PORT TOBACCO RIVER

WATERSHED ASSESSMENT

SEPTEMBER | 2015 FINAL

PREPARED FOR

Charles County
Department of Planning and Growth Management
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1 INTRODUCTION

1.1 BACKGROUND

Charles County Department of Planning and Growth Management has initiated a series of watershed assessments in response to requirements set forth by the Maryland Department of the Environment (MDE) in the County's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit (11-DP-3322 MD0068365), issued on December 26, 2014. The watershed assessments support the County's goals for healthy watersheds and natural resources, and also support progress towards satisfying several regulatory and permit requirements.

The Port Tobacco River Watershed was selected by the County for completion as a pilot watershed assessment. Future watershed assessments will follow the methodologies and formats set forth in this plan, with variations where needed depending on specific watershed conditions, targets and any future potential changes in the regulatory framework. The assessments will build from the planning strategies included in the County's Phase II Watershed Implementation Plan (WIP) Strategy (February 2013).

Located in Charles County, Maryland, the Port Tobacco River watershed drains directly into the Potomac River, which ultimately drains to the Chesapeake Bay (Figure 1). The Town of La Plata is located along the eastern portion of the watershed, with US Highway 301 (Crain Highway) running from the northern extent of the watershed through to the southern extent along the eastern boundary. The community of St. Charles is also located within a portion of the watershed along the northern boundary.

The Port Tobacco River is approximately 8.5 miles long with a watershed of approximately 44 square miles. Land use in the watershed is predominately forested (51%), with the remaining area devoted to agriculture (33%) and developed land (16%; MDP, 2010).

1.2 GOALS

1.2.1 CONDUCTING WATERSHED ASSESSMENTS

County watershed assessments satisfy section IV.E.1 of the NPDES permit to develop detailed watershed assessments for the entire County by the end of the permit term (2019). Further, the assessments will identify management strategies that will support several planning goals, including:

- Complete the implementation of restoration efforts for twenty percent of the County's impervious area;
- Meeting Chesapeake Bay Total Maximum Daily Load (TMDL) stormwater load reduction targets; and
- Meeting TMDL targets for local waterway impairments, specifically stormwater waste-load allocations (SW-WLAs).

To accomplish these goals the assessments are structured to meet the following objectives:

- Characterize current water quality conditions;

- Characterize current stream and watershed conditions;
- Identify and rank water quality problems;
- Identify and prioritize water quality improvement projects;
- Estimate pollutant load reductions achievable with implementation of the plan and develop reduction milestones towards meeting SW-WLAs.

1.2.2 Impervious Restoration

As a requirement of the NPDES MS4 Discharge Permit issued by MDE to Charles County, the County must treat 20% of remaining Countywide baseline untreated impervious acres by 2019. Impervious accounting methodology is included in Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated (MDE, 2014). Untreated impervious includes those areas where stormwater practices provide less than the current Maryland standard water quality volume for runoff from 1" of rainfall. Section 7.2 of this report describes the impervious credit achieved, with specificity for the Port Tobacco watershed.

1.2.3 TMDLs

Currently there are no local TMDL SW-WLAs assigned to Charles County for the Port Tobacco River; however water quality impairments do exist (Table 1). These impairments include those that have a final approved TMDL in place (listing category 4a) and those for which a TMDL has not yet been completed (listing category 5). For the Port Tobacco River, the completed TMDLs for nitrogen and phosphorus do not have an assigned SW-WLA, indicating the impairments are from sources other than stormwater, and are therefore not expressly included in this watershed assessment as a specific load reduction target. Currently the draft 2014 Integrated Report indicates that the 1999 TMDL for nitrogen and phosphorus is delisted as of 2012, with the Bay TMDL superseding the listing, however it also indicates that the older TMDL still may apply. The source of the nutrient impairment is defined by MDE as agriculture.

TABLE 1: LOCAL WATERWAY IMPAIRMENTS

Watershed	Water Type	Substance	Listing Category	Priority or Year Approved
Port Tobacco River	River	Cause Unknown	5	Low
Port Tobacco River	River	Enterococcus	5	Medium
Port Tobacco River Oligohaline	Estuary	Nitrogen (Total), Phosphorus (Total)	4a	1999

Category 4a: TMDL Completed; Category 5: Requires a TMDL

In December, 2010, the U.S. Environmental Protection Agency, (EPA) published the Chesapeake Bay TMDL. The Bay TMDL sets limits on loading of three pollutants (nitrogen, phosphorus and sediment) delivered to the Bay from contributing segments, such as the Port Tobacco River. Charles County's Bay TMDL goal is defined at the County scale and is provided here in Table 2 with the reduction described in terms of both the loading reduction and the percent reduction. Section 7 of this report describes the reductions achieved, with more specificity for the Port Tobacco watershed.

TABLE 2: CHARLES COUNTY BAY TMDL STORMWATER GOALS

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)*
Bay TMDL Goal %	20.3%	38.2%	-
Bay TMDL Target Stormwater Reduction	36,626	6,873	-

*No target reduction for sediment. It is anticipated that by achieving the phosphorus goal, enough sediment will be removed to improve water quality.

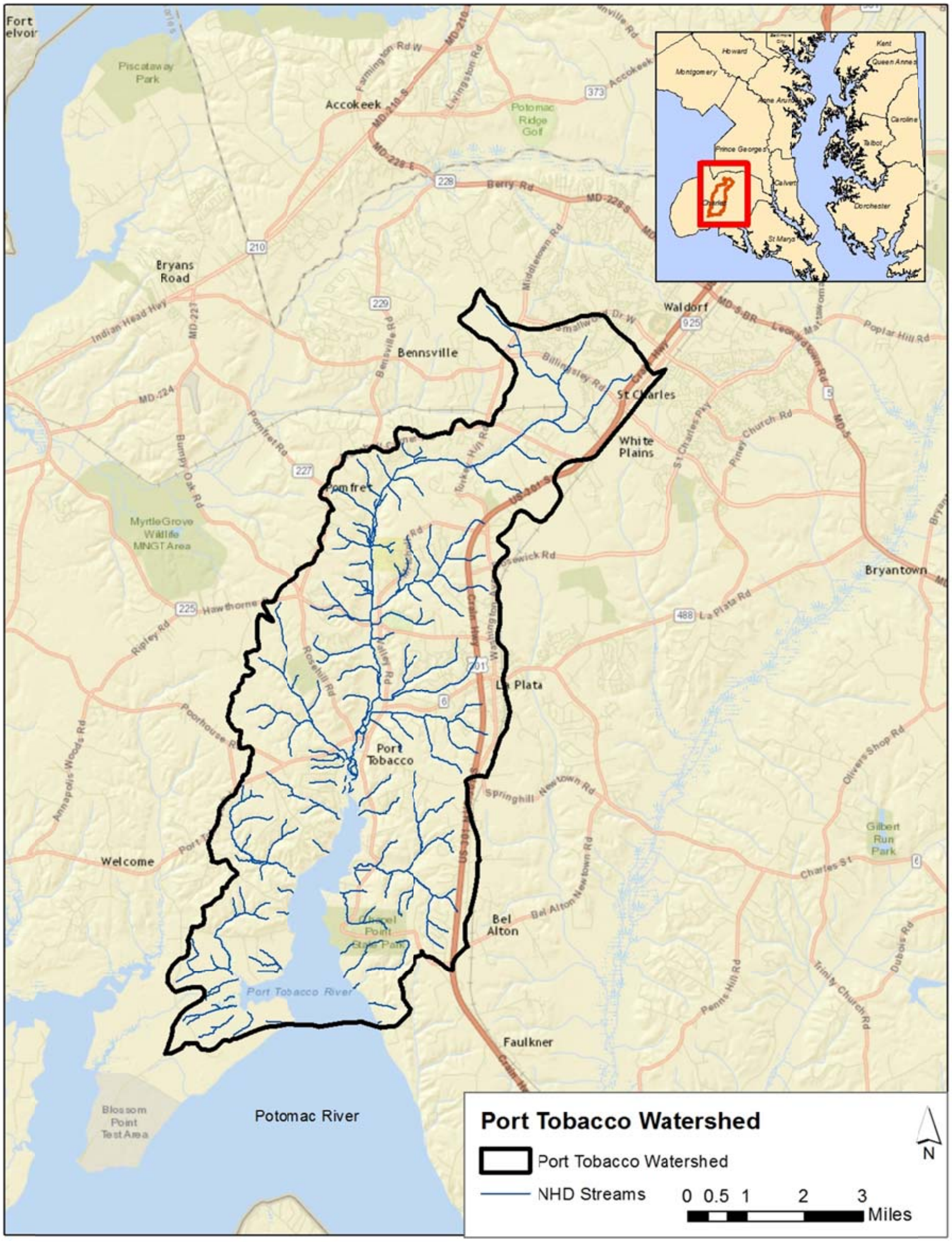


FIGURE 1: STUDY AREA LOCATION MAP

2 WATERSHED ASSESSMENT METHODS

The following assessments were conducted throughout the Port Tobacco River watershed:

- Upland Assessment
- Nutrient Synoptic Survey
- Stream Corridor Assessment

Property access permission letters were sent to all landowners within the target watersheds with streams on their property. Passive permission was assumed through the letters, although landowners were given the opportunity to deny access to their properties. However, all of the properties targeted for assessments were able to be accessed as part of this effort.

2.1 UPLAND ASSESSMENT

KCI assessed upland pollution sources and restoration opportunities using the methodology detailed in the Center for Watershed Protection's Unified Subwatershed and Site Reconnaissance Manual (CWP, 2004). These assessments included both the Neighborhood Source Assessment (NSA) and Hotspot Site Investigations (HSI). General procedures for each type of assessment are provided in the following sections.

2.1.1 NEIGHBORHOOD SOURCE ASSESSMENT

A Neighborhood Source Assessment (NSA) reconnaissance was conducted in residential neighborhood areas to evaluate the pollution-producing behaviors. The NSA rates the potential severity and type of non-point source pollution from residential behaviors. It also provides an assessment of the influence of imperviousness for each site by providing an estimate of whether roof drainage is directed to cisterns, storm drains, impervious areas or pervious areas and the percent of driveways in the neighborhood that are impervious.

The assessment was conducted in a variety of residential areas that represent different housing densities and types. Neighborhoods were then rated on the Pollution Severity Index as either severe, high, moderate, or none based on their potential to generate pollutants. Neighborhoods were also rated on the Restoration Opportunity Index as either high, moderate, or low based on their potential for restoration opportunities.

2.1.2 HOTSPOT SITE INVESTIGATIONS

A Hotspot Site Investigation (HSI) was conducted to identify potential stormwater hotspots. Hot Spots for this plan are defined as commercial, industrial, institutional, municipal or transportation-related operations that typically produce high levels of stormwater runoff and pollutants, while presenting potential risk for spills, leaks or illicit discharges. These include gas stations, commercial car washes, vehicle and equipment maintenance facilities, and sites where pesticides, fertilizers, or industrial chemicals may be stored or used.

The HSI assessment was conducted at locations identified in the office from aerial photography and mapping layers in GIS, and was targeted towards business, commercial, and industrial sites in the urban areas of the watershed. Field crews rated each hotspot on the likelihood that current activities at the site are causing stormwater runoff contamination. Appropriate follow-up actions for each hotspot, including education, retrofits, and referral for immediate enforcement were also noted.

2.2 Nutrient Synoptic Survey

2.2.1 Water Quality Sampling

Synoptic water quality sampling was performed across the Port Tobacco River Watershed, primarily at locations sampled during the previous Watershed Restoration Action Strategy (WRAS) study and following similar methodologies (DNR, 2006b). Sample collection did not occur within 24 hours after a rainfall event totaling more than 0.25 inches of precipitation. A sub-meter Trimble® GPS unit was used to navigate to each sample point. If a grab sample could not be collected at the original sampling point, the location was shifted upstream or downstream accordingly, and an additional GPS point was collected if the point was moved significantly. Sampling locations remained within the original sampling reach and were not moved downstream of a confluence that would include flow from any additional reaches. Site conditions (e.g. clarity, odor, condition of site) were recorded at each sampling site. Grab samples were collected from each site for laboratory analysis of water quality parameters. Samples were preserved on ice for transport immediately after they were collected. Three duplicate samples and one lab blank were collected for quality assurance purposes.

Environmental Testing Lab Inc.[1] completed all laboratory analysis according to standard, approved methods. A complete list of analytical parameters and methods, including detection limits, is presented in Table 3.

TABLE 3: WATER CHEMISTRY ANALYTICAL METHODS

Parameter	Method	Detection Limit	Units
Enterococcus (E. coli)	Colilert	1	MPN/100 ml
Ortho-phosphate Phosphorus	EPA 365.1	0.01	mg/L
TKN	EPA 351.2	0.5	mg/L
Nitrate + Nitrite	EPA 353.2	0.5	mg/L
Total Nitrogen	EPA 351.2 + 353.2	1	mg/L
Total Phosphorus	EPA 365.1	0.01	mg/L

[1] 3430 Rockefeller Ct, Waldorf, MD 20602

Additional water quality measurements were collected *in situ* from each sampling site. Temperature, pH, specific conductivity, and dissolved oxygen were measured with a YSI ProPlus® multiprobe, and turbidity was measured with a Hach 2100 Turbidimeter. Optical brightener (fluorescent whitening agents) samples were collected in sample bottles wrapped in aluminum foil, and analyzed in the KCI Lab using a Turner Designs AquaFluor® Handheld Flurometer configured with an Optical Brightener channel. The unit has a minimum detection limit of 0.5ppm and a range of 0-30,000ppm.

2.2.2 Stream Discharge Measurement

Stream discharge measurements were performed at each sampling site in conjunction with water quality sampling in order to calculate instantaneous baseflow pollutant loads. A suitable transect, one that approximates a "U" shaped channel, was located at each site for measuring stream discharge. Transects were selected to be free of irregularities that may create backflows and cross flows. A SonTek FlowTracker® Handheld Acoustic Doppler Velocimeter was used to collect a series of approximately 10 velocity measurements at regular intervals across the wetted width of the stream to determine instantaneous discharge. The measurements collected at regular intervals included depth (to the nearest 0.5cm) and velocity (to the nearest 0.00 m/sec). Velocity was measured at 0.6 of the distance from the water surface to the bottom of the stream. Due to the difficulty of obtaining accurate discharge measurements below approximately 0.05 cfs with the flowmeter, discharge at low flow sites was obtained by measuring cross sectional area and using a float to measure velocity.

2.3 Stream Corridor Assessment

Prior to performing stream corridor assessments, approximately 8 miles of stream reaches were prioritized using select GIS data elements as shown in the table below. KCI used the following general criteria for prioritizing stream reaches:

Criteria for selection:

- Previous WRAS results – if the channel was in very poor condition and warranted a re-visit
- MBSS and Stream Waders Biological Data – if conditions indicated Poor or Very Poor biological conditions
- Topography – narrow, steep stream valleys and tortuous meander

Criteria for exclusion:

- Located within LaPlata municipal boundary was an automatic exclusion
- Previous WRAS results – if the channel was walked and wasn't in very poor conditions it was determined that the 2006 data could be used and the channel likely would not require a re-visit.
- MBSS and Stream Waders Biological Data – if conditions indicated Fair or Good biological conditions

Data Element	**Factors for selection**	**Factors for exclusion**
SCA (WRAS 2006)	Previously not walked	Previously walked
SCA (WRAS 2006)	High density of more severe issues was deemed good reason to reassess the reach	Lower density of points, and/or lower severity of issues
SCA (WRAS 2006) – Access	Access granted	Access denied
La Plata Municipal Boundary	Outside boundary	Inside boundary
Biological Data (MBSS and Stream Waders)	Poor and Very Poor conditions	Fair and Good conditions
Topography	Narrow, steep valleys and side slopes, tortuous meanders	Flat, wide floodplains
Stormwater infrastructure (outfalls, BMPs, BMP treated areas, Stormwater by Era)	Reaches downstream of untreated or undertreated areas	Reaches downstream of treated areas
Forest Cover	Lack of riparian buffer and forest	Adequate forest cover, wide riparian buffers
Development	Higher density development	Low density development and agriculture

Field crews conducted stream field investigations using standard SCA protocols as outlined in Stream Corridor Assessment Survey: SCA Survey Protocols (Yetman, 2001). Using the same methodology as other SCA surveys will allow for the results to be incorporated into, and directly compared against, other County and State assessment datasets. Property access permission letters were sent to all landowners within the target watersheds with streams on their property. All of the properties targeted for assessments were able to be accessed as part of this effort.

The field investigation consisted of a two-person team walking the stream channel and conducting a visual assessment to locate problem areas and assess their severity and correctability. The field team collected information on channel alteration, erosion, exposed utility pipes, drainage pipe outfalls, fish barriers, inadequate buffers, construction in or near the stream, trash dumping, and recorded any unusual conditions. Representative sites were selected at locations representative of each stream segment. The general physical habitat condition was assessed at the representative sites using a modified version of the EPA’s Rapid Bioassessment Protocols (Barbour et al., 1999). The assessment includes qualitative ratings for ten habitat parameters as well as information on wetted width, pool, run, and riffle depths, and channel substrate.

During the field assessment points were given unique alphanumeric identifiers according to the stream reach and point type. This allowed each point to have a unique ID, for example, 001_IB001. A complete list of point types and corresponding alphanumeric identifiers used during the field assessments is included below:

- Erosion (ES)
- Exposed pipe (EP)
- Pipe outfall (PO)
- Inadequate buffer (IB)
- Fish barrier (FB)
- Trash dumping (TD)
- Channel alteration (CA)
- Unusual condition (UC)

A GPS location was recorded and a photograph was taken for each assessment point. Linear features (eroding banks, buffer impacts, and channel alteration) were documented with a GPS location at each end of the impact and a line feature was developed to better represent the full extent of the problem area. The assessment rated each feature on a 1 to 5 scale according to its severity, correctability, and accessibility; where a score of 1 is the most severe, but also the most correctible and the most accessible. The results were then compiled into a database which will be used to identify and prioritize areas for restoration actions.

In addition to the basic SCA set of impacts and assessments, KCI added an inventory of Potential BMP Locations, in which the field crew could identify up to five potential BMP types that could be implemented at any particular location. This reduced the need for additional field visits and property owner coordination. The potential BMP types included the following:

- Bioretention/raingarden
- Invasive plant control
- Livestock exclusion fencing
- Outfall stabilization
- Riparian buffer enhancement or replacement
- Stabilized crossing
- Stormwater management pond
- Streambank stabilization
- Streamside grass buffer
- Wetland creation
- Wetland restoration
- Water trough

3 WATERSHED ASSESSMENT RESULTS

3.1 UPLAND ASSESSMENT

Upland assessments including both the NSA and HSI were completed on April 23rd and 24th, 2014. Field crews assessed a total of 15 neighborhoods and 26 potential hotspots.

3.1.1 NEIGHBORHOOD SOURCE ASSESSMENT

A total of 15 neighborhoods were assessed, primarily in the northern portion of the watershed in the vicinity of St. Charles and just west of La Plata (Figure 2). General characteristics of each neighborhood are presented in Table 4. A complete record of NSA data is included in Appendix A.

TABLE 4: GENERAL CHARACTERISTICS OF NEIGHBORHOODS ASSESSED

Site ID	Neighborhood / Subdivision	LU Type	Lot Size (acres)	Age (Decade)	Curb & Gutter	% Imperv -ious	% Lawn	% Canopy
PT-01	Hampshire	Multifamily	<1/4	1980s	Yes	50	40	5
PT-02	Worthington and Greenhaven Run	Single Fam Detached	1/4	2000s	Yes	30	68	15
PT-03	Hampshire - Westlake/New Forest Apts	Multifamily	<1/4	1990s	Yes	50	30	20
PT-04	Dorchester	Single Fam Detached	1/4	1990s	Yes	30	50	15
PT-05	Southwinds and Aspen Woods	Multifamily	<1/4	1990s	Yes	60	25	10
PT-06	Westchester - Town Center South Westlake	Multifamily	<1/4	2010s	Yes	70	20	5
PT-07	Maryland Gardens	Single Fam Detached	>1	1960s-90s	No	20	40	40
PT-08	Waldorf Manor	Single Fam Detached	>1	1960s-90s	No	8	20	70
PT-09	Halley Estates, Capital Estates, Wallace Sub	Single Fam Detached	1	1970s	No	15	60	20
PT-10	Hope Acres	Single Fam Detached	>1	1970s	No	15	65	15
PT-11	Pheasant Farms	Single Fam Detached	>1	2000s	No	20	65	10
PT-12	Warren J Willet Subdivision	Single Fam Detached	>1	1960s-80s	Yes	10	40	48
PT-13	Mt. Carmel	Single Fam Detached	1	1970s-80s	No	15	23	60
PT-14	Mt. Carmel Estates	Single Fam Detached	>1	1970s-80s	No	10	15	75

Site ID	Neighborhood / Subdivision	LU Type	Lot Size (acres)	Age (Decade)	Curb & Gutter	% Imperv-ious	% Lawn	% Canopy
PT-15	Stone Hill and Long Meade	Single Fam Detached	>1	2010s	No	10	13	75

Of the 15 neighborhoods assessed, only one (Pheasant Farms) received a ‘high’ pollution severity rating due to the potential for nutrient and bacteria pollution (Table 5). A total of ten neighborhoods (67%) received pollution severity ratings of ‘moderate’, while the remaining four were rated ‘none’. Nutrients, bacteria, and sediments were the most common pollution sources identified.

