26_1	Riverside Dr, east of Sharps Point Rd	County	Stream Crossing	Fish barrier removal	$$	Low
TTSC43_1	Brick Kiln Road, north of Old Quantico Road	County	Stream Crossing	Fish barrier removal	$$	Low
TTSC44_1	American Legion Road	County	Stream Crossing	Fish barrier removal	$$	Low

Table E-4. Stream Impacts in the Tony Tank Subwatershed						
Site ID	**Location**	**Jurisdiction**	**Impact**	**Opportunity**	**Cost**	**Priority**
TTIB2_1	Camden Ave, upstream end of Tony Tank pond	County	Impacted Buffer	Buffer enhancement	$$$	Low
TTOT2_1c	Camden Ave, upstream end of Tony Tank pond	County	Outfall	Outfall restoration	n/a	Low
TTOT40_1	North of Isabella St	Salisbury	Outfall	Outfall restoration	$$	Low
TTCM13_1	Canal Woods Park	Salisbury	Channel Modification	Stream is diverted along Rt 13, southwest, to join southern prong. Area floods in this location, likely because of constricted and modified flow pattern. Unknown resolution.	n/a	n/a
TTOT13_1	Canal Woods Park	Salisbury	Outfall	Outfall restoration	n/a	n/a
TTSC1_1	Riverside Dr over Tony Tank pond	County	Stream Crossing	Not a restoration candidate.	n/a	n/a
TTSC2_1	Camden Ave, upstream end of Tony Tank pond	County	Stream Crossing	Bridge, under-sized for flow but not likely a restoration candidate	n/a	n/a

Table E-4. Stream Impacts in the Tony Tank Subwatershed						
Site ID	**Location**	**Jurisdiction**	**Impact**	**Opportunity**	**Cost**	**Priority**
TTSC33_1	Bells Island Trl	Salisbury	Stream Crossing	Not a restoration candidate. Dumping of grass clippings into buffer/around culvert - education.	n/a	n/a
TTSC36_1	Rose St	County/Salisbury	Stream Crossing	Not a restoration candidate.	n/a	n/a
TTSC39_1	Isabella St, west of Rt 50	Salisbury	Stream Crossing / Dam	Not a restoration candidiate.	n/a	n/a
TTSC39_2	Mitchell Road between TT_RCH39 & TT_RCH35	Salisbury	Dam	Road Crossing; weir controls water entering from RCH39 to RCH35; weir is a 5 feet diameter circular pipe that feeds down to pipe leading to RCH-35	n/a	n/a
TTSC9_1	Nutters Cross Rd, south of Waycroft Dr.	County	Stream Crossing	Not a restoration candidate.	n/a	n/a
TTER4_1	South of Arbutus Dr.	County/Salisbury	Erosion	See TT_RRI_4_1	n/a	n/a
TTIB43_1	County Recycling Center	County	Impacted Buffer	Not a restoration candidiate.	n/a	#N/A

Table E-4. Stream Impacts in the Tony Tank Subwatershed

Site ID	Location	Jurisdiction	Impact	Opportunity	Cost	Priority
TTOT36_1a	Rose St, right bank	County/Salisbury	Outfall	Dry outfall. Not a restoration candidate.	n/a	n/a
TTOT46_1	Right bank of Wicomico River near Chesapeake Shipbuilders	Salisbury	Outfall	Partially submerged, assessed from boat. Cannot tell if there is a discharge.	n/a	n/a
TTOT46_2	Right bank of Wicomico River near Chesapeake Shipbuilders	Salisbury	Outfall	Partially submerged, assessed from boat. Cannot tell if there is a discharge.	n/a	n/a
TTOT46_3	Left bank of Wicomico River near River Oak Ct.	Salisbury	Outfall	Partially submerged, assessed from boat. Cannot tell if there is a discharge.	n/a	n/a
TTSC14_1	Division St	Fruitland	Stream Crossing / Dam	Morris Mill Pond. Not a restoration candidate.	n/a	n/a
TTSC18_1	Jackson Rd, southwest of Union Church Rd.	County	Stream Crossing	Not a restoration candidate.	n/a	n/a

Table E-5. Tree Planting Opportunities in the Tony Tank Subwatershed

Site_ID	Subwatershed	Latitude	Longitude	Related Assessment	Area (acres)	Notes
TP_01A	Tony Tank	38.36134540610	-75.60995854110	NSA	0.5	NSA_22 - Common area - condos

Table E-5. Tree Planting Opportunities in the Tony Tank Subwatershed

Site_ID	Subwatershed	Latitude	Longitude	Related Assessment	Area (acres)	Notes
TP_01B	Tony Tank	38.36089370640	-75.61162090950	NSA	1.0	NSA_22 - Common area
TP_01C	Tony Tank	38.35985071100	-75.61226194720	NSA	0.7	NSA_22 - Common area
TP_02A	Tony Tank	38.34281104530	-75.58938958510	NSA	0.2	NSA_22 - Common area
TP_02B	Tony Tank	38.34271113480	-75.58872147450	NSA	0.2	NSA_26 - Common area
TP_02C	Tony Tank	38.34261189930	-75.58806164460	NSA	0.2	NSA_26 - Common area
TP_03A	Tony Tank	38.34480280410	-75.59422831080	NSA	0.4	NSA_27 - Individual lots
TP_03B	Tony Tank	38.34269879850	-75.59426622050	NSA	0.2	NSA_27 - Individual lots
TP_03C	Tony Tank	38.34242337950	-75.59680005350	NSA	0.5	NSA_27 - Individual lots
TP_03D	Tony Tank	38.34272589770	-75.59777529350	NSA	0.5	NSA_27 - Individual lots
TP_04A	Tony Tank	38.33591761880	-75.59117907090	NSA	1.0	NSA_28 - Common area/stormwater retention/backyards
TP_04B	Tony Tank	38.33545150390	-75.59212360060	NSA	0.7	NSA_28 - Individual lots/stormwater pond
TP_04C	Tony Tank	38.33651849180	-75.59083379670	NSA	1.1	NSA_28 - Individual lots
TP_04D	Tony Tank	38.33463060880	-75.59219345750	NSA	1.1	NSA_28 - Empty lot/private land?
TP_04E	Tony Tank	38.33249847650	-75.59291243600	NSA	1.1	NSA_28 - Individual lots
TP_05	Tony Tank	38.33102640090	-75.60330107740	NSA	0.3	NSA_29 - Common area - traffic island
TP_06A	Tony Tank	38.31943488450	-75.57251803710	NSA	2.4	NSA_32 - Individual lots
TP_06B	Tony Tank	38.32396244250	-75.56607710080	NSA	0.6	NSA_32 - Individual lots
TP_06C	Tony Tank	38.32474232180	-75.56461883510	NSA	1.8	NSA_32 - Individual lots
TP_06D	Tony Tank	38.32465153010	-75.56295534550	NSA	1.3	NSA_32 - Individual lots
TP_06E	Tony Tank	38.31919349670	-75.57322257360	NSA	2.3	NSA_32 - Individual lots
TP_07A	Tony Tank	38.30846965250	-75.61915524510	NSA	1.6	NSA_34 - Stormwater pond
TP_07B	Tony Tank	38.30986199000	-75.61973344060	NSA	1.9	NSA_34 - Individual lots
TP_07C	Tony Tank	38.30725606830	-75.61566836310	NSA	0.8	NSA_34 - Individual lots
TP_07D	Tony Tank	38.30729288010	-75.62114621540	NSA	1.1	NSA_34 - Individual lots
TP_07D	Tony Tank	38.30679336340	-75.61821372640	NSA	5.4	NSA_34 - Individual lots
TP_08A	Tony Tank	38.30514660880	-75.57803642330	NSA	6.2	NSA_35 - Common area
TP_08B	Tony Tank	38.30427196670	-75.57947904030	NSA	3.1	NSA_35 - Common area

Table E-5. Tree Planting Opportunities in the Tony Tank Subwatershed

Site_ID	Subwatershed	Latitude	Longitude	Related Assessment	Area (acres)	Notes
TP_09A	Tony Tank	38.35222275970	-75.63568022130	NSA	2.7	NSA_36 - Individual lots
TP_09B	Tony Tank	38.35186512040	-75.63416700760	NSA	1.7	NSA_36 - Individual lots
TP_09C	Tony Tank	38.35365182140	-75.63153278270	NSA	0.9	NSA_36 - Common area
TP_09D	Tony Tank	38.35364768560	-75.63472812570	NSA	2.2	NSA_36 - Common area
TP_09E	Tony Tank	38.35326698440	-75.63716536410	NSA	4.6	NSA_36 - Common area
TP_10A	Tony Tank	38.36615274960	-75.64478013950	NSA	1.9	NSA_37 - Common area - stormwater pond
TP_10B	Tony Tank	38.36702156160	-75.64612813520	NSA	3.5	NSA_37 - Individual lots
TP_10C	Tony Tank	38.36823179460	-75.64363702140	NSA	7.0	NSA_37 - Individual lots
TP_10D	Tony Tank	38.36587410960	-75.64098915190	NSA	5.7	NSA_37 - Individual lots
TP_10E	Tony Tank	38.36407603190	-75.64113692290	NSA	4.6	NSA_37 - Individual lots
TP_10F	Tony Tank	38.36465647620	-75.64768254200	NSA	2.6	NSA_37 - Individual lots
TP_10G	Tony Tank	38.36682093030	-75.65066109980	NSA	12.6	NSA_37 - Large church property
TP_11	Tony Tank	38.37784350290	-75.61568109380	NSA	3.2	NSA_39 - Common area
TP_12A	Tony Tank	38.36211210890	-75.62311277560	NSA	0.3	NSA_40 - Common area
TP_12B	Tony Tank	38.36046619260	-75.62097227610	NSA	1.7	NSA_40 - Common area
TP_13A	Tony Tank	38.36524311210	-75.61721152100	NSA	1.5	NSA_41 - Common area
TP_13B	Tony Tank	38.36443285780	-75.61828898240	NSA	0.6	NSA_41 - Common area
TP_14A	Tony Tank	38.36665565560	-75.61636020190	NSA	0.2	NSA_42 - Common area
TP_14B	Tony Tank	38.36682680990	-75.61558448750	NSA	0.2	NSA_42 - Common area
TP_15A	Tony Tank	38.39192778490	-75.62060795040	NSA	0.9	NSA_44-A - Individual lots
TP_15B	Tony Tank	38.39175210770	-75.61974690780	NSA	1.9	NSA_44-A - Individual lots
TP_16A	Tony Tank	38.39248321500	-75.61934013960	NSA	1.2	NSA_44-B - Individual lots
TP_16B	Tony Tank	38.39066230500	-75.61761043210	NSA	0.9	NSA_44-B - Individual lots
TP_16C	Tony Tank	38.39193759750	-75.61791831820	NSA	2.1	NSA_44-B - Individual lots
TP_17A	Tony Tank	38.36061736480	-75.63252238970	NSA	3.2	NSA_45 - Individual lots
TP_17B	Tony Tank	38.36150654650	-75.63356213100	NSA	1.9	NSA_45 - Individual lots
TP_17C	Tony Tank	38.36073549790	-75.63514382000	NSA	1.0	NSA_45 - Individual lots