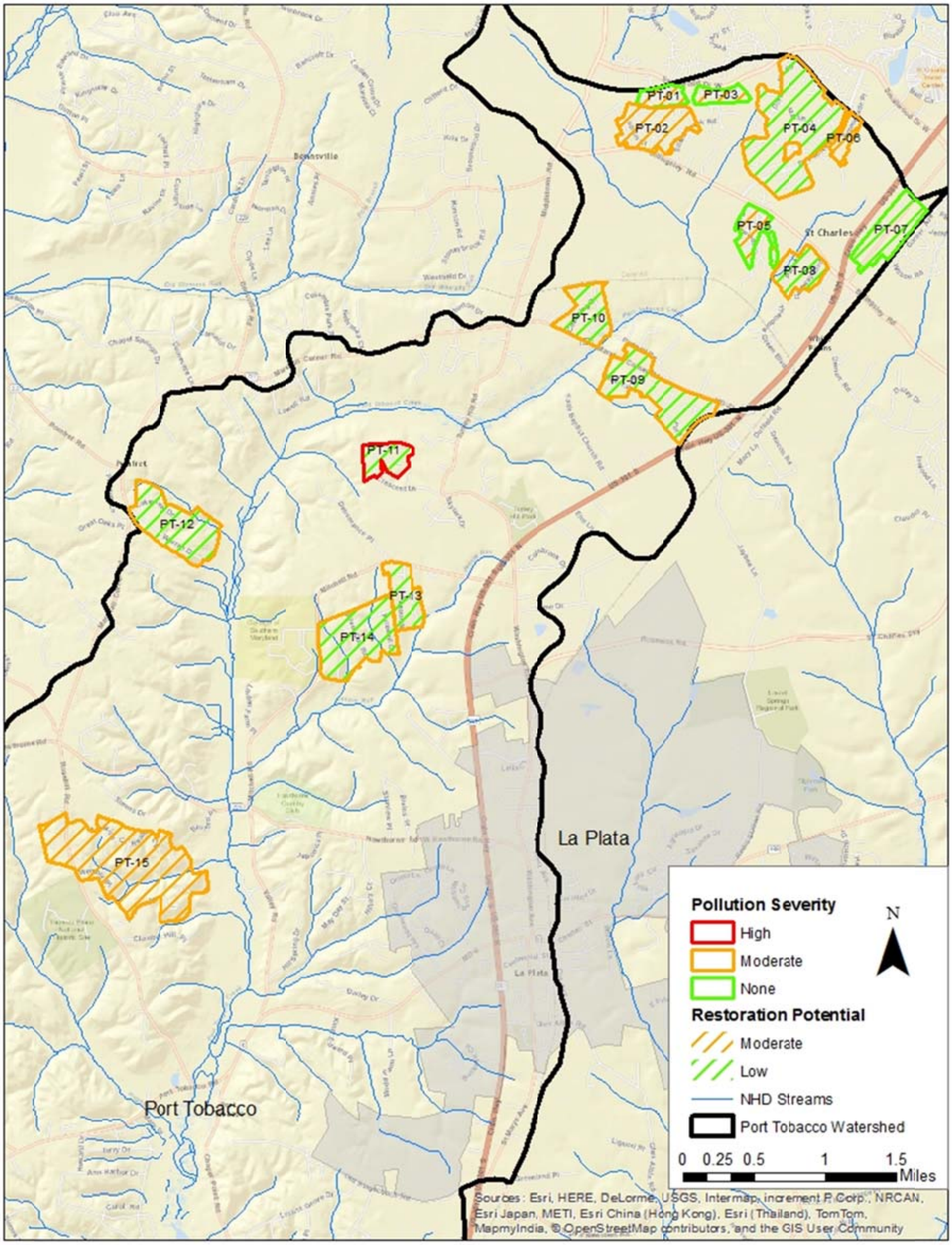


FIGURE 2: NEIGHBORHOOD SOURCE ASSESSMENT RESULTS MAP

The restoration potential was rated as 'low' for all but six neighborhoods, all of which received 'moderate' ratings (Table 5). The restoration potential is based off of an index that ranks specific neighborhood features using benchmark values (e.g., less than 10% of storm drains stenciled). Depending on the feature type, if more than five features fall above or below the benchmark value, the neighborhood is considered to have a 'high' restoration potential; three to five benchmarks will have a 'moderate' restoration potential; and, a neighborhood with a 'low' restoration potential will have two or fewer benchmarks. BayScaping, rain barrels, and stormdrain (SD) stenciling were the most common restoration actions recommended. Other recommended restoration measures include tree planting, stormwater management retrofits, outreach on fertilizer use, and bioretention/bioswales.

TABLE 5: NEIGHBORHOOD POLLUTION SEVERITY AND RESTORATION POTENTIAL

NSA Site ID	Neighborhood / Subdivision	Pollution Severity	Pollution Sources	Restoration Potential	Potential Action
PT-01	Hampshire	None	None	Moderate	BayScaping, tree planting, retrofits
PT-02	Worthington and Greenhaven Run	Moderate	Sediment from construction (contained w/ ESC)	Moderate	BayScaping, rain barrels, outreach on fertilizer, SD stencil
PT-03	Hampshire - Westlake/New Forest Appts	None	None	Moderate	Tree planting, reforestation, bioretention, SD stencil
PT-04	Dorchester	Moderate	Unspecified	Low	BayScaping, SD stenciling
PT-05	Southwinds and Aspen Woods	None	None	Moderate	Bioretention, BayScaping, SD stencil
PT-06	Westchester - Town Center South Westlake	Moderate	Unspecified	Moderate	Reforestation, bioswale, SD stencil
PT-07	Maryland Gardens	None	None	Low	Pond retrofit
PT-08	Waldorf Manor	Moderate	Bacteria	Low	BayScaping
PT-09	Halley Estates, Capital Estates, Wallace Sub	Moderate	Bacteria	Low	BayScaping, rain barrels
PT-10	Hope Acres	Moderate	Unspecified	Low	BayScaping, rain barrels
PT-11	Pheasant Farms	High	Nutrients, Bacteria	Low	Rain barrels, outreach on fertilizers, retrofit
PT-12	Warren J Willet Subdivision	Moderate	Nutrients, Sediment	Low	BayScaping, buffer enhancement, bioretention
PT-13	Mt. Carmel	Moderate	Unspecified	Low	Rain barrels, rain gardens/BayScaping, bioretention
PT-14	Mt. Carmel Estates	Moderate	Unspecified	Low	Rain barrels, rain gardens/BayScaping, bioretention
PT-15	Stone Hill and Long Meade	Moderate	Nutrients	Moderate	Rain barrels, rain gardens/BayScaping, pond retrofit, tree planting

3.1.2 Hotspot Site Investigations

A total of 26 sites were investigated, primarily in the northern portion of the watershed in the vicinity of St. Charles and adjacent to La Plata (Figure 3). The location, general description, and common operations (i.e., vehicle operations, outdoor materials, waste management, physical plant, turf/landscaping) of each site investigated are presented in Table 6. A complete record of HSI data is included in Appendix B.

Of the 26 sites investigated, only one (PT-40) was designated 'confirmed' as having high potential for discharging pollutants into stormwater runoff (Table 6). A total of 20 locations were designated as 'potential' hotspots, while the remaining five sites were considered 'low' potential. Follow-up site inspections were recommended at 23 HSI locations (88%) initially inspected. Additionally, follow-up recommendations were made at 15 sites (58%) to check if the site is required to file for NPDES permit coverage, and eight sites (31%) to schedule a review of stormwater pollution prevention plans.

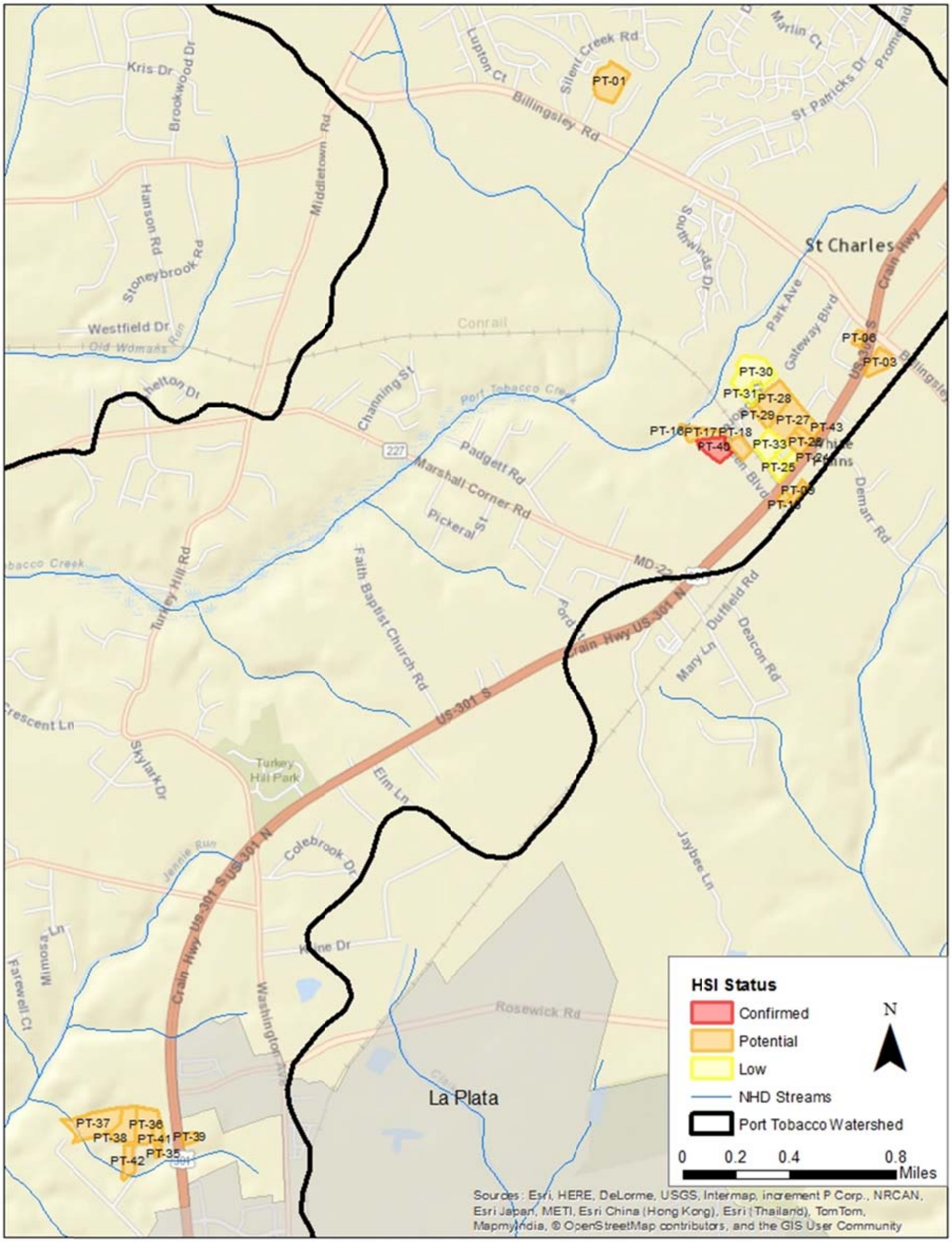


FIGURE 3: HOT SPOT INVESTIGATION RESULTS MAP

TABLE 6: HOT SPOT INVESTIGATION LOCATIONS AND OPERATIONS

HSI Site ID	Location	Description	Vehicle Ops	Outdoor Materials	Waste Mgmt.	Physical Plant	Landscaping	HSI Status	Potential Action	Notes
PT-01	Willett Construction	Construction materials/equipment	Yes	Yes	Yes	Yes	No	Potential	Suggest follow-up	Disconnected sheetflow; >700ft forested buffer for stream
PT-03	Wawa	Gas station, store	Yes	No	Yes	Yes	Yes	Potential	Suggest follow-up and pervious area restoration	Need a dumpster. Tree planting at corner of Billingsley Rd and Crain Hwy.
PT-06	CVS Pharmacy	Pharmacy, retail	No	No	Yes	Yes	Yes	Potential	Suggest follow-up	Area of concern - overflowing dumpster draining to SD inlet in parking lot. Some sediment deposition observed around inlet
PT-09	Unknown Business	Junk yard, equipment storage	Yes	Yes	No	No	No	Potential	Suggest follow-up. Check to see if site is required to file for NPDES permit coverage. Schedule a review of storm water pollution prevention plan.	Could not properly access site. Majority of area fenced in. Ownership: "Industrial Investments LLC" (from GIS) is NOT part of auto store property
PT-10	McConnel Pool Services Inc., Fuel Oil Inc.	Pool and fuel	Yes	Yes	No	Yes	Yes	Potential	Suggest follow-up, check to see if site is required to file for NPDES permit coverage, schedule a review of storm water pollution prevention plan	No additional notes for this site
PT-16	Austin Paving and Sealing	Paving supplies	Yes	Yes	Yes	Yes	No	Potential	Suggest follow-up. Check to	Connected sheet flow (~58ft) to

HSI Site ID	Location	Description	Vehicle Ops	Outdoor Materials	Waste Mgmt.	Physical Plant	Landscaping	HSI Status	Potential Action	Notes
									see if site is required to file for NPDES permit coverage. Schedule a review of storm water pollution prevention plan.	stream. Could not properly access-site fenced in and on private road
PT-17	Chutes International	Construction company	Yes	Yes	Yes	Yes	Yes	Potential	Suggest follow up.	Could not access fenced in area. Disconnected drainage to stream (230 ft from stream).
PT-18	Allen Scott Flooring + Multi use/rented garages	Multi-use commercial, rented garage	No	Yes	Yes	Yes	Yes	Potential	Suggest follow-up. Check to see if site is required to file for NPDES permit coverage.	Multi-owner site
PT-24	Mexico Restaurant	Restaurant	No	No	Yes	Yes	Yes	Low	No potential actions needed.	Could not properly access site - spotted taking photo and had to leave
PT-25	Multi-use Shopping Center on Middle Port Lane	Vet, nail salon, daycare, funeral home	No	No	Yes	Yes	Yes	Low	No potential actions needed.	No additional notes for this site
PT-26	Multi-use Shopping Center on Crain Hwy	Nail salon, restaurants, plumbing supply store, electronics retailer, B+G Electric	Yes	Yes	Yes	Yes	Yes	Potential	Suggest follow-up.	Could not access fenced in area - analyzed fenced area using aerials.

HSI Site ID	Location	Description	Vehicle Ops	Outdoor Materials	Waste Mgmt.	Physical Plant	Landscaping	HSI Status	Potential Action	Notes
PT-27	Used to be Southern MD Electric - For Lease	Office and Warehouse posted for lease. Used to be Electric co-op	Yes	No	Yes	Yes	Yes	Potential	Suggest follow-up.	Use of the property is unclear
PT-28	Waste Management of Southern MD	Waste management. Dumpsters, trash trucks	Yes	Yes	Yes	Yes	Yes	Potential	Suggest follow-up. Check to see if site is required to file for NPDES permit coverage.	Property fenced off. Used aerials to assist with assessment, confirmed BMP on property using GIS.
PT-29	Belair Road Supply	Materials/Supplies. Transportation	Yes	Yes	Yes	Yes	Yes	Potential	Suggest follow-up. Check to see if site is required to file for NPDES permit coverage.	Most of property fenced off. Used aerials to assist with assessment. Fuel tank lacking secondary containment
PT-30	Reliable Contracting	Contracting supplies and storage	Yes	Yes	No	Yes	Yes	Low	Suggest follow-up to verify conditions of NPDES Industrial permit.	Area fenced off, referred to aerials. Confirmed BMP on property in GIS - dry pond. ~30ft from stream/wetland
PT-31	Multi-use on Hackett Place	McClean Controls, Rail supply, Sheet metal	No	Yes	No	Yes	Yes	Low	No potential actions needed.	Material storage area fenced - referred to aerials. Confirmed BMP in GIS
PT-33	The Roof Center	Roofing materials	Yes	Yes	Yes	Yes	No	Low	Suggest follow-up. Check to see if site is required to file for NPDES permit coverage.	Materials/vehicles/operation fenced off (pic #2162). Aerials used to assist assessment.
PT-35	A+P Auto Salvage	Auto Service Garage	Yes	Yes	No	Yes	No	Potential	Suggest follow-up. Check to see if site is required to file for NPDES permit coverage.	Disconnected sheet flow to stream behind building ~110ft

HSI Site ID	Location	Description	Vehicle Ops	Outdoor Materials	Waste Mgmt.	Physical Plant	Landscaping	HSI Status	Potential Action	Notes
									Schedule a review of storm water pollution prevention plan.	
PT-36	Builders First Source and Paul Davis Remodeling	Commercial material	Yes	Yes	No	Yes	No	Potential	Suggest follow-up. Check to see if site is required to file for NPDES permit coverage.	Property fenced off. Potential source of sediment
PT-37	Facchina Construction Co., Inc.	Material Storage	No	Yes	Yes	Yes	No	Potential	Suggest follow-up. Check to see if site is required to file for NPDES permit coverage. Schedule a review of storm water pollution prevention plan.	Disconnected sheet flow to stream (215 ft forest buffer). Potential source of sediment. Property fenced off.
PT-38	Hash Construction, Inc.	Construction equipment and materials	Yes	Yes	No	Yes	No	Potential	Suggest follow-up. Check to see if site is required to file for NPDES permit coverage. Schedule a review of storm water pollution prevention plan.	Disconnected sheet flow (200ft forest buffer). Property fenced off
PT-39	Enterprise Rent-a-car	Rental car facility	Yes	No	Yes	Yes	No	Potential	Suggest follow-up. Check to see if site is required to file for NPDES permit coverage. Schedule a review of storm water pollution prevention plan.	Car washing area draining directly to inlet (pic #2136)

HSI Site ID	Location	Description	Vehicle Ops	Outdoor Materials	Waste Mgmt.	Physical Plant	Landscaping	HSI Status	Potential Action	Notes
PT-40	Multi-use on Theodore Green Blvd and Southern Business Park Drive	Screen printing, house cleaners, contractors, suppliers (welding)	Yes	Yes	Yes	Yes	Yes	Confirm	Suggest follow-up. Check to see if site is required to file for NPDES permit coverage.	No access behind properties during inspection
PT-41	S+M Body Shop and Boat Repair	Car repair	Yes	Yes	Yes	Yes	No	Potential	Suggest follow-up. Check to see if site is required to file for NPDES permit coverage. Schedule a review of storm water pollution prevention plan.	Disconnected sheet flow to stream >500ft
PT-42	C+B Installation	Installation Material	Yes	Yes	No	Yes	No	Potential	Suggest follow-up. Check to see if site is required to file for NPDES permit coverage.	Disconnected sheet flow to stream (190ft through forest buffer)
PT-43	Multi-use commercial	Tattoo, Music Store, Liquor Store	No	Yes	Yes	Yes	No	Potential	Suggest follow-up.	Junk stored behind building in gravel lot and woods (pic #2147-2148). Gas container on ground behind building (pic #2149)

3.2 Nutrient Synoptic Survey

Synoptic water quality sampling was performed across the Port Tobacco River Watershed on July 17th and 18th and August 5th through 8th, 2014. A total of 47 sites were visited for water quality and discharge measurements (Figure 4); however, eleven sites were dry and no samples could be collected for water quality analysis. Synoptic sampling occurred at least 24 hours after rainfall events totaling more than 0.25 inches. The only rain events totaling more than 0.25 inches that occurred during the range of sampling dates were 1.2 inches on July 15, 2014 and 0.25 inches on August 2, 2014. All sampling dates were at least 24 hours after these events (Wunderground weather station KMDLAPLA8).

3.2.1 Stream Discharge

Discharge measurements were collected at each site in conjunction with the collection of grab samples. Results of flow measurements are shown in Table 7. Eleven sites had no flow present during site visits due to dry (i.e., intermittent flow) conditions. Overall, discharge values ranged from 0.01 to 1.23 cubic feet per second (cfs) for sites where samples were collected.

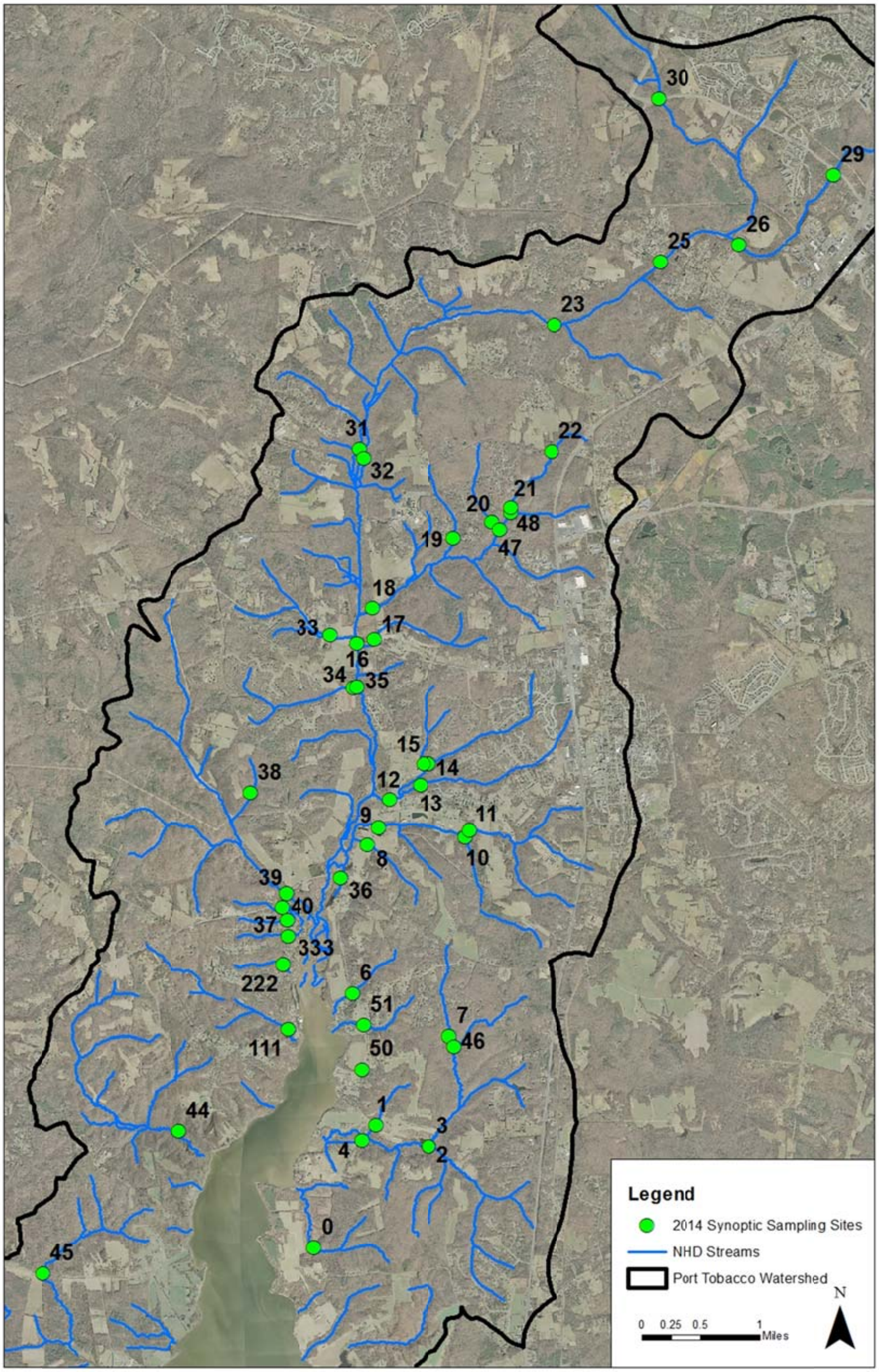


FIGURE 4: NUTRIENT SYNOPTIOC SURVEY SAMPLING LOCATIONS

TABLE 7: STREAM DISCHARGE MEASUREMENT RESULTS

Station	Date	Area (Hectares)	Area (Acres)	Discharge (cfs)	Discharge (Ls)
0	7/18/2014	82	202.6	0.10	2.7
1	7/18/2014	47	116.1	0.08	2.1
2	7/18/2014	434	1072.4	0.51	14.6
3	7/18/2014	466	1151.5	0.42	11.8
4	7/18/2014	994	2456.2	1.23	34.7
6	7/18/2014	71	175.4	0.40	11.3
7	8/5/2014	104	257.0	0.03	0.8
8	7/18/2014	73	180.4	0.00	0.0
9	8/5/2014	629	1554.3	0.29	8.3
10	8/5/2014	136	336.1	0.11	3.0
11	8/5/2014	389	961.2	0.23	6.4
12	8/5/2014	478	1181.2	0.98	27.8
13	8/5/2014	171	422.5	0.92	26.1
14	8/5/2014	178	439.8	0.00	0.0
15	8/5/2014	91	224.9	0.00	0.0
16	8/6/2014	2889	7138.9	0.49	14.0
17	8/5/2014	135	333.6	0.01	0.2
18	8/6/2014	764	1887.9	0.39	11.0
19	8/6/2014	81	200.2	0.04	1.1
20	8/8/2014	78	192.7	0.00	0.0
21	8/8/2014	142	350.9	0.02	0.5
22	8/6/2014	61	150.7	0.06	1.7
23	8/6/2014	1604	3963.6	0.05	1.5
25	8/6/2014	1090	2693.4	0.41	11.5
26	8/6/2014	405	1000.8	0.39	11.0
29	8/5/2014	165	407.7	0.00	0.0
30	8/5/2014	137	338.5	0.00	0.0
31	8/6/2014	130	321.2	0.00	0.0
32	8/6/2014	2332	5762.5	0.00	0.0
33	8/6/2014	225	556.0	0.00	0.1
34	8/6/2014	179	442.3	0.00	0.0
35	8/6/2014	2926	7230.3	0.27	7.6
36	7/17/2014	4601	11369.3	0.00	0.0
37	7/18/2014	869	2147.3	0.86	24.3
38	7/18/2014	46	113.7	0.03	0.8
39	7/17/2014	29	71.7	0.04	1.2
40	7/17/2014	25	61.8	0.04	1.1
44	7/17/2014	480	1186.1	0.03	0.8

Station	Date	Area (Hectares)	Area (Acres)	Discharge (cfs)	Discharge (Ls)
45	7/17/2014	234	578.2	0.19	5.5
46	8/5/2014	132	326.2	0.09	2.5
47	8/8/2014	249	615.3	0.33	9.5
48	8/8/2014	93	229.8	0.28	7.9
50	7/18/2014	33	81.5	0.02	0.5
51	7/18/2014	46	113.7	0.04	1.2
111	7/17/2014	207	511.5	0.19	5.2
222	7/17/2014	28	69.2	0.00	0.0
333	7/17/2014	17	42.0	0.03	0.7

3.2.2 WATER QUALITY

In situ water quality measurement results are presented in Table 8. Results of baseflow concentrations of nutrients and bacteria from water quality grab samples are presented in Table 9. Baseflow instantaneous load results, calculated using stream flow measurements (Table 7), are presented in Table 10. Due to complications with equipment calibration and sample holding times, optical brightener results were not obtained.

TABLE 8: IN SITU WATER QUALITY MEASUREMENTS. BOLD VALUES INDICATE EXCEEDANCES OF COMAR STANDARDS OR WATER QUALITY THRESHOLDS.

Station	Date	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Specific Conductance (µS/cm)	Turbidity (NTU)
0	7/18/2014	20.0	**5.96**	7.03	85.4	6.78
1	7/18/2014	21.0	**5.94**	7.88	85.2	4.26
2	7/18/2014	20.0	**6.1**	5.82	149.7	2.02
3	7/18/2014	20.3	**5.95**	**4.80**	112.2	3.23
4	7/18/2014	19.6	**6.13**	8.27	127.9	8.42
6	7/18/2014	18.8	**6.19**	8.44	80.1	4.26
7	8/5/2014	19.9	**6.31**	8.53	98.0	27.80
8	7/18/2014	-	-	-	-	-
9	8/5/2014	21.0	6.5	7.18	189.0	3.45
10	8/5/2014	21.6	**6.13**	9.04	73.2	2.32
11	8/5/2014	22.1	6.62	**4.00**	**254.4**	7.12
12	8/5/2014	22.3	7.57	5.06	**698.0**	5.48
13	8/5/2014	23.8	7.44	5.40	**713.0**	3.07
14	8/5/2014	-	-	-	-	-
15	8/5/2014	-	-	-	-	-
16	8/6/2014	21.0	**6.48**	6.47	**287.3**	4.92
17	8/5/2014	24.5	7.43	6.08	100.0	11.20
18	8/6/2014	20.8	6.61	9.3	**392.7**	3.24

Station	Date	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Specific Conductance (µS/cm)	Turbidity (NTU)
19	8/6/2014	19.9	6.61	6.8	**248.3**	2.91
20	8/8/2014	-	-	-	-	-
21	8/8/2014	19.0	6.71	-	**310.0**	3.44
22	8/6/2014	20.3	6.70	7.98	**318.9**	5.36
23	8/6/2014	21.6	6.67	8.82	208.6	5.33
25	8/6/2014	21.5	6.86	8.43	219.9	4.05
26	8/6/2014	20.6	**6.37**	**4.28**	**280.9**	4.82
29	8/5/2014	-	-	-	-	-
30	8/5/2014	-	-	-	-	-
31	8/6/2014	-	-	-	-	-
32	8/6/2014	-	-	-	-	-
33	8/6/2014	20.9	6.56	6.21	181.7	8.39
34	8/6/2014	-	-	-	-	-
35	8/6/2014	21.5	**6.27**	**4.98**	**285.0**	3.70
36	7/17/2014	-	-	-	-	-
37	7/18/2014	20.0	**6.06**	7.92	66.1	7.07
38	7/18/2014	18.3	**5.79**	8.66	93.6	4.40
39	7/17/2014	19.7	**6.03**	5.54	**295.9**	12.7
40	7/17/2014	19.9	**5.90**	3.64	**427.2**	6.05
44	7/17/2014	19.1	**5.63**	2.85	129.9	36.3
45	7/17/2014	18.5	**6.27**	9.92	80.8	7.70
46	8/5/2014	19.9	**6.13**	8.84	55.9	3.81
47	8/8/2014	18.7	7.02	-	**503.0**	8.13
48	8/8/2014	18.5	7.36	-	**565.3**	1.83
50	7/18/2014	18.5	**5.98**	8.38	111.0	4.74
51	7/18/2014	19.0	**6.00**	8.14	136.4	7.25
111	7/17/2014	20.2	**6.05**	7.65	139.4	5.32
222	7/17/2014	-	-	-	-	-
333	7/17/2014	20.6	**6.03**	5.65	226.8	1.45

MDE has established acceptable water quality standards for each designated Stream Use Classification, which are listed in the *Code of Maryland Regulations (COMAR) 26.08.02.03-.03 - Water Quality*. The non-tidal streams located in the Port Tobacco River watershed are covered in *COMAR* in Sub-Basin 02-14-01: Lower Potomac River Area as Use I waters. Specific designated uses for Use I streams include water contact sports, fishing, the growth and propagation of fish, agricultural water supply, and industrial water supply. The acceptable criteria for Use I waters are as follows:

- pH - 6.5 to 8.5
- DO - may not be less than 5 mg/l at any time
- Turbidity - maximum of 150 Nephelometric Turbidity Units (NTU's) and maximum monthly average of 50 NTU
- Temperature - maximum of 90°F (32°C) or ambient temperature of the surface water, whichever is greater
- E. coli – 576 MPN/100ml for *Infrequent Full Body Contact Recreation*.

For the majority of sites, *in situ* water quality parameters fell within COMAR limits for Use I streams. Six sites had DO levels below the COMAR standard of 5.0 mg/L. Twenty-two (22) sites had pH values below the minimum threshold of 6.5 SU, although pH values below 6.5 are common for streams that drain wetlands, which have naturally low pH levels. All sites within acceptable ranges for temperature and turbidity. Although MDE does not have a water quality standard for specific conductivity, Morgan et al. (2007) have reported biological impairment thresholds in Maryland of 247 µg/l for benthic macroinvertebrates. A total of 14 sites (30%) had specific conductivity values exceeding the threshold for benthic macroinvertebrates, with values ranging from 248.3 to 713.0 µS/cm.

TABLE 9: WATER QUALITY GRAB SAMPLING RESULTS – NUTRIENT AND BACTERIA CONCENTRATIONS

Station	Ortho-P (mg/L)	TKN (mg/ L)	Nitrate-Nitrite (mg/ L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	E_coli (MPN/100 ml)
0	0.11	0.5	0.25	0.5	0.11	214.3
1	0.07	0.9	0.25	0.5	0.07	365.4
2	0.06	0.25	0.25	0.5	0.05	461.1
3	0.11	0.25	0.25	0.5	0.12	1553.1
4	0.09	0.6	0.25	0.5	0.09	435.2
6	0.08	0.25	0.25	0.5	0.09	224.7
7	0.14	0.25	0.25	0.5	0.15	461.1
8	-	-	-	-	-	-
9	0.19	0.25	0.25	0.5	0.17	290.9
10	0.15	0.25	0.25	0.5	0.15	117.8
11	0.17	2.3	0.25	2.3	0.15	2419.6
12	0.32	0.25	0.25	0.5	0.29	185
13	0.24	0.8	0.25	0.8	0.21	55.6
14	-	-	-	-	-	-
15	-	-	-	-	-	-
16	0.13	0.25	0.25	0.5	0.13	156.5
17	0.05	0.25	0.25	0.5	0.15	19.7
18	0.1	0.25	0.25	0.5	0.09	133.3
19	0.1	0.25	0.25	0.5	0.11	133.4
20	-	-	-	-	-	-
21	0.09	0.25	0.7	0.5	0.07	85.5
22	0.02	0.25	1.5	1.5	0.005	298.7
23	0.04	0.25	0.7	0.5	0.02	145

Station	Ortho-P (mg/L)	TKN (mg/ L)	Nitrate-Nitrite (mg/ L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	E_coli (MPN/100 ml)
25	0.03	0.25	1.3	1.3	0.02	344.8
26	0.03	0.25	2.8	2.8	0.005	260.3
29	-	-	-	-	-	-
30	-	-	-	-	-	-
31	-	-	-	-	-	-
32	-	-	-	-	-	-
33	0.09	0.25	0.9	0.5	0.09	61.3
34	-	-	-	-	-	-
35	0.11	0.7	0.5	1.2	0.12	65.7
36	-	-	-	-	-	-
37	0.14	0.25	0.25	0.5	0.16	686.7
38	0.07	0.25	0.25	0.5	0.07	184.2
39	0.06	0.25	0.25	0.5	0.07	148.3
40	0.19	0.25	0.25	0.5	0.19	111.2
44	0.3	0.7	0.25	0.5	0.39	101.4
45	0.13	0.8	0.25	0.5	0.14	298.7
46	0.11	0.25	0.25	0.5	0.11	2419.6
47	0.05	0.25	0.7	0.5	0.04	920.8
48	0.02	0.25	0.25	0.5	0.01	129.1
50	0.07	0.25	0.25	0.5	0.09	161.6
51	0.1	0.25	0.25	0.5	0.1	325.5
111	0.15	0.25	0.25	0.5	0.17	387.3
222	-	-	-	-	-	-
333	0.04	0.25	13.1	13.1	0.03	214.3

At this time, Maryland does not have specific numeric water quality criteria for nitrogen and phosphorus. Nutrient ranges and ratings for nitrate-nitrite and orthophosphate were derived from Frink (1991) and used for comparison of water quality results (Table 11). Total nitrogen and total phosphorus concentrations were compared to those provided by the Maryland Biological Stream Survey (Southerland, et al. 2005; Table 12). Nitrate/nitrite concentrations were found to be excessive in one subwatershed, moderately elevated in three, and baseline in the remaining 43 subwatersheds (Table 9). Instantaneous nitrate/nitrite yields were found to be excessive in only one (1) subwatershed and baseline in the remaining 46 subwatersheds (Table 10). Total nitrogen concentrations were found to be high in one subwatershed, but low in the remaining 46 subwatersheds (Table 9). Excessive concentrations of orthophosphate were found in all 36 subwatersheds where samples were collected (Table 9), with values ranging from 0.02 mg/L to 0.320 mg/L. However, orthophosphate yields were only found to be excessive in one subwatershed, high in two (2), and moderate in one (1) subwatershed, with the remaining 43 at baseline levels (Table 10). Total phosphorus concentrations were found to be high in 24 subwatersheds, moderate in seven (7), and low in the remaining 16 subwatersheds (Table 9).

Elevated bacteria levels (*E. coli* > 576 mpn/100 ml; mpn = most probable number) were found in five (5) subwatersheds, or roughly 11% visited (Table 9). Three subwatersheds had levels exceeding 1,000 mpn. These subwatersheds are located in the southeastern portion of the Port Tobacco watershed.

In an attempt to correlate neighborhood pollution sources and water quality data from the synoptic survey, neighborhoods visited during the NSA with drainage to synoptic sites were identified. Three synoptic points were identified as receiving majority of their drainage from NSA neighborhoods. Neighborhood PT-14 drains to Site 19 and 20 and PT-15 drains to Site 34. Synoptic sites 20 and 34 were both dry, so no correlation can be made to neighborhood PT-15. Site 19, which drains to PT-14, had high orthophosphate and total phosphate concentrations. PT-14 was assessed to have "moderate" pollution severity; it had high forest cover, majority downspouts draining to pervious, and medium lawn management, but no stormwater management present. No obvious sources of phosphate were found during the neighborhood assessment, therefore no correlation can be made between neighborhood pollution and synoptic sites.

TABLE 10: WATER QUALITY GRAB SAMPLING RESULTS – INSTANTANEOUS LOADS

Station	Discharge (L/sec)	Ortho-P (kg/H/day)	TKN (kg/H/day)	Nitrate-Nitrite (kg/H/day)	Total Nitrogen (kg/H/day)	Total Phosphorus (kg/H/day)
0	2.7	0.00032	0.00143	0.00072	0.00143	0.00032
1	2.1	0.00027	0.00351	0.00098	0.00195	0.00027
2	14.6	0.00017	0.00072	0.00072	0.00145	0.00014
3	11.8	0.00024	0.00055	0.00055	0.00109	0.00026
4	34.7	0.00027	0.00181	0.00075	0.00151	0.00027
6	11.3	0.00110	0.00345	0.00345	0.00689	0.00124
7	0.8	0.00009	0.00016	0.00016	0.00032	0.00010
8	0.0	-	-	-	-	-
9	8.3	0.00022	0.00029	0.00029	0.00057	0.00019
10	3.0	0.00029	0.00048	0.00048	0.00096	0.00029
11	6.4	0.00024	0.00327	0.00036	0.00327	0.00021
12	27.8	0.00161	0.00126	0.00126	0.00251	0.00146
13	26.1	0.00317	0.01056	0.00330	0.01056	0.00277
14	0.0	-	-	-	-	-
15	0.0	-	-	-	-	-
16	14.0	0.00005	0.00010	0.00010	0.00021	0.00005
17	0.2	0.00001	0.00003	0.00003	0.00007	0.00002
18	11.0	0.00012	0.00031	0.00031	0.00062	0.00011
19	1.1	0.00011	0.00028	0.00028	0.00057	0.00012
20	0.0	-	-	-	-	-
21	0.5	0.00003	0.00008	0.00022	0.00016	0.00002
22	1.7	0.00005	0.00059	0.00355	0.00355	0.00001
23	1.5	0.00000	0.00002	0.00006	0.00004	0.00000
25	11.5	0.00003	0.00023	0.00119	0.00119	0.00002

Station	Discharge (L/sec)	Ortho-P (kg/H/day)	TKN (kg/H/day)	Nitrate-Nitrite (kg/H/day)	Total Nitrogen (kg/H/day)	Total Phosphorus (kg/H/day)
26	11.0	0.00007	0.00058	0.00655	0.00655	0.00001
29	0.0	-	-	-	-	-
30	0.0	-	-	-	-	-
31	0.0	-	-	-	-	-
32	0.0	-	-	-	-	-
33	0.1	0.00000	0.00001	0.00004	0.00002	0.00000
34	0.0	-	-	-	-	-
35	7.6	0.00002	0.00016	0.00011	0.00027	0.00003
36	0.0	-	-	-	-	-
37	24.3	0.00034	0.00060	0.00060	0.00121	0.00039
38	0.8	0.00010	0.00037	0.00037	0.00074	0.00010
39	1.2	0.00021	0.00089	0.00089	0.00177	0.00025
40	1.1	0.00070	0.00092	0.00092	0.00183	0.00070
44	0.8	0.00004	0.00010	0.00003	0.00007	0.00005
45	5.5	0.00026	0.00162	0.00051	0.00101	0.00028
46	2.5	0.00018	0.00040	0.00040	0.00081	0.00018
47	9.5	0.00016	0.00082	0.00230	0.00164	0.00013
48	7.9	0.00015	0.00183	0.00183	0.00366	0.00007
50	0.5	0.00009	0.00033	0.00033	0.00067	0.00012
51	1.2	0.00023	0.00059	0.00059	0.00117	0.00023
111	5.2	0.00033	0.00055	0.00055	0.00109	0.00037
222	0.0	-	-	-	-	-
333	0.7	0.00014	0.00090	0.04713	0.04713	0.00011

TABLE 11: NUTRIENT RANGES AND RATINGS FROM FRINK (1991)

Parameter	Baseline	Moderate	High	Excessive
Nitrate-Nitrite Concentration mg/L	<1	1 – 3	3 – 5	>5
Nitrate-Nitrite Yield kg/ha/day	<0.01	0.01 – 0.02	0.02 – 0.03	>0.03
Orthophosphate Concentration mg/L	<0.005	0.005 – 0.01	0.01 – 0.015	>0.015
Orthophosphate Yield kg/ha/day	<0.0005	0.0005 – 0.001	0.001 – 0.002	>0.002

TABLE 12: TOTAL NUTRIENT RANGES AND RATINGS FROM SOUTHERLAND ET AL., 2005. ALL UNITS IN MG/L.