Table E-5. Tree Planting Opportunities in the Tony Tank Subwatershed

Site_ID	Subwatershed	Latitude	Longitude	Related Assessment	Area (acres)	Notes
TP_17D	Tony Tank	38.36233437570	-75.63644033290	NSA	1.5	NSA_45 - Individual lots
TP_17E	Tony Tank	38.36335199690	-75.63572188260	NSA	1.5	NSA_45 - Individual lots
TP_18	Tony Tank	38.36490275400	-75.61319407960	USA	0.6	North of Fitzwater Street
TP_19	Tony Tank	38.37674068540	-75.61899073570	USA	2.0	American Legion Road
TP_20	Tony Tank	38.32982924520	-75.59480817630	USA	0.6	Colbourne Mill Pond
TP_07E	Tony Tank	38.30855983520	-75.61775626170	NSA	2.5	NSA_34 - Individual lots
TP_07F	Tony Tank	38.30957743570	-75.61821027680	NSA	1.7	NSA_34 - Individual lots
TP_17F	Tony Tank	38.35984153710	-75.63174497720	NSA	1.8	NSA_45 - Stormwater pond
TP_17G	Tony Tank	38.35910158660	-75.63188103880	NSA	0.8	NSA_45 - Common area
TP_10H	Tony Tank	38.36737437140	-75.64529904850	NSA	0.9	NSA_37 - Common area (was RRI_NSA_37 - Runoff reduction)
TP_22A	Tony Tank	38.30733450560	-75.57834601790	USA	0.4	Grosse Pointe Dr
TP_22B	Tony Tank	38.30519503500	-75.57455770370	USA	0.7	Grosse Pointe Dr
TP_22C	Tony Tank	38.30503932020	-75.57645452450	USA	0.4	Grosse Pointe Dr
TP_23	Tony Tank	38.30776287900	-75.53564710030	USA	2.1	Snow Hill Rd ag ditch
TP_26A	Tony Tank	38.36378949340	-75.60807167680	USA	1.3	Wicomico from downtown to energy facility
TP_26B	Tony Tank	38.36412152050	-75.60511067510	USA	0.4	Wicomico from downtown to energy facility
TP_26C	Tony Tank	38.36192523260	-75.61044008390	USA	0.1	Wicomico from downtown to energy facility
TP_27A	Tony Tank	38.35170195110	-75.62021115810	USA	2.6	Wicomico from energy facility to Tony Tank creek
TP_27B	Tony Tank	38.34746064360	-75.63149542220	USA	0.5	Wicomico from energy facility to Tony Tank creek
TP_28	Tony Tank	38.34070702760	-75.63809241270	USA	1.1	Wicomico from Tony Tank creek to watershed boundary
TP_29	Tony Tank	38.34186761020	-75.63049728770	USA	0.2	Riverside Dr
TP_30B	Tony Tank	38.33362216860	-75.60772226620	USA	0.2	Canal Park
TP_30A	Tony Tank	38.33254216290	-75.60913685900	USA	0.1	Canal Park
TP_01D	Tony Tank	38.36077708380	-75.61264609000	NSA	0.1	Common Area - Georgia Ave Apts

Appendix F – Ranking Metrics

Potential projects in the South Prong and Tony Tank subwatersheds were inventoried following the completion of the stream assessment, upland assessment, and stormwater retrofit inventory. A ranking system was developed to prioritize candidate projects within each assessment. Using best professional judgment, stormwater retrofit, hotspots, neighborhood, ESC sites, and stream impact projects were assigned points and ranked according to the following factors:

- *Cost* – The cost associated with project implementation
- *Community Education and Involvement* – Project with potential to educate and involve the community
- *Visibility* – Project with high visibility and potential to raise the public's awareness of the watershed (visible from street or located in public park)
- *Feasibility* – Project with high potential that it will be implemented. The site has access for equipment, low maintenance burden, serves as a demonstration site and is publicly owned
- *Water Quality Improvement* – Potential for treatment or prevention of pollutants. Treats water quality volume or eliminates exposure of pollutants to stormwater runoff
- *Ecological Benefit* – Project provides an ecological, habitat, or natural resource protection benefit
- *Protection Priority* – Location of project in relation to High Priority Protection Areas and Protection Areas
- *Meeting Watershed Objectives* – Potential for project to assist in achieving watershed objectives

Water quality improvement was given the highest weight of all criteria. Cost was given the second highest weight, followed by feasibility and protection priority, both of which received equal weighting. Watershed goals identified by Wicomico River stakeholders were factored into the project ranking as well. Each of the three goals was given a weight of two points, with the exception of Goal 4, which was already accounted for under community education and involvement. The more objectives a project met, the higher the end score.

The ranking system was based on 120 points. Each project screening factor and ranking criteria is outlined in Table D-1.

Table F-1. Scoring criteria for identified projects in the South Prong and Tony Tank subwatersheds			
Project Screening Factor	**Total Weight**	**Scoring Criteria**	
Cost	20	Low cost	16
		Medium cost	10
		High cost	5
Community Education and Involvement	12	High educational benefit or potential to involve community in project implementation	12
		Medium educational benefit or potential to involve community in project implementation	7
		Low educational benefit or potential to involve community in project implementation	3
Visibility	10	High visibility and potential to raise the public's awareness of the project	10
		Medium visibility and potential to raise the public's awareness of the project	5
		Low visibility and potential to raise the public's awareness of the project	2
Feasibility	15	High potential that this project will be implemented	15
		Medium potential that this project will be implemented	10
		Low potential that this project will be implemented	5
Water Quality Improvement	30	*Add for any projects draining to headwater streams*	5
		High potential for treatment or prevention of pollutants	25
		Medium potential for treatment or prevention of pollutants	15
		Low potential for treatment or prevention of pollutants	5
Ecological Benefit	12	High ecological, natural resource protection, or habitat benefit provided	10
		Medium ecological, natural resource protection, or habitat benefit provided	5
		Low ecological, natural resource protection, or habitat benefit provided	2
Protection Priority	15	Project is located in High Priority Protection Area	15
		Project is located in Priority Protection Area	10
		Directly adjacent to High Priority or Priority Protection Area	5
Goal 1	2	Improve water quality	2
Goal 2	2	Protect existing resources, particularly green infrastructure, ecologically significant areas, farmland, and drinking water supplies	2
Goal 3	2	Restore watershed function, particularly green infrastructure, in-stream and upland habitat, and shellfish beds	2

Table F-1. Scoring criteria for identified projects in the South Prong and Tony Tank subwatersheds			
Project Screening Factor	**Total Weight**	**Scoring Criteria**	
Goal 4	0	Educate the public on watershed restoration efforts; accounted for above in Community Education and Involvement	0
Total Points	120		

Project costs represent only planning level estimates and were determined based on guidance provided in Schueler et al. (2007), Wright et al. (2005), Kitchell and Schueler (2004), King and Hagan, 2011 and best professional judgment. High, medium and low thresholds to determine priority differ among project types and these are defined below.

Stormwater Retrofits

High: Estimated Planning Level Cost < $30,000
Medium: Estimated Planning Level Cost $30,000-$100,000
Low: Estimated Planning Level Cost > $100,000

Neighborhood Projects

High: Estimated Planning Level Cost < $5,000
Medium: Estimated Planning Level Cost $5,000-$20,000
Low: Estimated Planning Level Cost > $20,000

Stream Projects

High: Estimated Planning Level Cost < $2,000
Medium: Estimated Planning Level Cost $2,000-$8,000
Low: Estimated Planning Level Cost > $8,000

Hotspot Projects

High: Estimated Planning Level Cost < $5,000
Medium: Estimated Planning Level Cost $5,000-$10,000
Low: Estimated Planning Level Cost > $10,000

For stormwater retrofit practices, three factors were used to determine the overall water quality of a particular practice and priority rating. These factors are defined below.

Water Quality Improvement 1

High: Tv/WQv =1.0
Medium: Tv/WQv =0.5 - 1.0
Low: Tv/WQv <0.5

Water Quality Improvement 2

High: TN>30
Medium: TN>15
Low: TN<5

Water Quality Improvement 3

High: Wet Ponds, Constructed wetlands
Medium: Wetlands, Bioretention, Infiltration, IC removal
Low: All others

Appendix G – Maryland Assessment and Scenario Tool Scenarios

MAST Scenario for the Wicomico River South Prong Subwatershed Action Plan

Introduction

The Center for Watershed Protection (Center) performed field assessments for the City of Salisbury in the South Prong subwatershed. This work identified specific stormwater management and other watershed improvement projects to support the subwatershed action plan. The proposed water quality improvement, protection, and restoration projects were input into the Maryland Assessment and Scenario Tool (MAST) to determine a potential N, P, and sediment reduction.