Parameter	Low	Moderate	High
Total Nitrogen	< 1.5	1.5 – 7.0	>7.0
Total Phosphorus	< 0.025	0.025 – 0.070	> 0.070

3.3 STREAM CORRIDOR ASSESSMENT

There were a total of 11 stream reaches targeted for assessments within the watershed, as shown on Figure 6. Field crews walked approximately 8 miles of mapped stream channels between July 30, 2014 and September 16, 2014. Figure 5 shows the stream reaches walked by field crews and the location of the representative sites for each walked reach. Erosion sites, pipe outfalls, and buffer breaks were the most widespread and frequent problems identified. The total number of points identified and ranked by severity can be found in Table 13. The majority of points were categorized as moderate to minor severity. Only four (4) points received ratings of "very severe," while 34 received a rating of "severe". A more detailed discussion of each data point type follows. A complete dataset is included as Appendix C.

TABLE 13: DATA POINTS BY SEVERITY

Potential Problems	Total	Very Severe	Severe	Moderate	Low	Minor
Erosion (5.1 miles)	90	3	25	45	15	2
Buffer (3.2 miles)	22	0	5	8	9	0
Pipe Outfall	32	1	1	4	4	22
Fish Barrier	1	0	1	0	0	0
Trash	15	0	2	5	5	3
Channel Alteration	4	0	0	0	1	3
Construction	0	0	0	0	0	0
Exposed Pipe	2	0	0	0	0	2
Unusual Conditions	10	0	0	2	2	6
Total	***176***	4	34	64	36	38
Representative Sites	**25**					
Potential BMP Sites	**21**					

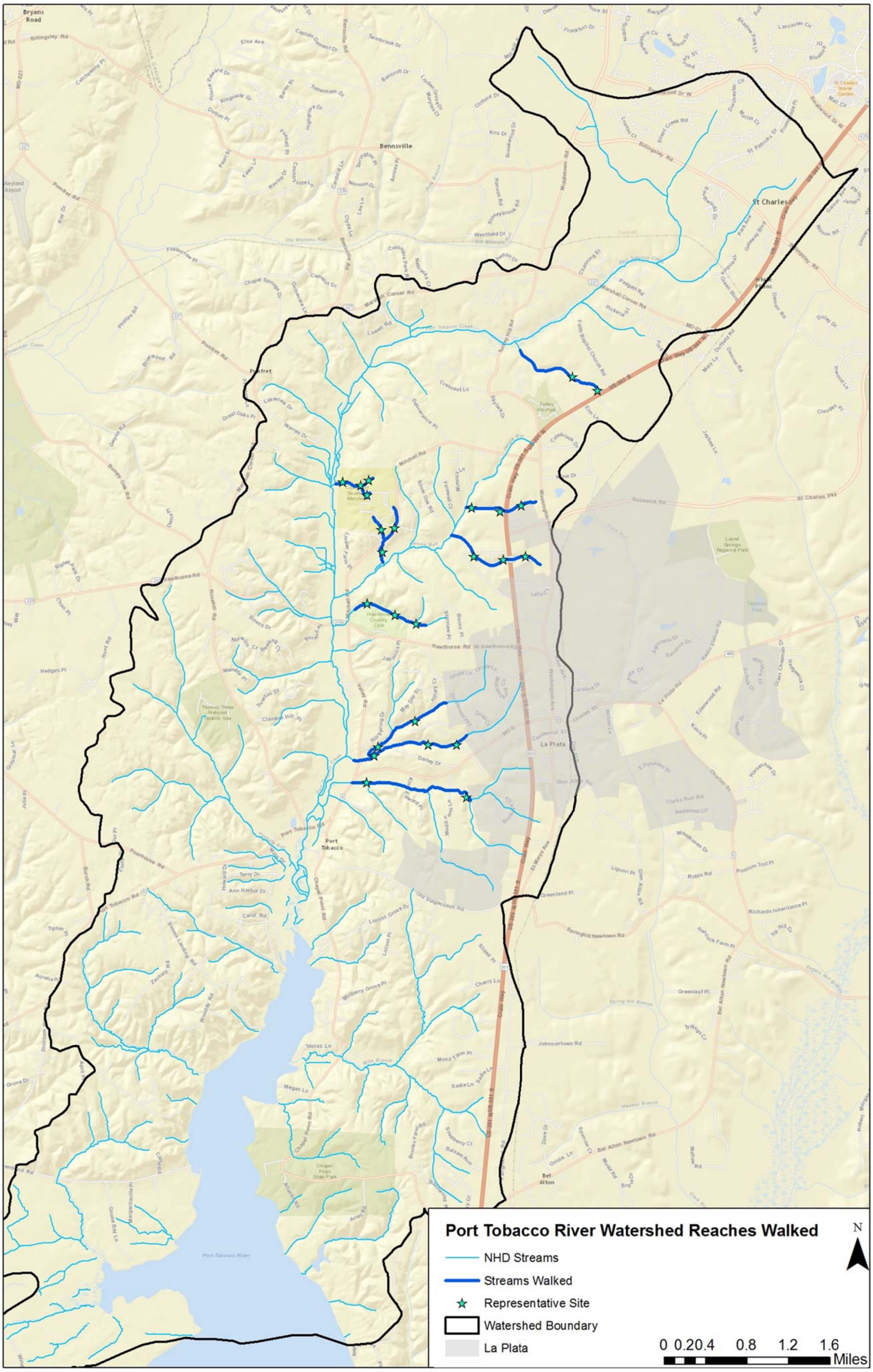


FIGURE 5: REACHES WALKED FOR STREAM CORRIDOR ASSESSMENT

Erosion Sites

The field survey identified 90 actively eroding sites throughout the study area totaling 5.1 miles in length for both right and left banks combined. The stream erosion process was identified as widening for 81% of sites, headcutting for 11%, and downcutting for 8% of sites. While collecting stream erosion data, field crews also attempted to determine the leading possible cause of erosion at each site. These potential causes included: upstream channelization, an upstream road crossing, bends and slopes in the stream channel, upstream land use changes, livestock near or in the stream, pipe outfalls and other causes. Throughout the watershed, the most commonly described possible causes for erosion was landuse change upstream (41%), followed by bend at steep slope (37%). Only two sites were classified as an immediate threat to infrastructure. Locations of erosion sites can be found in Figures 7 and 8. Erosion sites less than 50 feet are not displayed.

Inadequate Buffers

Inadequate buffers, defined as buffers less than 50 feet wide from the edge of the stream, were identified at 22 sites throughout the watershed totaling 3.2 miles of inadequate buffers. Approximately 21 percent of the inadequate buffer length (0.67 miles) identified was affecting both sides of the stream channel. Crop fields, lawn, and pasture were the most commonly identified types of land use where the stream buffer was found to be deficient. The presence of livestock (cattle and horses) was noted for only two properties during the survey period. The location of reaches with inadequate buffers is displayed in Figures 7 and 8.

Pipe Outfalls

Thirty-two pipe outfall points were located and assessed throughout the watershed. Approximately 81 percent of the outfalls received severity ratings of either “low” or “minor,” indicating that they typically do not have dry weather discharges nor appear to be causing localized erosion. A total of four (4) outfalls were rated as “moderate”, while one each were rated “severe” and “very severe” due to localized erosion impacts. All of the pipe outfalls were associated with stormwater conveyance, and any observed discharge was clear and odorless. Locations and severity of these points is shown in Figures 7 and 8. Pipe outfalls with severity scores less than moderate are displayed, but not labeled.

Fish Barriers

Only one (1) fish barrier was observed during the survey and was identified as a road crossing. The barrier received a severity rating of “severe” due to a 30 inch drop in elevation. The location and severity of the fish barrier is displayed in Figures 7 and 8.

Channel Alteration

Channel alteration impacts were found at four (4) sites throughout the subwatershed, totaling approximately 350 feet in length. All channel alteration locations had a severity rating of “low” to “minor” and were primarily associated with rip rap stabilization efforts. Only one of the sites was located at a road crossing. Locations of channel alteration sites can be found in Figures 9 and 10.

Unusual Conditions and Trash

There were 12 unusual condition/comment points identified in the study area. Two of the points noted excessive algae in the stream, both linked potentially to excessive nutrients from cattle. Other unusual conditions noted include a large beaver dam complex, a dense stand of invasive bamboo, a stream channel migrating toward the roadway and threatening infrastructure, and a blown-out former road crossing with an exposed culvert in the channel.

A total of 15 trash dumping sites were also identified throughout the watershed. Eight sites were rated as “low” to “minor” severity, most of which could be cleaned up by a group of volunteers. Five sites were rated as “moderate”, while the remaining two were rated “severe” due to very large quantities of refuse, namely tires. Point locations and severity scoring of unusual conditions and trash sites can be seen in Figures 9 and 10.

Representative and Other Points

A representative point was taken at 25 locations throughout the watershed. Figure 6, below, presents the proportion of reaches in each assessment category for each habitat parameter, giving insight into the types of stream impacts creating the most degradation. In general, the modified qualitative RBP assessment at these sites revealed stream channels dominated by cobble and gravel substrates. Riparian vegetation was primarily rated “optimal” to “suboptimal” throughout most of the study area, while bank vegetation was generally “suboptimal” but with a slightly higher proportion of “marginal” to “poor” sites. Channel alteration was also primarily rated “optimal” to “suboptimal” with no reaches receiving a “poor” rating. Sediment deposition was primarily rated “marginal” to “poor”, with fewer than 25% of sites being rated as either “optimal” or “suboptimal.” Channel flow status was rated as “poor” for over 50% of sites, which could have been due to seasonal (summer) low-flow conditions. Both velocity/depth diversity and benthic substrate were split nearly equally between “suboptimal”, “marginal” and “poor” conditions, with no sites receiving “optimal” ratings for these parameters. Shelter for fish was generally rated similarly to benthic substrate, but with a slightly larger proportion of sites (48%) receiving “poor” ratings.

Stream channel erosion is a major factor leading to impaired habitat conditions. The majority of the identified erosion points (81 %) were described as channel widening processes. As the stream channels widen, the ability to effectively transport sediments (eroded bank material and from runoff over land) is reduced, leading to reduced scores for several habitat parameters including flow, velocity, embeddedness and macroinvertebrate habitat.

Agricultural land uses can contribute sediment and pollutants if not properly managed. A sizeable portion of the land in the Port Tobacco River watershed is in agricultural uses, especially in the southern and western portion of the watershed.

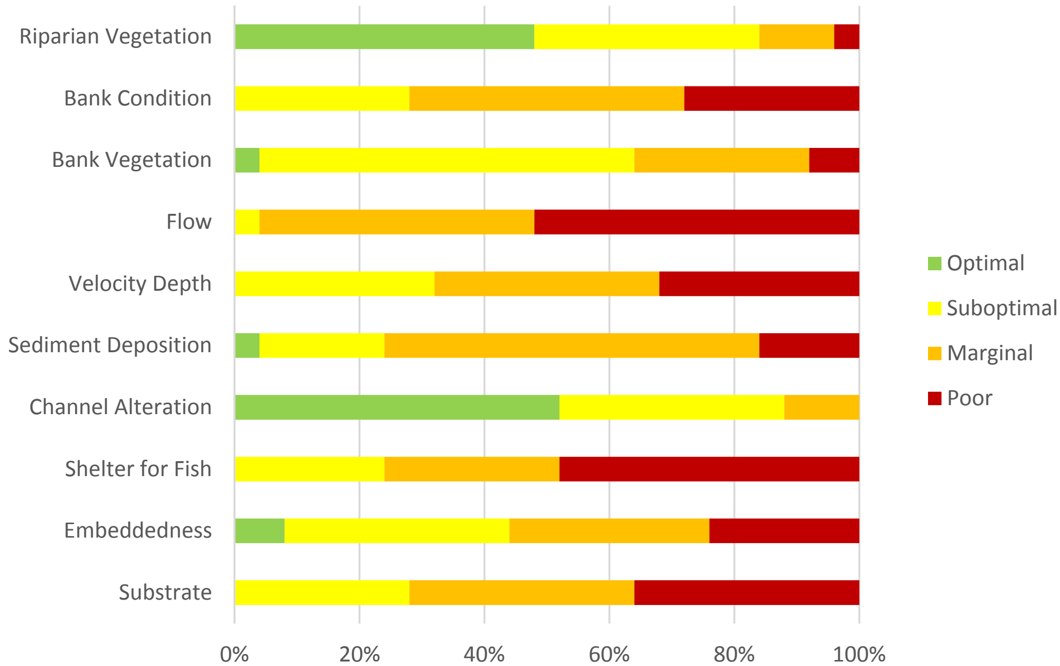


FIGURE 6: PROPORTION OF REACHES PER ASSESSMENT CATEGORY

Exposed Pipes

A total of two (2) exposed pipes were identified in the assessment. One of the pipes was perched above the stream channel, while the other pipe was exposed across the bottom of the stream bed. No discharge was observed from either of the pipes and both were rated as minor for severity. The purpose of one exposed pipe, or whether it is still actively in use, was not immediately clear, while the other appeared to be a water supply pipe. Locations of exposed pipes can be found in Figures 9 and 10.

Potential Improvements (BMP Locations)

Twenty-one potential improvement sites were identified throughout the watershed. Multiple improvements were recommended for 19 sites. The most commonly recommended BMP type was outfall stabilization, which was recommended at 12 sites (57 percent). Streambank stabilization projects were the next most numerous (10 projects), followed by stormwater management facilities (8). Other suggested primary improvements include bioretention/raingarden, livestock exclusion fencing, riparian buffer enhancement, grass buffers, and wetland creation. The locations of these preliminary sites as well as the primary BMP type are displayed in Figure 11.

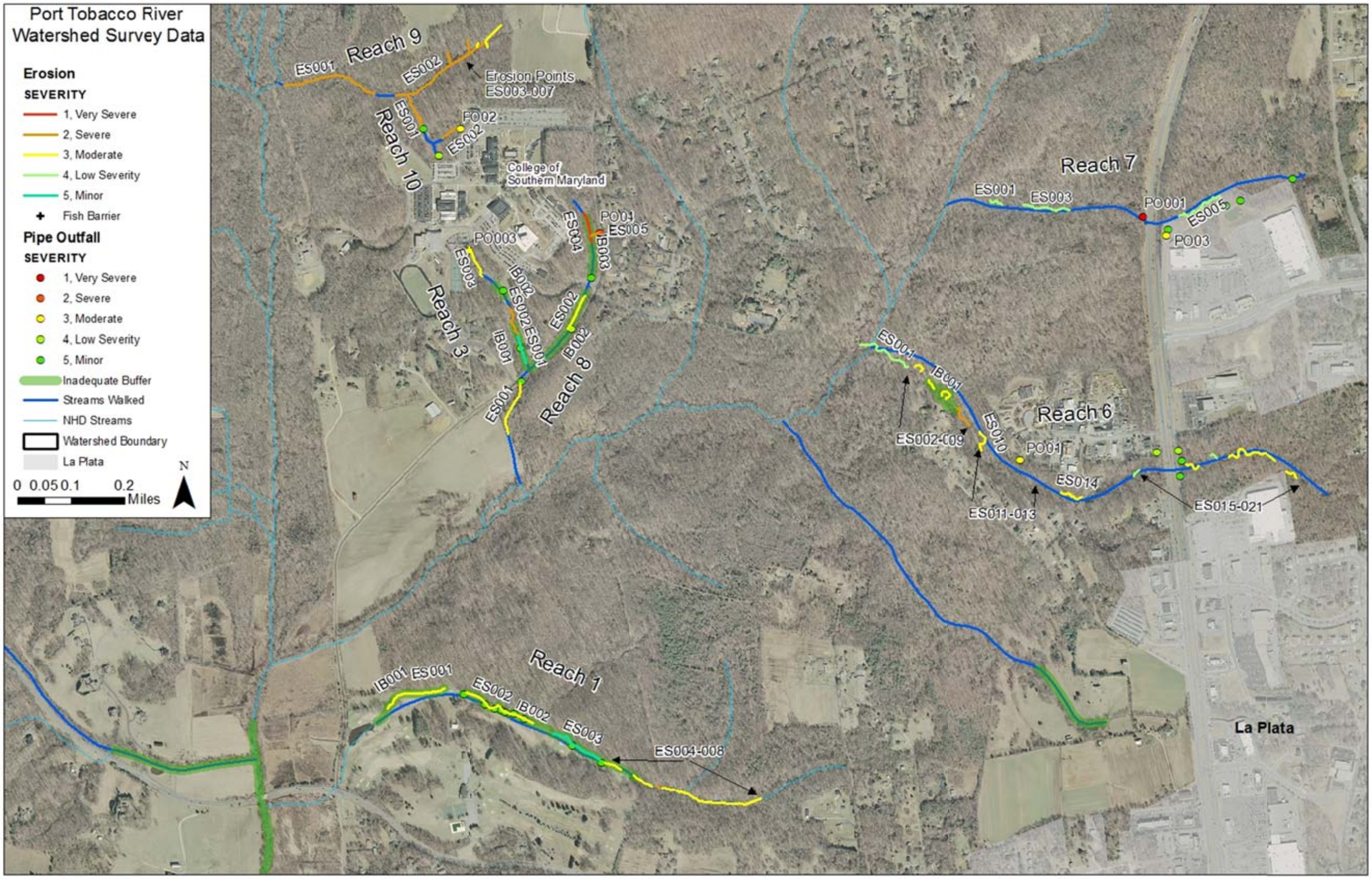


FIGURE 7: SURVEY DATA MAP SHOWING PIPE OUTFALL, EROSION, FISH BARRIER, AND INADEQUATE BUFFER SITES, NOTHERN REACHES

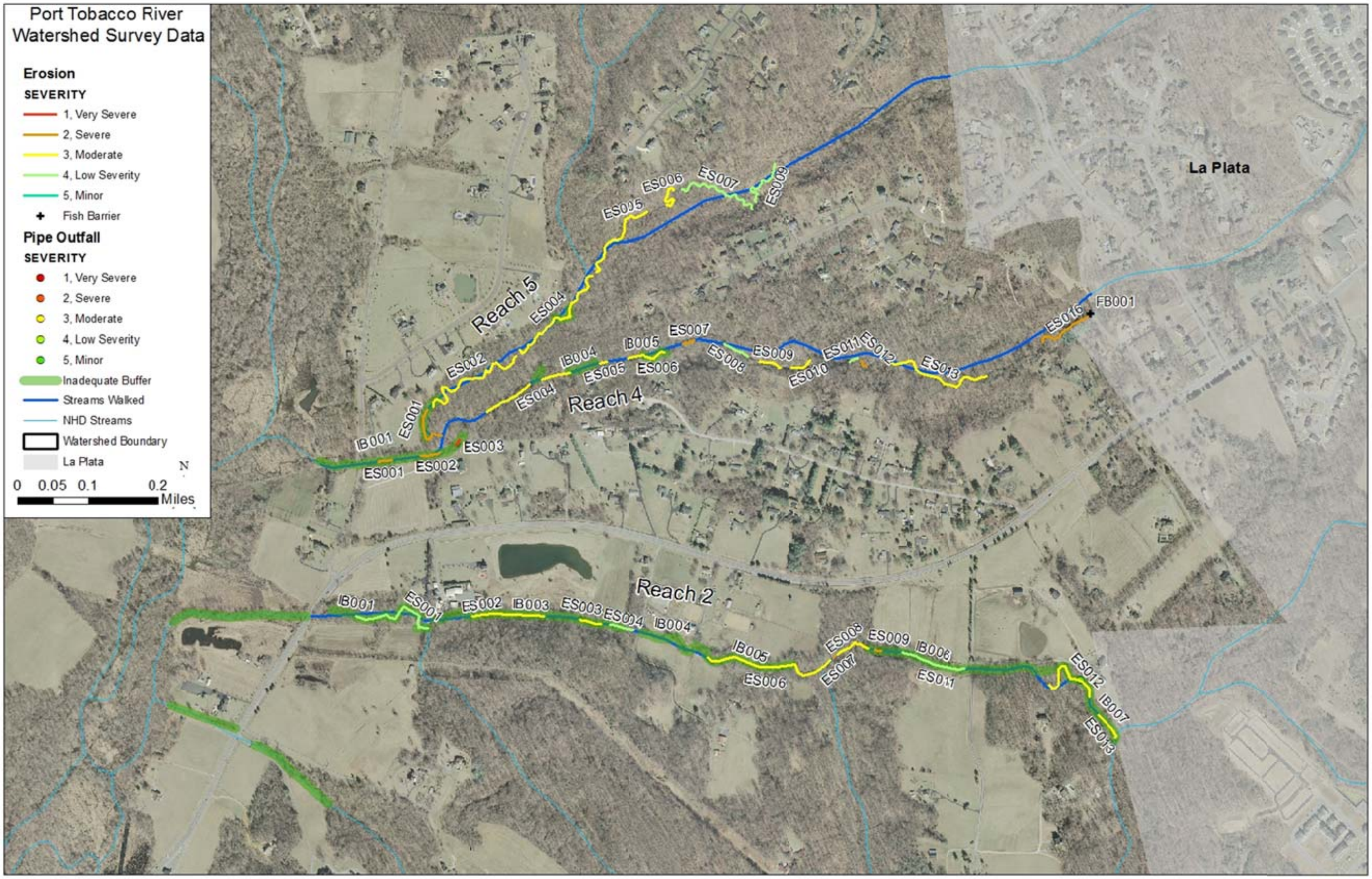


FIGURE 8: SURVEY DATA MAP SHOWING PIPE OUTFALL, EROSION, FISH BARRIER, AND INADEQUATE BUFFER SITES, SOUTHERN REACHES

FIGURE 9: SURVEY DATA MAP SHOWING CHANNEL ALTERATION, TRASH DUMPING, EXPOSED PIPES, AND UNUSUAL CONDITION SITES, NORTHERN REACHES

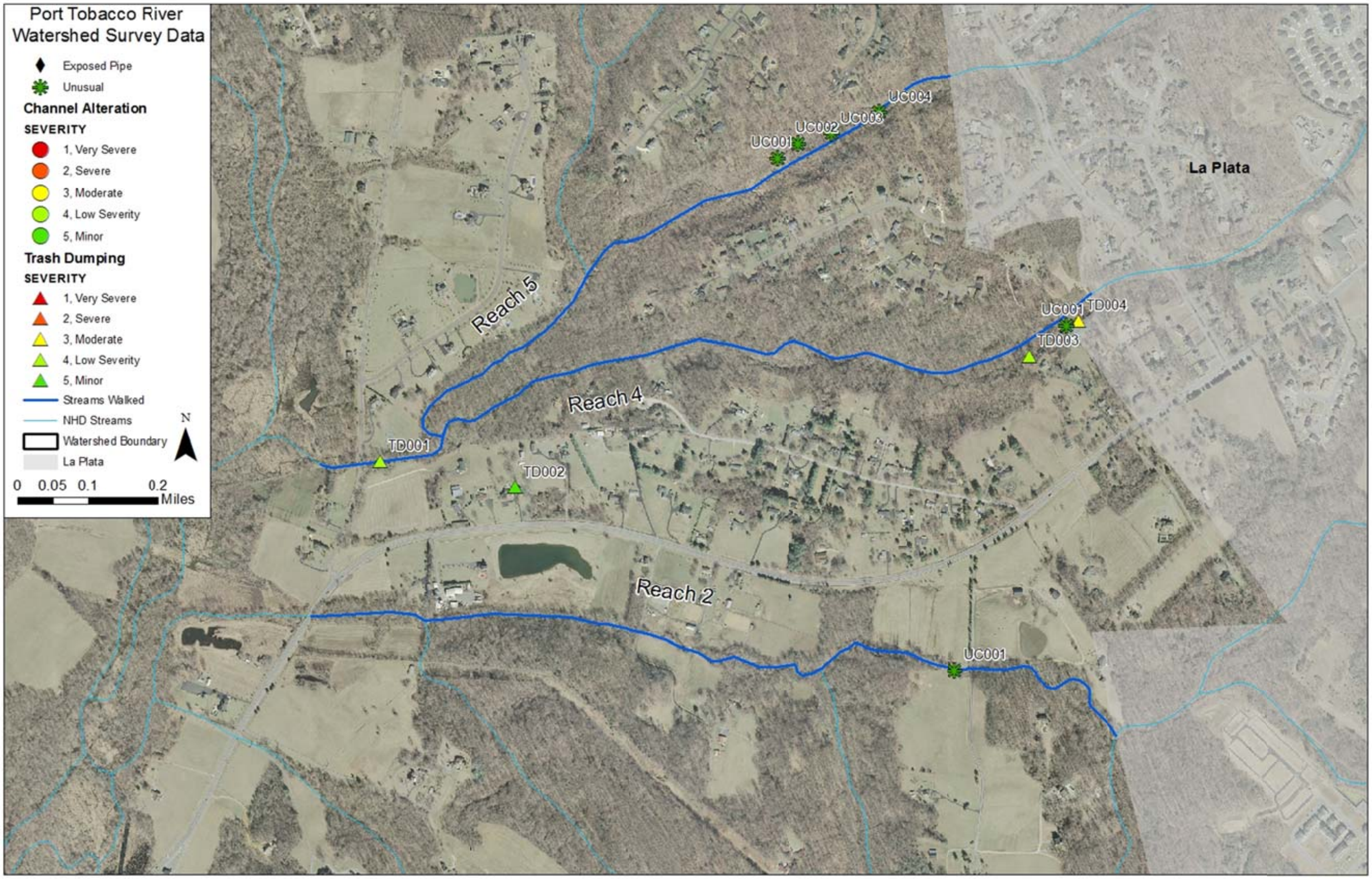


FIGURE 10: SURVEY DATA MAP SHOWING CHANNEL ALTERATION, TRASH DUMPING, EXPOSED PIPES, AND UNUSUAL CONDITION SITES, SOUTHERN REACHES

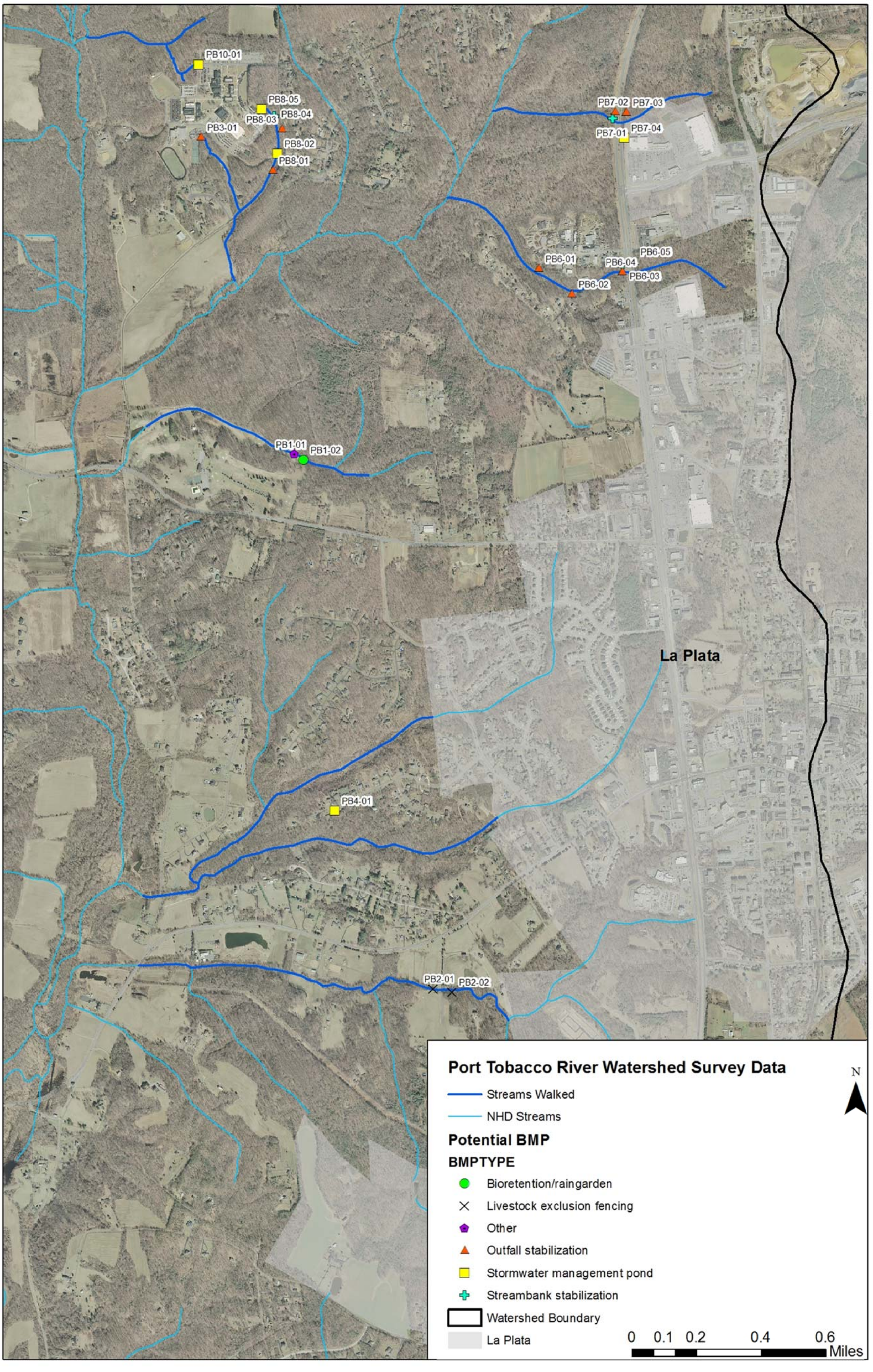


FIGURE 11: SURVEY DATA MAP SHOWING POTENTIAL BMP LOCATIONS

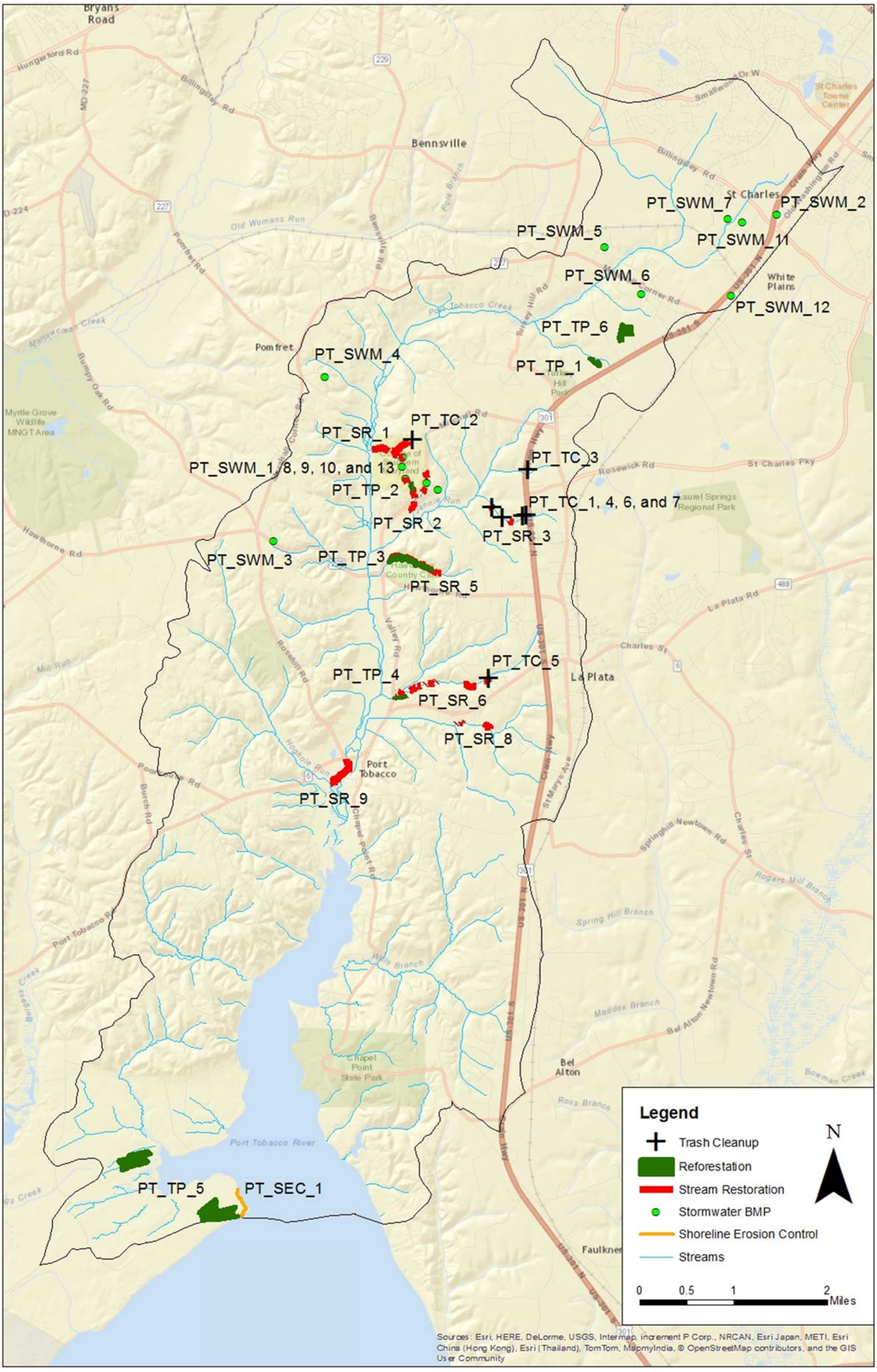
4 Potential Water Quality Improvement Projects

Results of the desktop and field watershed assessments were compiled and the results were analyzed to determine those specific areas of impairment most in need of restoration. Restoration measures were then developed according to the type and source of impact. The following section presents the methods and results for each restoration measure type which include both structural and non-structural practices and programs:

- Stream restoration;
- Shoreline erosion control;
- Stormwater BMPs (swales, step pool stormwater conveyance, bioretention, wet pond);
- Reforestation;
- Environmental site design;
- Street sweeping;
- Inlet cleaning;
- Trash clean-up;
- Homeowner practices (rain barrels, rain gardens, downspout disconnect.

Mapping of the site specific structural practices are included on Figure 12.

FIGURE 12: LOCATION OF POTENTIAL WATER QUALITY IMPROVEMENT PROJECTS



4.1 Stream Restoration

Stream restoration opportunities were field identified during the SCA assessment. The SCA stream segments were selected based on the surrounding land use within their drainage areas; streams receiving a high percent of impervious area were selected to better identify stream reaches in need of restoration. The current condition of streams was assessed and locations of stream erosion were identified and mapping using GPS. The assessment rated each segment of stream erosion on a 1 to 5 scale according to its severity, correctability, and accessibility; where a score of 1 is the most severe, but also the most correctible and the most accessible. Priority areas in need of stream restoration were determined using these three scores. The site ranking criteria can be found in Table 14.

TABLE 14: STREAM RESTORATION AND PIPE OUTFALL SITE RANKING CRITERIA

Priority Ranking	Scores
High	Severity = 1 or 2 AND Correctability/Access = 1 - 4
Medium	Severity = 1 or 2 AND Correctability or Access = 5, OR Severity = 3 AND Correctability/Access = 1 - 4
Low	Severity = 1 or 2 AND Correctability AND Access = 5; OR Severity = 3 AND Correctability/Access = 5; OR Severity = 4 - 5
Very Low	Severity = 4 or 5 AND Correctability/Access = 5; OR Severity = 3 AND Correctability AND Access = 5

Next, high and medium priority erosion sites were identified and combined into stream restoration projects based on proximity to other erosion sites. Overall, only high and medium erosion sites were selected to be included in potential restoration sites, however some low priority erosion segments were included if they were located between other higher priority segments. Pipe outfall data collected during the SCA assessment was ranked according to the same methods used for stream restoration sites (Table 14). Pipe outfalls with high and medium priority rankings were selected and incorporated into nearby stream restoration projects.

A total of eight stream restoration projects were identified with a total length of approximately 16,000 linear feet (Table 17). Reasons for stream restoration include stream headcutting, widening, downcutting, and fish barriers. One additional stream restoration site was identified by the County to be incorporated into the list of potential projects, bringing the total length of potential stream restoration up to 18,769 linear feet. A unit cost estimate of $645/ft was used to estimate the initial cost of the stream restoration projects and a cost factor per impervious acre treated was used to derive the total cost over 20 years (King and Hagan, 2011).

Load reductions were calculated for total nitrogen, total phosphorus, and total suspended sediment for each restoration site with estimated removal efficiencies from *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (MDE, 2014) which are shown in Table 16.

TABLE 15: STREAM RESTORATION PROJECT DESCRIPTIONS

Restoration Site ID	SCA Reach	Current Condition	Proposed Actions
PT_SR_1	009, 010	Stream receives runoff from agricultural field and College of Southern Maryland. Channel deeply incised with severe bank erosion.	Stream bank and bed stabilization to repair many headcuts and eroding banks.
PT_SR_2	003, 008	Stream receives runoff directly from Mitchell Road and College of Southern Maryland. Channel incised with localized areas of severe bank erosion.	Stream bank and bed stabilization and reparing two (2) pipe outfalls.
PT_SR_3	006	Stream receives runoff directly from Crain Hwy and W & W Industrial Road. Channel slightly incised with localized areas of severe bank erosion.	Stream bank stabilization to repair bank erosion. Potential floodplain reconnectivity.
PT_SR_4	006	Stream reach adjacent to Walmart parking lot, located upstream of Crain Hwy. Channel incised with localized areas of bank erosion.	Stream bank stabilization to repair bank erosion. Potential floodplain reconnectivity.
PT_SR_5	001	Stream receives runoff directly from Hawthorn Country Club golf. Channel primarily incised with considerable amount of bank erosion.	Stream bank stabilization to repair bank erosion.
PT_SR_6	004	Stream located downstream from Town of La Plata north of Darley Dr. Channel incised with localized areas of severe bank erosion.	Stream bank stabilization to repair bank erosion. Potential floodplain reconnectivity.
PT_SR_7	005	Stream located behind residence off Valley Rd. Heavy bank erosion due to tight meander bend.	Channel realignment and stream bank stabilization to repair bank erosion.
PT_SR_8	002	Stream located downstream from town of La Plata near Mudd Farm Ln. Channel incised with localized areas of severe bank erosion.	Stream bank stabilization to repair bank erosion.
PT_SR_9	N/A	Degraded stream channel south of MD Route 6 (Port Tobacco Road)	Provide grade control and habitat improvement

TABLE 16: STREAM RESTORATION REMOVAL EFFICIENCY AND IMPERVIOUS ACRE EQUIVALENT

Pounds Reduced per Linear Foot			Impervious Acre Equivalent
TN	TP	TSS	
0.075	0.068	15	0.01

TABLE 17: STREAM RESTORATION COST, IMPERVIOUS CREDIT, AND LOAD REDUCTION

Restoration Site ID	SCA Reach	Erosion length (ft)	Total Initial Cost	Total Cost Over 20 Years	Imperv-ious credit	Load Reduction (lbs/yr)		
						TN	TP	TSS
PT_SR_1	009, 010	2,828	$1,824,060	$2,328,010	28.3	212.1	192.3	42,420.0
PT_SR_2	003, 008	3,843	$2,478,735	$3,163,558	38.4	288.2	261.3	57,645.0
PT_SR_3	006	800	$516,000	$658,560	8.0	60.0	261.3	57,645.0
PT_SR_4	006	170	$109,650	$139,944	1.7	12.8	11.6	2,550.0
PT_SR_5	001	3,190	$2,057,550	$2,626,008	31.9	239.3	216.9	47,850.0
PT_SR_6	004	3,976	$2,564,520	$3,273,043	39.8	298.2	270.4	59,640.0
PT_SR_7	005	418	$269,610	$344,098	4.2	31.4	28.4	6,270.0
PT_SR_8	002	744	$479,880	$612,461	7.4	55.8	50.6	11,160.0
PT_SR_9	N/A	2,800	$1,806,000	$2,304,960	28.0	210.0	190.4	42,000.0
Total		**18,769**	**$12,106,005**	**$15,450,641**	**187.7**	**1,407.7**	**1,483.2**	**327,180.0**

4.2 Shoreline Erosion Control

Areas with significant shoreline erosion were identified using the Maryland DNR Maryland Coastal Atlas (DNR, 2015). Historic shoreline data and shoreline rate of change transects were used to search for shoreline with moderate (4 to 8 feet of erosion per year) and high (greater than 8 feet of erosion per year) erosion along the Port Tobacco River. Shoreline without adequate erosion transect data was also analyzed using the historic shoreline data to identify additional areas with significant erosion issues. Areas with artificial stabilization or bulkhead were excluded from this search.