Watershed Plan Field Work

In June, 2012, field work was conducted in the 23.15 square mile South Prong subwatershed of the Wicomico River. The watershed field assessment strategy aimed to meet initial watershed restoration and protection goals outlined by the watershed planning Core Team and watershed stakeholders. These general watershed goals were to:

- Improve water quality;
- Protect existing resources; and
- Restore watershed function

During these field assessments, the field crew teams, consisting of one Center staff and volunteers from the Wicomico Environmental Trust, Wicomico County, and other interested individuals, visited over 184 locations in the watershed to identify areas to improve water quality, to protect resources, and to restore watershed function. These field assessments used the Stormwater Retrofit Inventory (Schueler et al., 2007), Hotspot Site Investigation, Neighborhood Source Assessment (Wright et al., 2005), and/or Unified Stream Assessment (Kitchell and Schueler, 2004) to evaluate the feasibility of implementing a management or restoration practice. Approximately 46 potential stormwater retrofit sites, 16 potential hotspot locations, 23 residential neighborhoods, and 8.4 miles of stream (22 stream reaches) were assessed in the South Prong subwatershed. Table E-1 provides a summary of general findings from the field assessments. The field findings were ranked, priced, and pollutant load efficiencies were estimated where possible. These findings will be included in the Wicomico River South Prong Subwatershed Action Plan (*Plan*) submitted to the City of Salisbury in 2012. The Plan will be used as a roadmap to improve water quality, protect resources, and restore the watershed function. The *Plan* will also support the Wicomico County and the City of Salisbury Phase II Watershed Implementation (WIP).

Table G-1. General findings from field assessments.

Task	General Findings
Stormwater Retrofit Inventory	• 46 sites visited • 67 potential stormwater retrofits identified for 39 sites • Focus on water quality treatment • Identified 6 high priority projects and 48 medium priority projects • Types of retrofits include bioretention areas, infiltration, constructed wetlands, sand filters, and impervious cover removal

Table G-1. General findings from field assessments.	
Task	**General Findings**
Hotspot Site Investigation	• 25 potential hotspot sites investigated • 5 sites identified as potential, confirmed or severe hotspots
Neighborhood Source Assessment	• 23 neighborhoods assessed • Pollution severity index: 19 moderate, 4 high • Neighborhood restoration potential: 7 low, 13 moderate and 3 high • Neighborhoods were mix of older and newer single family homes, most without downspouts or disconnected • Types of recommendations include rain barrels, demonstration rain gardens, free community trainings, storm drain stenciling, tree planting, buffer management, and nutrient/lawn homeowner management outreach
Unified Stream Assessment	• Walked 8.4 miles of stream • Assessed 22 stream reaches and impacts to 2 ponds • Completed site impact evaluations at 6 stream crossings, 7 modified channels, 1 erosion site, 18 outfalls, 13 impacted buffers, 1 trash site, 3 dams and 1 miscellaneous impact • Identified 20 project, including 7 high priority riparian corridor projects • Major findings include reaches with abundant trash in lower reaches, many dry channels in the headwaters, areas of excellent habitat and intact buffers in the upper reaches, poor stream buffers in the lower reaches, several channel modifications, and invasive Japanese knotweed noted throughout the watershed

MAST Findings

Projects identified in the Plan were input into a MAST scenario to estimate the pollutant load reductions achieved through the *Plan's* project implementation. MAST is a tool that evaluates alternative load reduction strategy scenarios and provides information valuable for decision making. The urban BMP strategies were developed as urban runoff loading decks using the MAST. These strategies represent planning level efforts as opposed to an engineering grade report and have not been endorsed or adopted by any member jurisdiction. Therefore, the loading decks are presented to identify potential Best Management Practices (BMPs) for future consideration in the *Plan* and to provide options for Maryland to meet water quality standards in the Chesapeake Bay.

The strategies reflected in the loading decks are based on field work, discussions with Center staff that are currently developing the Wicomico County Draft Phase II WIP Technical Addendum, and limited spatial data analysis using Geographic Information Systems (ArcGIS 10). In order to input the Plan's projects into MAST the following actions were performed:

- Center internal meeting and training for Wicomico County Phase II WIP Assistance and MAST;
- Identify the *Plan's* stormwater retrofit, neighborhood, and stream projects applicable for MAST;

- Determine which *Plan* projects and when applicable what % of the project is located in the City of Salisbury or in Wicomico County;
- Determine the corresponding MAST Urban BMP type for each *Plan* project;
- Determine appropriate *Plan* project data needed for MAST input (e.g., impervious area, pervious area, linear feet, number of trees planted, etc.);
- Consolidate and organize *Plan* project data in a database for MAST input;
- Input the *Plan's* projects into the appropriate MAST City (Municipal Phase II MS4 Impervious/Municipal Phase II MS4 Pervious) or County (nonregulated impervious developed/nonregulated pervious developed) urban sector land use (see Table E-2);
- Save the *Plan's* MAST Scenario;
- Develop a MAST 2010 Progress Scenario for the baseline pollutant load; and
- Use MAST's "Compare Scenarios" for the 2010 Progress Scenario to the *Plan's* MAST Scenario to determine the % change of N, P, and sediment delivered (Table E-3).