One potential shoreline erosion project was identified (Table 19). The site is located on the western shore of the Port Tobacco River where it meets the Potomac River, on the Blossom Point Proving Grounds property. Transect data was not available in a portion of the shoreline, however using historic shoreline data it was determined to be an area of active erosion and it was calculated that at the worst point of erosion, the shoreline has eroded 370 feet in the past 111 years.

A unit cost estimate of $310/ft was used to estimate the cost of this shoreline erosion control project (MDE, 2012). Load reductions were calculated for total nitrogen, total phosphorus, and total suspended sediment for the site with estimated removal efficiencies from *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (Table 18; MDE 2014).

TABLE 18: SHORELINE EROSION CONTROL REMOVAL EFFICIENCY AND IMPERVIOUS ACRE EQUIVALENT

Pounds Reduced per Linear Foot			Impervious Acre Equivalent
TN	TP	TSS	
0.075	0.068	137	0.04

TABLE 19: SHORELINE EROSION CONTROL PROJECTS

Restoration Site ID	SCA Reach	Erosion Length (ft)	Cost	Impervious Credit
PT_SEC_1	N/A	2,432	$753,920	97.3

4.3 Stormwater BMPs

Sites to develop new or retrofit stormwater BMPs were identified as part of the watershed assessment and planning process. An additional BMP site search was conducted in the Port Tobacco Watershed by Vista Design, Inc. for Charles County to identify BMP projects specifically focused on the County's impervious surface treatment goals. Both assessments including the resulting proposed stormwater BMPs and projected treatment are included in the sections below. Section 4.3.1 describes the analysis completed through this watershed assessment while Section 4.3.2 includes the analysis conducted by Vista Design, Inc.

4.3.1 Watershed Assessment Stormwater BMP Analysis

A desktop analysis was performed to compile a list of potential sites for stormwater management. Results from Port Tobacco Watershed investigations conducted prior to the stormwater (BMP) assessment, including the neighborhood source assessment, hot spot investigation, and stream corridor assessment, were reviewed for potential concurrent stormwater management opportunities. Several of these sites were selected for additional review to assess feasibility for stormwater management through structural or ESD practices. The sites selected included neighborhoods with little to no existing stormwater management, as well as pipe outfalls requiring stabilization. A database containing geospatial information for existing Charles County stormwater facilities was also used to identify potential BMP retrofit sites.

A field visit was then conducted for each site. Sites with limited opportunity for stormwater management were noted, but not evaluated further. Sites that displayed potential for stormwater management were documented through photographs, field map annotation, and field reconnaissance forms. Existing site conditions, including ownership, existing stormwater management, site drainage, and conveyance, were recorded. Details that may not be readily available in GIS format, such as adjacent land use, access constraints, potential permitting considerations, and potential utility conflicts were also noted. Finally, a preliminary stormwater BMP proposed treatment option, purpose, and location was established for each site.

Following the field visit, the potential stormwater BMP sites were inventoried, and field information was corroborated and/or expanded upon using a variety of additional resources such as County as-built records and County spatial data. With additional supporting information, the potential sites were again queried for conditions that eliminate the project from consideration completely.

Planning-level drainage areas were then delineated to the remaining potential stormwater BMP sites in ArcGIS using stormdrain shapefiles, two-foot contour data, and orthography, as well as field-observed drainage patterns. An impervious area layer was created by merging building, roadway, and driveway shapefiles and then clipped to each drainage area to establish the acres of impervious area draining to each site.

To determine the water quality volume (WQv) required at each retrofit site, procedures from MDE 2000 Maryland Stormwater Design Manual were used including the following equation:

$$WQv = \frac{(0.05+0.009*I)(A)}{12}$$

where:

I = Percent impervious cover
A = Drainage area (in acres)
I = Percent impervious cover

Once the MDE required water quality volume was established for each potential site, the proposed BMP type was finalized, and an estimate of the WQv provided was completed for each retrofit.

The BMP facility types that were identified within the Port Tobacco watershed include dry swales, step pool storm conveyance systems bioretention, and wet ponds. Table 20 below includes a brief discussion of the existing site conditions and the proposed site improvements. Table 21 contains a summary of the impervious area treated by the proposed BMP types.

TABLE 20: PROPOSED SWM BMPS PROJECTS

Restoration Site ID	SCA Site ID	Existing Conditions	Proposed Improvements
PT_SWM_4	N/A	Existing drainage ditches throughout the WJ Willet subdivision (residential). Not all ditches are suitable for retrofit due to steep slopes, utilities; primarily in ROW although may require permission from residents. Drainage ditches have mild grade (< 2%).	Convert into swales
PT_SWM_5	N/A	Existing drainage ditches throughout Hope Acres subdivision (residential). Not all ditches are suitable for retrofit due to steep slopes, utilities, and evidence of baseflow in one ditch; primarily in ROW although may require permission from residents. Ditches have about 2% gradient.	Convert into swales
PT_SWM_6	N/A	Existing drainage ditches throughout White Plains subdivision (residential). Median length of ditches is about 50’ with 0.5% slope. Not all ditches are suitable for retrofit due to steep slopes, and utilities; primarily in ROW although may require permission from residents	Convert into swales
PT_SWM_7	N/A	Existing drainage ditches in Waldorf Manor subdivision (residential), specifically at the southern end of Gateway Blvd. Ditches have mild grade (<2%); primarily in ROW although may require permission from residents	Convert into swales

Restoration Site ID	SCA Site ID	Existing Conditions	Proposed Improvements
PT_SWM_9	N/A	Existing drainage ditches throughout Mt. Carmel Estates subdivision (residential). Ditches have mild grade, about 0.5%; primarily in ROW although may require permission from residents	Convert into swales
PT_SWM_1	PB3-01	Existing outfall with severe downstream incision which is propagating upstream. Located on College of Southern Maryland property, in heavily wooded area receiving flow from adjacent parking lot. Grass area upstream of outfall suitable for bioretention retrofit as alternative to conveyance retrofit.	SPSC
PT_SWM_13	PB10-01	Existing outfall with severe incision downstream which is propagating upstream. Located on College of Southern Maryland property, in heavily wooded area.	SPSC
PT_SWM_2	N/A	Dry pond built in 1990, located adjacent to commercial lot. Corrugated metal riser structure is corroded and needs replacement, flow is bypassing riser and draining into barrel pipe via a hole in the pipe. Limited surface area	Bioretention
PT_SWM_3	N/A	Existing dry pond installed in 1996 with corrugated metal riser, located in Preswicke Hills residential development. Adjacent to privately owned lot; Very small surface area	Bioretention
PT_SWM_10	N/A	Grass island adjacent to College of Southern Maryland parking lot, receives flow from adjacent roadway and buildings.	Bioretention
PT_SWM_11	N/A	Grass area at the end of a residential parking lot receiving drainage from the lot. Evidence of underground utilities (telephone) adjacent.	Bioretention
PT_SWM_12	N/A	Small grass islands in commercial parking lot receiving sheet flow from the lot.	Bioretention
PT_SWM_8	PB8-02	Existing excavated pond installed in 1997, location on College of Southern Maryland property. Has baseflow channel with 84" concrete riser in good condition and 15" CMP inflow pipe. Surface area limited-constrained by intersection. Utilities on top of embankment.	Wet Pond

TABLE 21: AREA TREATED BY SWM BMP PROJECTS PER TYPE

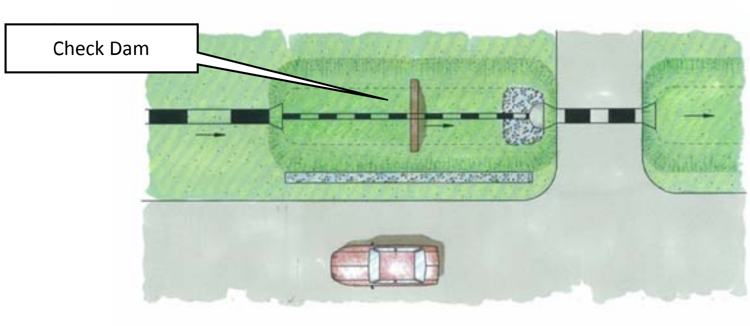
Treatment Type	Restoration Site IDs	Total Drainage Area (ac)	Impervious Area Treated (ac)
Dry Swales	PT_SWM_4 PT_SWM_5 PT_SWM_6 PT_SWM_7 PT_SWM_9	532.92	49.3
SPSC	PT_SWM_1 PT_SWM_13	17.03	7.03
Bioretention	PT_SWM_2 PT_SWM_3 PT_SWM_10 PT_SWM_11 PT_SWM_12	15.26	1.11
Wet ponds	PT_SWM_8	17.60	0.72
	TOTAL	**582.81**	**58.16**

Dry Swales

A dry swale is an open channel used to convey drainage and promote the filtering of stormwater runoff. Dry swales, which are used to treat WQv, may also contain an underdrain beneath the filter material to ensure runoff is conveyed away within 48 hours.

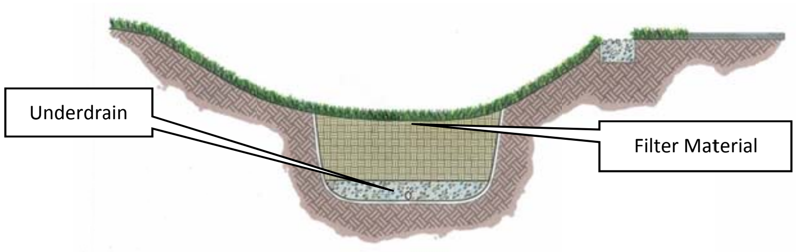
A dry swale contains filter material, an underdrain system, and check dams. The filter material is typically 2.5 feet of permeable soil underlain by a gravel bed surrounding an underdrain system consisting of a perforated pipe. The pipe conveys the filtered water to the downstream channel or a local storm drain.

A check dam is a small dam used within the channel to temporarily pool water, which promotes deposition of sediment, increases filtration through the filter media, and reduces flow velocities. Check dams allow channels to have a longitudinal slope of up to 4% and still provide WQv with non-erosive flow velocities.



Plan view of Dry Swale

The side slopes of a dry swale are typically designed to be flatter than 3:1. The vegetative cover usually consists of grass with some riprap at swale inlets and outlets. The bottom width of the dry swale is between two feet and eight feet and the maximum ponding depth is 18 inches.



Cross section of Dry Swale

Of the neighborhoods that were identified as having little to no existing stormwater management, five were identified as potential sites for bioswale or dry swale installation. Most of the neighborhoods have areas with existing, low gradient drainage ditches, making them good candidates for retrofit.

It should be noted that instead of evaluating each swale on an individual basis, each neighborhood was evaluated as a whole to establish the required and proposed water quality volume. Neighborhood boundaries were used to represent the drainage area, and the total impervious area within each neighborhood was used in water quality calculations.

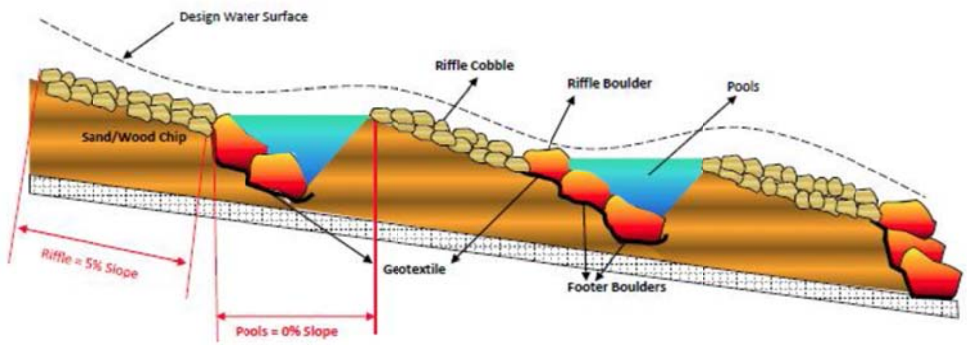
Limitations to the dry swale retrofits include the existence of utilities in the neighborhoods, including overhead lines and the presence of electric and cable lines that were observed in the field. Detailed utility information is needed to determine which locations are suitable for retrofit. Also, some of the existing ditches extend outside of the right-of-way, meaning in some instances, permission from residents would need to be obtained.

SPSC

Step pool storm conveyance systems or SPSC are open-channel conveyance structures that convert surface storm flow to shallow groundwater flow, and safely convey, attenuate, and treat the quality of storm flow. They utilize a series of constructed shallow aquatic pools, riffle grade control, native vegetation, and an underlying sand/woodchip mix filter bed media.

An SPSC system consists of alternating pools and riffle channels. The length of the pools is typically twice the length of the riffles and a minimum of 18 inches deep. The maximum length of the riffle structures is typically eight feet so as not to build excessive energy. Also, an SPSC segment used for water quality should not exceed 5% in longitudinal slope. If the overall slope exceeds five percent, boulder cascades may be utilized to traverse the grade. All unarmored sides of the pool are laid at no steeper than 3H:1V. In the event the connecting stream is incised, boulders are used to construct an in-stream weir.

Two sites were identified as potential step pool stormwater conveyance (SPSC) opportunities, PT_SWM_1, and PT_SWM_13. Both sites are located on College of Southern Maryland property. Flow from both of these outfalls is causing significant erosion issues that will eventually result in failure of the storm drain system. Limitations to the potential SPSC installation include unavoidable tree impacts and the potential for steep gradients. PT_SWM_1 also has potential for bioretention upstream of the channel, which may be investigated if it is later if it is determined that an SPSC system is not feasible.

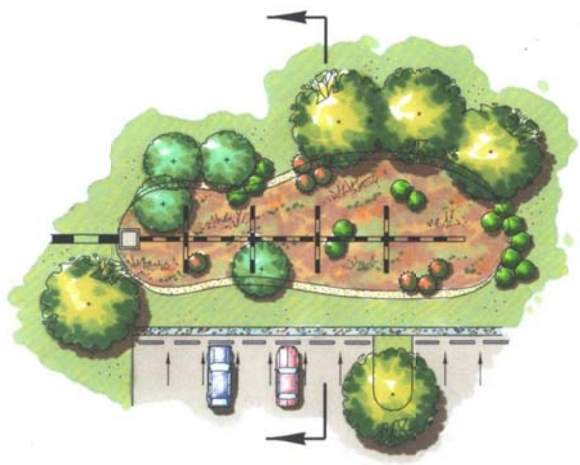


Profile for Regenerative Stormwater Conveyance System (source: Anne Arundel County, 2011)

Bioretention

A bioretention area combines open space with SWM through the use of landscaping and permeable soils to treat runoff from parking lots and urban areas. The permeable soils filter suspended sediments and some pollutants from the runoff while the landscaping promotes evapotranspiration of the runoff and uptake of nutrients.

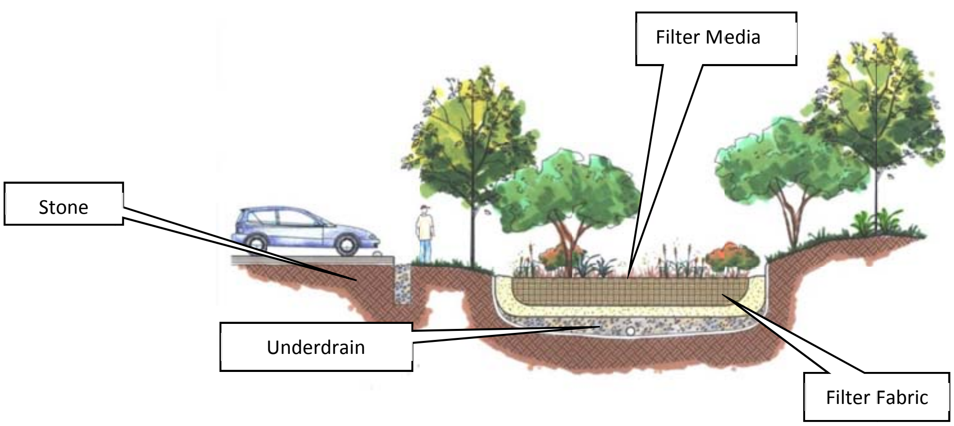
Bioretention areas generally consist of a stone diaphragm, filter fabric, filter media, landscaping, and an underdrain system. The stone diaphragm reduces the velocity of the runoff from the impervious surface that is entering the facility and also removes suspended material that may clog the filter media. The underdrain system is a perforated pipe system that collects the water that has filtered through the permeable media and transports it to a downstream open channel or connects into a nearby storm drain.



Plan view of bioretention area

The landscaping in a bioretention area is also very important. The plants chosen are native plant species that are tolerant of standing water. A wide variety of trees, shrubs, and herbaceous plants are selected for varying levels of vegetative uptake, for encouragement of various wildlife species, and for improved aesthetics. The permeable soil in the bioretention area is approximately 2.5 feet to 4 feet deep with 3 inches of mulch above it.

The ponding within the bioretention area is typically 6 inches to 12 inches. There is generally a catch basin or weir provided within the ponding area that is used for overflow when the ponding area reaches its maximum volume.



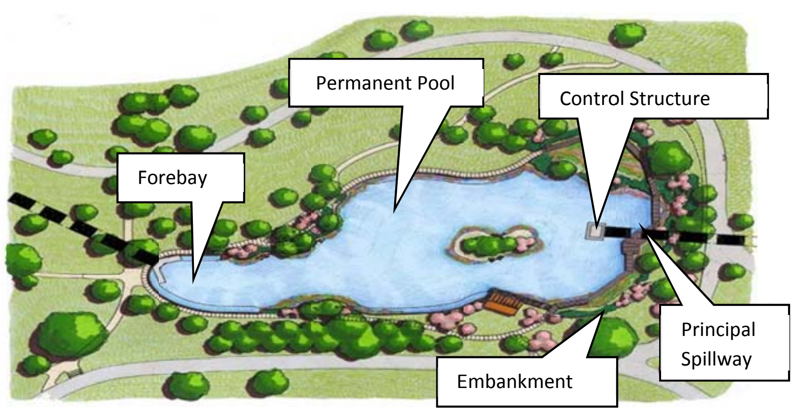
There were five opportunities for bioretention identified within the Port Tobacco watershed. Two of the six are existing dry ponds (PT_SWM_2 and PT_SWM_3). Existing pond retrofits are ideal since land costs are minimal, and construction costs are less than the cost of constructing a new pond. However, both sites are located adjacent to private property. The surface area of PT_SWM_2 is limited by existing infrastructure and site PT_SWM_3 is adjacent to residential property.

The remaining areas with the potential for bioretention include PT_SWM_10, PT_SWM_11, and PT_SWM_12. All of these sites were identified in the field and have a relatively small amount of drainage reaching them. PT_SWM_10 is a grass island adjacent to a roadway running through the College of Southern Maryland. PT_SWM_11 is an open grass area receiving drainage from an existing parking lot and site PT_SWM_12 consists of grass islands that could be opened up to intercept runoff from a commercial parking lot. The drainage areas to these sites are small, but the potential bioretention areas would provide treatment for small drainage areas with high amounts of imperviousness. Obvious limitations include obtaining permission from property owners and confirming that there are no existing underground utilities.

Wet Pond

A wet pond is designed to provide water quality treatment with a permanent pool of water. This is accomplished by detaining water and releasing it at a controlled rate, which allows time for suspended sediment and some nutrients to settle out of the water before it leaves the pond.

A wet pond consists of a forebay, embankment, control structure, principal spillway, and a permanent pool. The forebay is small pool located at the inflow of a pond and is designed to allow coarse sediment to settle out of the water column before it flows into the main body of the pond. The embankment, which is typically designed to confine the 100-year storm, contains a clay core to minimize seepage from the upstream side to the downstream side. The principal spillway runs through the embankment and is the primary means for flow to leave the pond. The control structure regulates the level of water within the facility. It has openings set at specific elevations, the lowest of which controls the depth of water in the pond. The permanent pool is the elevation of water that remains in the facility, maintained by the control structure.



Plan view of wet pond

Typically a safety bench is installed just above the permanent pool elevation around the perimeter of the pond. Approximately 18 inches below the water surface is typically an aquatic bench that is required to be put in for wetland planting to improve aesthetics and vegetative uptake of nutrients. The aquatic bench should extend to a depth of 18 inches below the permanent pool elevation. The combined minimum width of these two benches is 15 feet.

There was one site identified as having potential for wet pond retrofit, site PT_SWM_8. It is currently a dry pond with a baseflow channel running through it, located at the intersection of Mitchell Road and South Campus Drive on College of Southern Maryland property. As previously stated, existing pond retrofits are ideal since land costs are minimal, and construction costs are less than the cost of constructing a new pond. There appears to be opportunity to increase capacity and the site has visibly filled in significantly with sediment over time. However, the surface area is limited by adjacent roadways.

There was one site identified as having potential for wet pond retrofit, site PT_SWM_8. It is currently a dry pond with a baseflow channel running through it, located at the intersection of Mitchell Road and South Campus Drive on College of Southern Maryland property. As previously stated, existing pond retrofits are ideal since land costs are minimal, and construction costs are less than the cost of constructing a new pond. There appears to be opportunity to increase capacity and the site has visibly filled in significantly with sediment over time. However, the surface area is limited by adjacent roadways and there are utilities running along the top of the embankment.

The potential to provide stormwater management through BMP facilities throughout the Port Tobacco Watershed is relatively limited. One of the most widely used retrofits to obtain water quality treatment involves modifying existing ponds. Considering this, a review of all existing BMPs that are documented in the Port Tobacco watershed was conducted, and any ponds exhibiting potential for retrofit were field visited. However, a large portion of the ponds are already providing water quality treatment, so existing pond retrofit opportunities are sparse. Although the BMP retrofit opportunities that were identified do not individually provide a large amount of impervious area treatment, constructing a series of small BMP facilities may be the most effective way to provide stormwater management in the Port Tobacco watershed.

4.3.2 NPDES MS4 Retrofit Study

Vista Design, Inc. was contracted by Charles County to identify potential sites for implementing pond retrofits, streams restoration, new water quality facilities, or alternative BMPs to assist with the County's impervious surface treatment requirement as specified in the MS4 permit. Refer to the document *Port Tobacco River Watershed NPDES: MS4 Retrofit Study* (Vista, 2015b) for project background, methodology, and concept designs.

Fifteen sites were identified in the study including the following facility types: wet swales, filtering practice, pond reclassification, submerged gravel and created wetlands, and sheetflow to conservation. Impervious treatment, load reductions, and project costs are summarized in section 4.3.3.

4.3.3 Stormwater BMP Cost and Treatment Summary

Results from both stormwater BMP assessments are compiled in tables 23 and 24 below. Impervious acres treated, initial costs, and total costs over 20 years are shown in Table 23 with runoff depth treated and load reductions shown in Table 24. Restoration site IDs that include "PT_SWM" are from the watershed assessment while sites that include "PTR-C" are from the study conducted by Vista.

TABLE 22: STORMWATER BMP COSTS

Restoration Site ID	BMP Type	Impervious Acres Treated	Total Initial Costs*	Total Costs Over 20 Years**
PT_SWM_1	SPSC	3.71	$ 230,709	$272,951
PT_SWM_2	Bioretention	0.36	$66,718	$77,658
PT_SWM_3	Bioretention	0.17	$30,872	$35,934
PT_SWM_4	Swale	6.77	$298,066	$424,202
PT_SWM_5	Swale	5.19	$228,467	$325,150
PT_SWM_6	Swale	17.70	$778,928	$1,108,557
PT_SWM_7	Swale	4.84	$212,904	$303,002
PT_SWM_8	Wet Pond	0.72	$47,202	$58,305
PT_SWM_9	Swale	14.79	$650,919	$926,376
PT_SWM_10	Bioretention	0.44	$82,906	$96,499
PT_SWM_11	Bioretention	0.08	$14,691	$17,100
PT_SWM_12	Bioretention	0.06	$11,760	$13,688
PT_SWM_13	SPSC	3.32	$220,398	$262,641
	Subtotal	**58.16**	**$2,874,541**	**$3,922,061**
PTR-C-1	Pond Reclassification / Dry Swales	37.06	$362,500	
PTR-C-2	Filtering Practice	3.75	$591,500	
PTR-C-3	Pond Reclassification	66.28	$42,000	
PTR-C-4	Sheetflow to Conservation	3.69	$60,000	
PTR-C-4A	Sheetflow to Conservation	2.40	$60,000	
PTR-C-5	Submerged Gravel Wetland	4.93	$256,000	
PTR-C-6	SGW/Wet Swales	4.51	$301,500	
PTR-C-7	SGW/Wet Swales	3.00	$161,500	
PTR-C-8	Submerged Gravel Wetland	12.66	$736,000	
PTR-C-9	Created Wetland	5.48	$257,000	
PTR-C-10	Pond Reclassification	25.68	$42,000	
PTR-C-11	Submerged Gravel Wetland	5.70	$472,500	
PTR-C-12	Sheetflow to Conservation	4.54	$67,500	
PTR-C-13	SGW/Wet Swales	3.38	$500,000	
PTR-C-14	Pond Reclassification	13.09	$36,000	
	Subtotal	**196.24**	**$3,946,000**	**$4,735,200**
	Total	**254.4**	**$6,820,541**	**$8,657,261**

*Swale, bioretention, wet pond cost estimates from King and Hagan, 2011

**Watershed assessment sites (projects termed: 'PT_SWM'), swale, bioretention, wet pond 20 year cost estimates from King and Hagan, 2011. For Vista retrofit sites (projects termed 'PTR-C') additional costs to calculate total cost over 20 years are not provided, therefore a 20% factor was applied to estimate Vista sites subtotal to calculate the additional cost needed over time.

TABLE 23: STORMWATER BMP RUNOFF DEPTH TREATED, IMPERVIOUS TREATED, AND LOAD REDUCTION

Restoration Site ID	Type	Runoff Depth (inches)	Impervious (acres)	Load Reduction (lbs/yr)		
				TN	TP	TSS
PT_SWM_1	SPSC	0.71	3.71	22.2	4.4	1,554.2
PT_SWM_2	Bioretention	0.89	0.36	2.3	0.4	139.1
PT_SWM_3	Bioretention	0.09	0.17	5.0	0.6	187.0
PT_SWM_4	Swale	0.77	6.77	409.3	31.6	7,495.7
PT_SWM_5	Swale	1.00	5.19	250.5	19.5	4,649.1
PT_SWM_6	Swale	1.00	17.70	489.1	43.3	10,959.3
PT_SWM_7	Swale	1.00	4.84	192.7	15.6	3,786.5
PT_SWM_8	Wet Pond	0.32	0.72	20.5	2.4	729.2
PT_SWM_9	Swale	1.00	14.79	499.3	41.9	10,372.1
PT_SWM_10	Bioretention	0.97	0.44	3.7	0.6	162.9
PT_SWM_11	Bioretention	0.49	0.08	0.8	0.2	40.8
PT_SWM_12	Bioretention	0.23	0.06	0.6	0.1	37.3
PT_SWM_13	SPSC	0.83	3.32	14.3	3.3	1,181.9
		Subtotal	**58.16**	**1,910.3**	**163.9**	**41,295.10**
PTR-C-1	Pond Reclassification / Dry Swales	0.50	37.06	569.5	88.9	28,795.7
PTR-C-2	Filtering Practice	0.50	3.75	60.2	14.6	5,343.3
PTR-C-3	Pond Reclassification	0.49	66.28	1,442.5	196.7	61,010.7
PTR-C-4	Sheetflow to Conservation	0.49	3.69	42.0	5.0	1,188.1
PTR-C-4A	Sheetflow to Conservation	0.51	2.40	27.4	3.2	773.4
PTR-C-5	Submerged Gravel Wetland	0.74	4.93	35.3	6.6	2,021.5
PTR-C-6	SGW/Wet Swales	0.99	4.51	75.8	8.2	2,197.7
PTR-C-7	SGW/Wet Swales	1.00	3.00	89.2	8.2	2,037.1
PTR-C-8	Submerged Gravel Wetland	0.83	12.66	798.3	61.6	14,048.4
PTR-C-9	Created Wetland	0.98	5.48	77.3	9.7	2,887.6
PTR-C-10	Pond Reclassification	0.89	25.68	491.7	58.1	16,906.0
PTR-C-11	Submerged Gravel Wetland	1.00	5.70	32.6	5.8	1,763.2
PTR-C-12	Sheetflow to Conservation	0.47	4.54	93.0	8.5	1,870.3
PTR-C-13	SGW/Wet Swales	0.99	3.38	210.2	19.1	4,773.6
PTR-C-14	Pond Reclassification	0.46	13.09	417.9	30.2	5,524.9
		Subtotal	**196.15**	**4,462.9**	**524.4**	**151,141.5**
		Total	**254.35**	**6,373.2**	**688.3**	**192,436.6**

For Vista retrofit sites, impervious acres represent the additional impervious surface treatment that may result from completion of the project and does not include current facility treatment.

For watershed assessment sites, load reductions are calculated using updated removal curves from Schueler and Lane, 2013. Load reductions for Vista retrofit sites from Vista, 2015b.

4.4 REFORESTATION

Several potential reforestation sites were field identified during the SCA assessment performed July-September 2014, however these sites were limited to the stream segments walked during the SCA assessment. A GIS desktop assessment was performed to supplement the SCA identified reforestation projects. The desktop assessment focused first on the opportunity to plant riparian buffers. Using the most recent available aerial photography, stream reaches without adequate 50 foot buffer on both banks were identified. Streams within land use areas categorized as agriculture were excluded from this search. Next, tree planting opportunities larger than 0.25 (as required by MDE in *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* Guidance, 2014) acres outside of riparian areas were identified. Targeted property types include property owned by the Charles County Board of Education, parks, other Charles County owned sites, residential, and church parcels.

Cost estimates for the proposed plantings were calculated based King and Hagan. A total initial cost estimate of $11,000/acre and a total cost over 20 years of $19,069 was used to estimate the cost of reforestation projects (King and Hagan, 2011). Load reductions were calculated for total nitrogen, total phosphorus, and total suspended sediment for the site with estimated removal efficiencies from *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (Table 24; MDE, 2014). These efficiencies assume a survival rate of 100 trees/acre or greater with at least 50% of trees having a two inch diameter or greater (4.5 feet above ground; MDE, 2014). Six potential reforestation sites were identified, totaling 82 acres (Table 25).

TABLE 24: REFORESTATION ON PERVIOUS URBAN REMOVAL EFFICIENCY AND IMPERVIOUS ACRE EQUIVALENT

Efficiency Per Acre			Impervious Acre Equivalent
TN	TP	TSS	
66%	77%	57%	0.38

TABLE 25: REFORESTATION SITE COST AND IMPERVIOUS CREDIT

Restoration Site ID	SCA Reach ID	Property type	Area (acres)	Total Initial Cost	Total Cost Over 20 Years	Impervious Credit
PT_TP_1	N/A	church field	1.96	$21,605	$37,454	0.7
PT_TP_2	Reach 003 IB002	college open space	0.93	$10,178	$17,644	0.4
PT_TP_3	Reach 001 IB001, IB002	golf course	10.95	$120,463	$208,827	4.2
PT_TP_4	Reach 004 IB002	residential lawn	0.75	$8,238	$14,281	0.3
PT_TP_5	N/A	Blossom Point Proving Ground open field	57.84	$636,241	$1,102,953	22.0
PT_TP_6	N/A	church field	9.80	$107,753	$186,794	3.7
Total			82.2	$904,478	$1,567,954	31.2

5 Environmental Site Design / New Development

Environmental Site Design (ESD) BMPs are currently implemented throughout the County and will continue to be utilized as new development occurs. Table 26 shows the types of ESD BMPs and area treated within the Port Tobacco watershed that were completed in 2013 and 2014 and will be implemented in 2015.

TABLE 26: ESD BMPS, 2013 - 2015

ESD Type	Acres Treated*
Disconnection of non-rooftop runoff	0.02
Disconnection of rooftop runoff	4.31
Dry well	1.17
Landscape infiltration	0.01
Level spreader	0.05
Rain barrel	0.01
Rain garden	0.02
Sheetflow to gravel	0.01
Sheetflow to conservation area	0.10
Swale	4.50

*ESD strategies include all practices completed in 2013 and 2014 and programmed practices that will be implemented in 2015

Pollutant removal from ESD practices was modeled using Maryland Assessment Scenario Tool (MAST); therefore, ESD types needed to be matched with an appropriate MAST BMP type to model. Table 27 shows the BMP type crosswalk used for modeling as well as nutrient and sediment removal from the suite of ESD BMPs used in the Port Tobacco watershed. Pollutant removal was modeled using a standard area of treatment applied per BMP type implemented throughout the watershed: 0.25 impervious acres for swales and 0.01 impervious acres (500 sq ft) for all other ESD practices.

TABLE 27: ESD PRACTICIES EFFICIENCY AND IMPERVIOUS ACRE EQUIVALENT

ESD Type	MAST BMP Type	Efficiency Per Acre		
		TN	TP	TSS
Rain garden	Bioretention	25%	45%	55%
Disconnection of non-rooftop runoff Disconnection of rooftop runoff Level spreader Rain barrel Sheetflow to gravel Sheetflow to conservation area	Impervious Surface Reduction*	-	-	-
Dry well	Infiltration without sand, veg.	80%	85%	95%
Landscape infiltration	Infiltration with sand, veg.	85%	85%	95%
Swale	Bioswale	70%	75%	80%

*Calculated as a land use change to a lower loading land use

6 Programmatic Practices

Currently, the County performs several programmatic practices throughout the Port Tobacco watershed including the following: mechanical street sweeping and inlet cleaning, which are conducted continually throughout each fiscal year; trash clean-ups, which are organized on an as-needed basis and vary in location; and, homeowner practices, including rainwater harvesting, rain gardens, and downspout disconnection, which are generally reliant on homeowner participation.

Nutrient and sediment removal for both street sweeping and inlet cleaning under the existing program were calculated using fiscal year 2014 County data. The potential to increase sweeping route miles and number of inlets cleaned and the resultant increased pollutant removal were investigated in Sections 6.1 and 6.2 below. The potential to expand the County's trash clean-up program with the inclusion of sites identified during the SCA assessment is also discussed in Section 6.3. Nutrient removals from planned homeowner practices if implemented throughout the Port Tobacco watershed are included in Section 6.4.

6.1 Mechanical Street Sweeping

Nutrient and sediment removal from mechanical street sweeping was calculated using fiscal year 2014 County data following load reductions as noted in the MDE guidance (MDE, 2014) and shown in Table 28. It is expected that this practice will continue in the Port Tobacco watershed annually. Street sweeping data was recorded by date collected, location and total miles swept, and amount of material removed in dry tons.

Table 29 shows the amount of material collected in the Port Tobacco watershed as well as the amount of pollutants removed. The cost of mechanical street sweeping is $122/mile with a total cost of $563.64 in the Port Tobacco watershed Table 29.

TABLE 28: MECHANICAL STREET SWEEPING REMOVAL EFFICIENCY AND IMPERVIOUS ACRE EQUIVALENT

Pounds Reduced per Dry Ton			Impervious Acre Equivalent
TN	TP	TSS	
3.5	1.4	420	0.04

TABLE 29: POLLUTANT REMOVAL FROM FY 14 MECHANICAL STREET SWEEPING

Miles Swept	Material Removed Weight (Ton)	Cost	Total Cost Over 20 Years*	Lbs Reduced / yr			Impervious Credit (Ac)
				TN	TP	TSS	
4.6	3.5	$564	$11,273	12.3	4.9	1,478.4	1.4

* Annual practice cost over 20 years calculated by multiplying initial costs by 20 years.

6.2 Inlet Cleaning

Similar to mechanical street sweeping, nutrient and sediment removal from inlet cleaning was calculated using fiscal year 2014 County data following load reductions as noted in the MDE guidance (MDE, 2014; Table 30). Inlet cleaning data was recorded by date collected, location, number of pipes cleaned, and total weight of material removed in dry tons. In order to extrapolate these data to the amount of material collected within the Port Tobacco watershed, the average amount of material removed per pipe was applied to the total pipes cleaned per watershed. This practice will continue in the Port Tobacco watershed annually. Table 31 shows the amount of material collected in the Port Tobacco watershed as well as the amount of pollutants removed. The cost of inlet cleaning is $26/pipe with a total cost of $2,990 in the Port Tobacco watershed (Table 31).

TABLE 30: STREET SWEEPING REMOVAL EFFICIENCY AND IMPERVIOUS ACRE EQUIVALENT

Pounds Reduced per Dry Ton			Impervious Acre Equivalent
TN	TP	TSS	
3.5	1.4	420	0.04

TABLE 31: POLLUTANT REMOVAL FROM FY 2014 INLET CLEANING

# of Pipes Cleaned	Average Removed / Site (Ton)	Material Removed Weight (Ton)	Cost	Total Cost Over 20 Years*	Lbs Reduced / yr			Impervious Credit (Ac)
					TN	TP	TSS	
115	0.13	15.2	$2,990	$59,800	53.3	21.3	6,394.8	6.1

* Annual practice cost over 20 years calculated by multiplying initial costs by 20 years.

6.3 Trash Clean-Ups

Areas in need of trash cleanup were field identified during the SCA assessment. Data collected at each site included the type of trash, an estimate of truckloads of trash, and if the site is a good opportunity for a volunteer clean-up. During the assessment the sites were given scores for severity, correctability, and access. Using these scores, the sites were prioritized in the same way as stream restoration and pipe outfall sites. Medium and high priority sites were recommended for trash clean-up sites.

Charles County's NPDES MS4 permit includes a requirement for Litter and Floatables (Section IV.D.4). The County currently operates an aggressive litter control program which utilizes three full-time crews who remove debris from County maintained right-of-ways throughout the workweek. In addition, volunteers perform litter pickup on the weekends through community cleanups, the Adopt-A-Road Program, and annual Watershed Cleanup Events. Watershed cleanup events and volunteer opportunities are posted through the County's website (http://www.charlescountymd.gov/pw/ litter/litter-control).

A total of seven sites were identified as medium and high priority (Table 32). The cost of trash removal is dependent on the removal approach. Of the seven sites identified, three were determined to be suitable for a volunteer clean-up opportunity and four were not. Using volunteers would obviously be less expensive than a paid crew. The cost of trash removal is estimated to be $1,000/site, for a total of $7,000 in the Port Tobacco watershed.

TABLE 32: TRASH CLEAN-UP SITES

Restoration Site ID	Type	Truck Loads	Volunteer Opportunity	Cost
PT_TC_1	Tires, mixed garbage	7	No	$1,000
PT_TC_2	Tires	5	No	$1,000
PT_TC_3	Tires, mixed garbage	2	Yes	$1,000
PT_TC_4	Appliances	2	No	$1,000
PT_TC_5	Scrap metal	3	No	$1,000
PT_TC_6	Residential	4	Yes	$1,000
PT_TC_7	Tires	2	Yes	$1,000
			Total	$7,000

6.4 Homeowner Practices

The implementation of homeowner practices is not only a cost effective strategy to supplement County restoration BMPs (e.g., stormwater BMPs, stream restoration, shoreline erosion control, etc.), but they also encourage the community to actively participate in cleaning up and taking ownership of the health of their watershed.