Table G-2. Input data for the *Plan's* MAST Scenario.

Location	Urban BMP Type	Impervious Area (acre)	Pervious Area (acre)	Notes
City of Salisbury	Bioretention/raingardens	21.32	12.35	
	Urban Infiltration Practices-with sandveg no underdrain	15.00	5.98	
	Wet Pond and Wetlands	5.85	0.38	Constructed Wetland
	Impervious Urban Surface Reduction	26.08	NA	
	Urban Tree Planting; Urban Tree Canopy	NA	NA	3.9 pervious urban area converted to forest (acres)*
	Urban Nutrient Management	9.85	26.65	
	Urban Forest Buffers	NA	5.28	
	Urban Stream Restoration (interim)	NA	NA	1370 linear feet; pervious land use only
Wicomico County	Bioretention/raingardens	18.56	10.20	
	Urban Infiltration Practices-with sandveg no underdrain	17.39	18.59	
	Wet Pond and Wetlands	79.17	546.53	
	Impervious Urban Surface Reduction	0.07	NA	
	Urban Tree Planting; Urban Tree Canopy	NA	NA	3.5 pervious urban area converted to

Table G-2. Input data for the *Plan's* MAST Scenario.				
Location	**Urban BMP Type**	**Impervious Area (acre)**	**Pervious Area (acre)**	**Notes**
				forest (acres)*
	Urban Nutrient Management	12.29	58.71	
	Urban Forest Buffers	NA	4.35	
* Planting 100 trees is equivalent to one acre of "pervious urban" to forest (MDE, 2011).				

Table G-3. Urban land use load reductions for N, P, and sediment. The load reductions are the % change from the MAST 2010 Progress Scenario to the *Plan's* MAST Scenario.			
Land Use Sector	**% N Reduction**	**%P Reduction**	**% Sediment Reduction**
Municipal Phase II MS4 Impervious	1.9%	2.1%	2.4%
Municipal Phase II MS4 Pervious	1.5%	10.4%	100%
Nonregulated Impervious Developed	0.8%	1.2%	1.7%
Nonregulated Pervious Developed	0.9%	1.7%	2.2%

Summary

The *Plan* projects can reduce pollutant loads in the City of Salisbury and Wicomico County. These projects are estimated to cost about $7.3 million. Pollutant load reduction can be achieved through community action and through Plan implementation (Table E-4). Inputting these planning level projects into MAST determines the pollutant load reduction and communicates findings between user groups. In addition, this information can support decisions to implement projects that will meet city, county, state, community, and Chesapeake Bay goals. Future work can include: 1) present these findings to the appropriate user groups; 2) track future implementation and actual pollutant load reductions, and 3) refine the MAST scenarios using the best available information.

Table G-4. The *Plan's* MAST Scenario urban land use load reductions for N, P, and sediment.			
Land Use Sector	**N (lbs)**	**P (lbs)**	**Sediment (lbs)**
Urban	2,482	309	278,494

References

Kitchell, A. and T. Schueler. 2004. *Unified Stream Assessment: A User's manual. Manual 10 in the Urban Subwatershed Restoration Manual Series.* Center for Watershed Protection. Ellicott City, MD.

Maryland Department of the Environment (MDE). 2011. *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated: Guidance for National Pollutant Discharge Elimination System Stormwater Permits (Draft).* Baltimore, MD.

Schueler, T., Hirschman, D., Novotney, M., and J. Zielinski. 2007. *Urban Stormwater Retrofit Practices Version 1.0. Manual 3 in the Urban Subwatershed Restoration Manual Series*. Center for Watershed Protection. Ellicott City, MD.

Wright, T., C. Swann, K. Cappiella, T. Schueler. 2005. *Unified Subwatershed and Site Reconnaissance: A User's Manual-Version 2.0. Manual 11 in the Urban Subwatershed Restoration Manual Series*. Center for Watershed Protection. Ellicott City, MD.

MAST Scenario for the Wicomico River
Tony Tank Subwatershed Action Plan

The Center for Watershed Protection (Center) performed field assessments during November 2012 in the Wicomico River Tony Tank subwatershed. This work identified specific stormwater management and other watershed improvement projects to support the subwatershed action plan. The proposed water quality improvement, protection, and restoration projects were input into the Maryland Assessment and Scenario Tool (MAST) to determine a potential N, P, and TSS reduction.

In order to input the Plan's projects into MAST the following actions were performed:

- Identify the Plan's stormwater retrofit, neighborhood, and stream projects applicable for MAST;
- Determine which Plan projects and when applicable what % of the project is located in the City of Salisbury or in Wicomico County;
- Determine the corresponding MAST Urban and Agricultural BMP type for each Plan project;
- Determine appropriate Plan project data needed for MAST input (e.g., impervious area, pervious area, linear feet, number of trees planted, etc.);
- Consolidate and organize Plan project data in a database for MAST input;
- Input the Plan's projects into the appropriate MAST City (Municipal Phase II MS4 Impervious/Municipal Phase II MS4 Pervious), County (nonregulated impervious developed/nonregulated pervious developed) and agricultural land uses (see Tables E-5 - E-7);
- Develop a MAST 2010 Progress Scenario for the baseline pollutant load; and
- Compare the 2010 Progress Scenario and the Plan's MAST Scenario to determine the reduction of N (Table E-8), P (Table E-9), and TSS delivered (Table E-10).

Table G-5. Stormwater Retrofit Input Data for the Tony Tank MAST Scenario

Location	Urban BMP Type	Impervious Area (acres)	Pervious Area (acres)
City of Salisbury (Municipal Phase II MS4)	Bioretention A/B Soils	-	-
	Bioretention C/D Soils	3.97	1.26
	Infiltration	0.52	0.01
	Regenerative Stormwater Conveyance	-	100 ft
	Regenerative Stormwater Conveyance (Retrofit of Existing Practice)	-	-
	Wet Pond (Retrofit of Existing Practice)	-	-
	Dry Swale A/B Soils	-	-
	Dry Swale C/D Soils	1.25	0.00
	Extended Detention Pond (Retrofit of Existing Practice)	5.27	0.43

Table G-5. Stormwater Retrofit Input Data for the Tony Tank MAST Scenario			
Location	**Urban BMP Type**	**Impervious Area (acres)**	**Pervious Area (acres)**
	Impervious Cover Removal	0.14	0.00
	Urban Filtering Practice	1.00	0.00
Wicomico County (Nonregulated Developed)	Bioretention A/B Soils	1.67	0.79
	Bioretention C/D Soils	1.64	0.05
	Infiltration	-	-
	Regenerative Stormwater Conveyance	-	246 ft
	Regenerative Stormwater Conveyance (Retrofit of Existing Practice)	-	100 ft
	Wet Pond (Retrofit of Existing Practice)	2.67	0.00
	Dry Swale A/B Soils	10.43	4.46
	Dry Swale C/D Soils	-	-
	Extended Detention Pond (Retrofit of Existing Practice)	2.64	0.47
	Impervious Cover Removal	0.22	0.00
	Urban Filtering Practice	3.33	0.00

Table G-6. Living Shoreline and Forest Buffers for the Tony Tank MAST Scenario		
Location	**Urban BMP Type**	**Pervious Acres or Feet**
City of Salisbury (Municipal Phase II MS4)	Living Shoreline	10,350 ft
	Forest Buffer	0.66 ac
Wicomico County (Nonregulated)	Living Shoreline	2,361 ft
	Forest Buffer	1.20 ac
Agriculture (Hightill w/Manure)	Living Shoreline	-
	Forest Buffer	2.15 ac

Table G-7. Urban Tree Planting on Institutional, Neighborhood Common Areas, and Neighborhood Individual Lots for the Tony Tank MAST Scenario	
Location	**Pervious Acres**
City of Salisbury (Municipal Phase II MS4)	41.0
Wicomico County (Nonregulated)	77.6

MAST contains a predefined list of BMPs that can be selected. Assumptions made to align the projects identified for the Tony Tank subwatershed with the BMPs available in MAST include:

- Soil type was not measured in the field. To account for practices in MAST that are categorized according to soil type (e.g., bioretention on A/B soils, bioretention on C/D soils, etc), a desktop GIS analysis was conducted that intersected the Tony Tank project points with USDA SSURGO data.
- MAST currently does not have an option to account for retrofits of existing practices. In order to estimate the load reduction attributed to these retrofits, only half the area treated by these practices was entered into MAST.
- Urban infiltration practices in MAST are currently only listed for A/B soils. However, the two infiltration practices identified in the Tony Tank subwatershed are on C/D soils. These practices were entered into MAST under the urban infiltration practices on A/B soils option.
- A trash rack was identified as potential project during fieldwork, but was not included in the MAST scenario because there was no BMP equivalent in the tool.
- Dry swales identified during fieldwork were entered into MAST as vegetated open channels.
- Forest buffers on agricultural land were entered into MAST under the Hightill w/Manure land use based on observation made during field work. A GIS layer for the specific land uses included in MAST could not be located to verify this assumption.
- The urban forest buffer BMP in MAST requires a 35 ft minimum buffer width. However, some of the buffers recommended for the Tony Tank subwatershed are less than 35 ft. These were still entered into MAST as the total acreage of forest buffers. A 35 ft buffer is not always easy to implement, especially in urban areas where space is limited adjacent to the stream corridor. A Chesapeake Bay Program forest buffer Expert Panel is currently underway to reevaluate this BMP and the minimum buffer width may be adjusted in the future.
- Living shorelines identified during fieldwork were entered into MAST as shoreline erosion control.

Table G-8. N Load Reduction from the Tony Tank MAST Scenario

Land Use Sector	2010 Progress Load (lbs)	Tony Tank Scenario Load (lbs)	% Reduction from 2010 Progress
Municipal Phase II MS4 Impervious	31,059	31,032	0.09%
Municipal Phase II MS4 Pervious	21,121	20,925	0.93%
Nonregulated Impervious Developed	61,892	61,814	0.13%
Nonregulated Pervious Developed	131,475	130,990	0.37%
Hightill w/Manure	4,355	4,354	0.02%
Total County Load	1,746,837	1,746,075	0.04%

Table G-9. P Load Reduction from the Tony Tank MAST Scenario			
Land Use Sector	**2010 Progress Load (lbs)**	**Tony Tank Scenario Load (lbs)**	**% Reduction from 2010 Progress**
Municipal Phase II MS4 Impervious	2,763	2,759	0.14%
Municipal Phase II MS4 Pervious	891	866	2.81%
Nonregulated Impervious Developed	5,494	5,486	0.15%
Nonregulated Pervious Developed	5,527	5,502	0.45%
Hightill w/Manure	308	308	0.00%
Total County Load	161,652	161,579	0.05%

Table G-10. TSS Load Reduction from the Tony Tank MAST Scenario			
Land Use Sector	**2010 Progress Load (lbs)**	**Tony Tank Scenario Load (lbs)**	**% Reduction from 2010 Progress**
Municipal Phase II MS4 Impervious	1,181,258	1,178,456	0.24%
Municipal Phase II MS4 Pervious	190,991	167,148	12.48%
Nonregulated Impervious Developed	2,158,756	2,153,338	0.25%
Nonregulated Pervious Developed	1,094,626	1,085,253	0.86%
Hightill w/Manure	26,036	26,030	0.02%
Total County Load	12,184,304	12,142,849	0.34%

It is important to note that the load reductions presented in Tables E-8 – E-10 are for Wicomico County as a whole. Therefore, the results represent the reductions achieved within the County based on the projects identified in the Tony Tank Subwatershed Plan.

The required load reduction for the County to achieve the 2017 Interim and 2025 Final Nutrient Reduction Targets for the State's Phase II WIP and Bay TMDL goals was obtained from Maryland's WIP Phase II Target Load Summaries based on the Phase 5.3.2 Watershed Model. The 2025 target load for the County corresponds to the 2020 target load in the target load summaries document prepared by MDE. The summaries document uses the 2010 progress load as a starting point for determining the reductions required to meet the 2017 and 2025 nutrient reductions. Specifically, to determine the load reduction between 2010 and 2025, the 2025 target load was subtracted from the 2010 progress load for the non-regulated land use categories (Non-Regulated Impervious Developed, Non-Regulated Pervious Developed, and Non-Regulated Extractive) for the County and the Municipal Phase II MS 4 land use categories (impervious and pervious) for the City of Salisbury. The 2017 target load was calculated as 60% of the 2025 target load reduction. The required load reductions are presented in Table E-11 below.

Table G-11. MDE Defined Nutrient Reduction Targets for Wicomico County and Salisbury						
	2010 Progress*	**2017 Target**	**2025 Target**	**Reduction between 2010 and 2017 (lbs, %)**	**Reduction between 2010 and 2025 (lbs, %)**	**Reduction from Tony Tank projects between 2010 and 2025 (lbs, %)**
County N	194,609	165,627	146,306	28,982 lbs, 14.9%	48,303 lbs, 24.8%	563 lbs, 0.50%
County P	11,213	8,244	6,265	2,969 lbs, 26.5%	4,948 lbs, 44.1%	33 lbs, 0.60%
Salisbury N	52,096	44,599	39,600	7,497 lbs, 14.4%	12,496 lbs, 24.0%	223 lbs, 1.02%
Salisbury P	3,648	2,780	2,201	868 lbs, 23.8%	1,447 lbs, 39.7%	29 lbs, 2.95%

Source: MDE Nutrient Allocation Files (CBP Model 5.3.2.) and MDE prepared 2010 Progress MAST loading decks

**Note that the 2010 Progress in this table is slightly inconsistent with the 2010 Progress reported in Tables E8 – E10. The 2010 Progress and associated 2017 and 2025 targets based on the TMDL requirements were derived from an original 2010 Progress MAST scenario generated in early 2012. Since then, MAST has undergone refinements, which accounts for the variation between the 2010 Progress presented in this Table and Tables E8 – E10.*

Appendix H – Best Management Practice Profile Sheets

Appendix I – South Prong Subwatershed Field Forms

See accompanying data disc.

Appendix J – Tony Tank Subwatershed Field Forms

See accompanying data disc.