Nutrient removal from planned homeowner practices, including rainwater harvesting (i.e., rain barrels), rain gardens, and downspout disconnection, was calculated for each neighborhood assessed during the NSA reconnaissance and then projected to the watershed scale. The removal rates for 1 inch of rainfall treatment for this suite of homeowner BMPs are included in Table 33 (Goulet and Schueler, 2014). However, rainfall treatment varies based on site constraints, homeowner participation, and feasibility. Therefore, removal rates were calculated individually, by neighborhood, for each practice type based on specific site and design parameters in order to estimate total rain treatment and nutrient removal as shown in Tables 35, 36 and 37.

Impervious acre equivalencies for homeowner practices are also included in Table 33. An impervious acre equivalent assumption was applied to each homeowner practice based on the associated modeling BMP type (rain barrel: impervious surface reduction, rain garden: bioretention/rain gardens, disconnection of rooftop runoff: impervious surface reduction).

TABLE 33: REMOVAL EFFICIENCIES FOR HOMEOWNER PRACTICES

Practice	Efficiency Per Acre*		Impervious Acre Equivalent
	TN	TP	
Rain Barrel	28%	33%	0.75
Rain Garden	60%	70%	1.00
Downspout Disconnection	45%	52%	0.75

* based on treating the full 1 inch runoff

A series of assumptions were incorporated into the calculation of nutrient removal from homeowner practices, including the following:

General Assumptions

- Household participation per neighborhood:
  - Rain barrels = 30% of homes
  - Rain gardens = 10% of homes
  - Downspout Disconnections = 10% of homes
- Apartment or condominiums are not included in homeowner practices
- These practices will treat rooftop impervious area only
- Townhomes generally have 2 downspouts; Single-family homes generally have 4 downspouts – based on data collection during the NSA reconnaissance
- Total nitrogen and total phosphorus removed by each NSA neighborhood are standard removals that can be applied to additional neighborhoods identified as having similar housing densities, lot size, and forest cover in order to calculate total removal at the watershed scale.

Rain Barrel Assumptions

- Townhomes would use 1 rain barrel; Single-family homes would use 2 rain barrels
- Rain barrel capacity = 55 gal
- 50% of roof area will be treated

Rain Garden Assumptions

- Townhomes are not participating in the rain gardens strategy due to site limitations
- 50% of roof area will be treated
- Average rain garden depth = 8 in. as per Chesapeake Stormwater Network guidance (2013a)
- Engineering factor of 0.12 used to calculate Surface Area of rain garden as per Chesapeake Stormwater Network guidance (2013a)

Downspout Disconnection Assumptions

- Townhomes are not participating in the downspout disconnection strategy due to site limitations
- 1 downspout will be disconnected per single-family home
- Available pervious land measured in GIS between driveway and property line for a subset of households within each NSA neighborhood. As per Chesapeake Stormwater Network guidance, available pervious land area should be >10 feet in width with a length no less than 40 feet (2013b).
- An 'Average' infiltration ranking with an infiltration factor of 0.5 was applied to all NSA neighborhoods.

Nutrient removal and impervious credit for rain barrel, rain garden, and downspout disconnection practices for each NSA neighborhood, projection by neighborhood type, and watershed total are shown in Tables 35, 36 and 37.

Estimated costs for each homeowner practice are also included in the following tables. While some costs may be the responsibility of individual homeowners, the County is currently working with partners to subsidize costs and is in the process of securing additional funding for further support.

For the rain barrel practice, a cost of $60/barrel plus $25/fixtures and attachments was used to calculate an estimated cost of $308,780 for implementation in the Port Tobacco watershed. The County currently covers 50% of costs for home owners who participate in the rain barrel practice. According to the University of Connecticut Cooperative Extension System, rain garden costs may vary from a minimum cost of $5/sq ft of rain garden size - $45/sq ft of rain garden size dependent on soil removal costs, soil amendments, need for a contractor, and planting size (http://nemo.uconn.edu/raingardens /calculator.htm). An initial cost estimate of $25/sq ft of rain garden size and a total cost of $1,815,124.78 is projected for implementing the rain garden practice in the Port Tobacco Watershed. An estimated cost of $10/downspout extension was used to calculate the cost of implementing the downspout disconnection practice in the Port Tobacco watershed. A grant program with Chesapeake Bay Trust and the County was initiated in FY 2016 for non-profit organizations to help alleviate practice costs in which the County provides 50% credit to the annual stormwater remediation fee for these practices.

TABLE 34: PROJECTED NUTRIENT REMOVAL AND IMPERVIOUS CREDIT FROM PLANNED RAIN BARRELS

NSA ID	Neighbor-hood Type	Average Roof Area to Treat (sq ft) for 50% of Total Area	Rainfall Depth Treated (in)	% Removal Based on Total Rain Treatment		Lbs Reduced per NSA Neighborhood		# of Similar Neighbor-hoods in Port Tobacco	Total # of Homes	Projected Lbs Reduced per Neighborhood Type		Treated Imperv-ious Acres	# of Rain Barrels Needed	Cost
				TN	TP	TN lbs/yr	TP lbs/yr			TN lbs/yr	TP lbs/yr			
PT-01	Townhomes	416	0.21	24%	29%	1.0	0.2	0	57	1.0	0.2	0.4	57	$4,845
PT-02	Single Family	1,033	0.17	20%	24%	2.0	0.4	1	107	3.9	0.8	3.8	214	$18,156
PT-03	Apartments	-	-	-	-	-	-	-	0	-	-	0.0	0	$0
PT-04*	Single Family	814	0.22	25%	29%	8.9	1.9	3	440	15.6	3.3	12.3	880	$74,792
PT-05	Townhomes	397	0.22	25%	30%	1.7	0.4	3	389	6.9	1.5	2.7	389	$33,048
PT-06	Apartments	-	-	-	-	-	-	-	0	-	-	0.0	0	$0
PT-07	Single Family	929	0.19	22%	26%	0.9	0.2	0	25	0.9	0.2	0.8	50	$4,233
PT-08	Single Family	1,051	0.17	20%	23%	0.4	0.1	1	20	0.8	0.2	0.7	41	$3,468
PT-09	Single Family	962	0.18	22%	25%	1.9	0.4	4	264	9.6	2.1	8.7	528	$44,880
PT-10	Single Family	1,045	0.17	20%	24%	0.7	0.1	1	35	1.3	0.3	1.3	71	$6,018
PT-11	Single Family	1,449	0.12	15%	18%	0.3	0.1	6	61	2.3	0.5	3.0	122	$10,353
PT-12	Single Family	1,044	0.17	20%	24%	0.7	0.1	2	57	2.1	0.4	2.0	113	$9,639
PT-13	Single Family	1,120	0.16	19%	22%	0.7	0.2	1	38	1.4	0.3	1.5	77	$6,528
PT-14	Single Family	1,163	0.15	18%	21%	0.9	0.2	8	216	8.0	1.7	8.6	432	$36,720
PP-15	Single Family	1,507	0.12	14%	17%	1.1	0.2	10	330	12.5	2.7	17.1	660	$56,100
								Total	**2,039**	**66.3**	**14.2**	**63.1**	**3,633**	**$308,780**

*PT-04 is a very large neighborhood containing over 800 single-family homes. Projected reductions for neighborhoods similar to PT-04 were factored down by 25% due to their smaller size.

TABLE 35: PROJECTED NUTRIENT REMOVAL AND IMPERVIOUS CREDIT FROM PLANNED RAIN GARDENS

NSA ID	Neighbor-hood Type	Average Roof Area to Treat (sq ft) for 50% of Total Area	Rainfall Depth Treated (in)	% Removal Based on Total Rain Treatment		Lbs Reduced per NSA Neighborhood		# of Similar Neighbor-hoods in Port Tobacco	Total # of Homes	Projected Lbs Reduced per Neighborhood Type		Treated Imperv-ious Acres	Cost
				TN	TP	TN lbs/yr	TP lbs/yr			TN lbs/yr	TP lbs/yr		
PT-01	Townhomes	-	-	-	-	-	-	-	0	-	-	0.0	$-
PT-02	Single Family	1,033	1.00	60%	70%	1.9	0.4	1	36	3.8	0.8	0.8	$114,890
PT-03	Apartments	-	-	-	-	-	-	-	0	-	-	0.0	$-
PT-04*	Single Family	814	1.00	60%	70%	7.1	1.5	3	147	12.5	2.7	2.7	$372,812
PT-05	Townhomes	-	-	-	-	-	-	-	0	-	-	0.0	$-
PT-06	Apartments	-	-	-	-	-	-	-	0	-	-	0.0	$-
PT-07	Single Family	929	1.00	60%	70%	0.8	0.2	0	8	0.8	0.2	0.2	$24,094
PT-08	Single Family	1,051	1.00	60%	70%	0.4	0.1	1	7	0.7	0.2	0.2	$22,325
PT-09	Single Family	962	1.00	60%	70%	1.8	0.4	4	88	8.9	1.9	1.9	$264,423
PT-10	Single Family	1,045	1.00	60%	70%	0.6	0.1	1	12	1.3	0.3	0.3	$38,523
PT-11	Single Family	1,449	1.00	60%	70%	0.4	0.1	6	20	3.1	0.7	0.7	$91,952
PT-12	Single Family	1,044	1.00	60%	70%	0.7	0.1	2	19	2.1	0.4	0.5	$61,665
PT-13	Single Family	1,120	1.00	60%	70%	0.7	0.2	1	13	1.5	0.3	0.3	$44,785
PT-14	Single Family	1,163	1.00	60%	70%	1.0	0.2	8	72	8.8	1.9	1.9	$261,564
PP-15	Single Family	1,507	1.00	60%	70%	1.6	0.3	10	110	17.4	3.7	3.8	$518,092
								Total	**531**	**60.8**	**13.0**	**13.3**	**$1,815,125**

*PT-04 is a very large neighborhood containing over 800 single-family homes. Projected reductions for neighborhoods similar to PT-04 were factored down by 25% due to their smaller size.

TABLE 36: PROJECTED NUTRIENT REMOVAL AND IMPERVIOUS CREDIT FROM PLANNED DOWNSPOUT DISCONNECTION

NSA ID	Neighbor-hood Type	Average Roof Area to Treat (sq ft) with one Downspout Disconnect	Rainfall Depth Treated (in)	% Removal Based on Total Rain Treatment		Lbs Reduced per NSA Neighborhood		# of Similar Neighbor-hoods in Port Tobacco	Total # of Homes	Projected Lbs Reduced per Neighborhood Type		Treated Imperv-ious Acres	# of Downspout Extensions Needed	Cost
				TN	TP	TN lbs/yr	TP lbs/yr			TN lbs/yr	TP lbs/yr			
PT-01	Townhomes	-	-	-	-	-	-	-	0	-	-	0.0	0	$0
PT-02	Single Family	516	0.36	37%	43%	0.6	0.1	1	36	1.2	0.3	0.3	36	$356
PT-03	Apartments	-	-	-	-	-	-	-	0	-	-	0.0	0	$0
PT-04*	Single Family	407	0.49	44%	52%	2.7	0.6	3	147	4.6	1.0	1.0	147	$1,467
PT-05	Townhomes	-	-	-	-	-	-	-	0	-	-	0.0	0	$0
PT-06	Apartments	-	-	-	-	-	-	-	0	-	-	0.0	0	$0
PT-07	Single Family	464	0.92	58%	68%	0.4	0.1	0	8	0.4	0.1	0.1	8	$83
PT-08	Single Family	525	0.86	57%	67%	0.2	0.0	1	7	0.4	0.1	0.1	7	$68
PT-09	Single Family	481	1.09	61%	72%	0.9	0.2	4	88	4.5	1.0	0.7	88	$880
PT-10	Single Family	522	3.06	81%	89%	0.4	0.1	1	12	0.9	0.2	0.1	12	$118
PT-11	Single Family	725	2.21	67%	78%	0.2	0.1	6	20	1.7	0.4	0.3	20	$203
PT-12	Single Family	522	1.84	67%	78%	0.4	0.1	2	19	1.2	0.2	0.2	19	$189
PT-13	Single Family	560	1.21	63%	73%	0.4	0.1	1	13	0.8	0.2	0.1	13	$128
PT-14	Single Family	581	3.01	78%	87%	0.6	0.1	8	72	5.7	1.2	0.7	72	$720
PP-15	Single Family	754	3.18	89%	96%	1.2	0.2	10	110	12.9	2.6	1.4	110	$1,100
								Total	**531**	**34.3**	**7.1**	**5.0**	**531**	**$5,312**

*PT-04 is a very large neighborhood containing over 800 single-family homes. Projected reductions for neighborhoods similar to PT-04 were factored down by 25% due to their smaller size.

6.5 Septic Practices

Although septic strategies including pump outs and upgrades do not receive load reduction credits, they do count towards impervious credit and were included in the County's impervious accounting (Section 7.2). According to the MDE guidance (MDE, 2014) each pump out achieves an impervious acre equivalent of 0.03 ac and each septic upgrade achieves an impervious acre equivalent of 0.26 ac (Table 37).

Table 38 shows impervious credit for septic pump outs and upgrades in the Port Tobacco watershed. As of Spring 2015, there were 130 septic pump outs in the Port Tobacco watershed and an estimation of 20 septic upgrades throughout the County. Septic upgrades were estimated by watershed based on the proportion of the total number of septics in the County per watershed. For example, 15% of septics are located in the Port Tobacco watershed; therefore, 15% of 20 septic upgrades were estimated for the watershed (i.e., 3 upgrades). The cost of septic pump outs and upgrades is $250/pump out (LimnoTech, 2013) and $13,000/upgrade (MDE, 2011) with a total cost of $71,500 for septic practices in the Port Tobacco watershed (Table 38). The County has a septic pump-out reimbursement program to encourage residents to use this practice (http://www.charlescountymd.gov/pgm/planning/septic-system-pump-out-reimbursement-program).

TABLE 37: SEPTIC EFFICIENCIES AND IMPERVIOUS AREA EQUIVALENCIES

Practice	Efficiency Per Practice*		Impervious Acre Equivalent
	TN	TP	
Septic Pumping	0%	0%	0.03
Septic Denitrification	0%	0%	0.26
Septic Connections	0%	0%	0.39

* No credit given to septic practices for Urban MS4 source sector

TABLE 38: POLLUTANT REMOVAL AND IMPERVIOUS CREDIT FROM SEPTIC PRACTICES

Practice	Number	Cost	Total Cost over 20 Years	Lbs Reduced / yr**			Impervious Credit (Ac)
				TN	TP	TSS	
Septic Pumping*	130	$32,500	$650,000	0.0	0.0	0.0	3.9
Septic Denitrification	3	$39,000	N/A	0.0	0.0	0.0	0.5

* Annual practice cost over 20 years calculated by multiplying initial costs by 20 years.

** No credit given to septic practices for Urban MS4 source sector

7 TREATMENT SUMMARY

7.1 EXPECTED LOAD REDUCTIONS

This section provides a summary of pollutant load treatment from current and planned BMP implementation throughout the Port Tobacco watershed. As described in Section 1, the goal of this watershed assessment is to ensure that there is enough treatment throughout the Port Tobacco, the first of a series of watershed assessments, so that the Charles County Bay TMDL goals are achieved. Descriptions of the reductions are described below. Table 39 provides a summary of the loads and reductions at important timeline intervals including the 2010 baseline, 2013 progress, and 2025 final planning intervals. It is important to note that loads for the Town of LaPlata are not included in baseline, progress, or planning loads for Countywide or Port Tobacco results as LaPlata is not considered part of the County's MS4 permit. Since LaPlata is located in the Port Tobacco and Zekiah Swamp watersheds, loads were disaggregated from both watersheds based on land area proportion for Countywide results.

- **2010 Baseline Loads:** Baseline levels (i.e., land use loads with baseline BMPs) from 2010 conditions in the Port Tobacco watershed using the Maryland Assessment Scenario Tool (MAST) Chesapeake Bay Program Phase 5.3.2 (CBP P5.3.2) model. 2010 Baseline BMPs are from the County's urban stormwater BMP database and were entered at the watershed level.
- **2013 Progress Loads:** Progress loads achieved from urban stormwater BMP implementation through 2013, with additional treatment from ESD practices implemented in 2014 and 2015 and street sweeping and inlet cleaning practices completed in fiscal year 2014.
- **2013 Progress Reductions and Percent Reductions:** Progress load reductions achieved from urban stormwater BMP implementation. This is calculated as the difference and percent change between 2013 Progress and 2010 Baseline.
- **2025 Target Load:** The proportion of the Charles County Bay TMDL allocated load to be achieved in the Port Tobacco watershed. This was calculated from the 2010 Baseline load, calibrated to CBP P5.3.2 as noted above, using the following calculation: e.g., TN 2025 Target Reduction = 2010 Baseline – (2010 Baseline x 0.203); or, 2010 Baseline x (1-0.203)
- **2025 Target Reductions and Percent Reductions:** The same 2025 target percent reductions that are required for the Charles County Bay TMDL were applied to the Port Tobacco watershed. 2025 target reductions were calculated by applying the percent reduction to the 2010 Baseline load.

TABLE 39: PORT TOBACCO RIVER TARGET AND PLANNED LOADS

Bay TMDL Progress	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Port Tobacco Progress			
2010 Baseline Loads	31,834	2,618	636,526
2013 Progress Loads	33,301	2,610	605,525
2013 Progress Reductions	(1,467)	8	31,001
2025 Target Loads	25,372	1,618	-
2025 Target Reductions*	6,462	1,000	-
2025 Planned Loads**	24,866	220	(250,138)

Bay TMDL Progress	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
2025 Planned Reductions	8,435	2,391	855,663
2025 Target Percent Reduction*	**20.3%**	**38.2%**	**-**
2025 Planned Percent Reduction Achieved	**21.9%**	**91.6%**	**139.3%**
Countywide Progress			
2010 Baseline Loads	175,896	17,598	6,492,537
2013 Progress and 2025 Planned Reductions**	6,968	2,398	886,664
2025 Target Percent Reduction*	**20.3%**	**38.2%**	**-**
2025 Planned Percent Reduction Achieved**	**4.0%**	**13.6%**	**13.7%**

Loads outside of the Town of LaPlata.

*No target reduction for sediment. It is anticipated that by achieving the phosphorus goal, enough sediment will be removed to improve water quality.

**Includes reductions achieved in the Port Tobacco watershed only. Additional data will be added to the Countywide Progress in subsequent watershed plans as they are developed. Additional loads from growth projected through 2025 are not included in 2025 planned results.

7.1.1 Existing BMPs – Actual Implementation

Charles County maintains an extensive database of stormwater urban BMP facilities and water quality and capital improvement projects (WQIP and CIP) in addition to tracking ESD and operational practices. Current BMP implementation through 2013 in the Port Tobacco is shown in Table 40.

TABLE 40: CURRENT BMP IMPLEMENTATION THROUGH 2013

BMP	Unit	2013 Current Implementation*
BaySaver	acre	0.3
Bioretention	acre	6.8
Dry extended detention pond	acre	75.0
Dry Pond	acre	713.6
Dry Well	acre	33.7
ESD Practices	acre	10.2
Filtering practices	acre	0.03
Hydrodynamic structures	acre	2.1
Infiltration basin	acre	7.1
Infiltration trench	acre	46.8
Inlet Cleaning	# of pipes	115
Level Spreader	acre	2.0
Oil grit separator	acre	14.0
Shallow marsh	acre	33.0
Street Sweeping	miles swept	4.6
Surface sand filter	acre	16.0
Swale	acre	4.3
Underground detention	acre	12.0
Wet extended detention pond	acre	1.0
Wet Pond	acre	1,063.7

*ESD strategies include all practices completed in 2013 and 2014 and programmed practices that will be implemented in 2015. Street sweeping and inlet cleaning implementation completed in fiscal year 2014.

Pollutant load reductions from current BMP implementation were modeled in MAST, which calculates pollutant loads and reductions calibrated to the Chesapeake Bay Program Partnership Watershed Model.

2013 Progress results are compared to 2010 Baseline loads in Table 41. As displayed in the table, loads have increased for nitrogen in 2013 due to additional urban stormwater loads since 2010.

TABLE 41: 2013 PROGRESS REDUCTIONS ACHIEVED

Port Tobacco River	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
2010 Baseline Loads	31,834	2,618	636,526
2013 Progress Loads	33,301	2,610	605,525
2013 Progress Reductions	(1,467)	8	31,001
2025 Target Loads	25,372	1,618	-
2025 Target Reductions*	6,462	1,000	-
2013 Progress Percent Reduction	(4.6%)	0.3%	4.9%
2025 Target Percent Reduction*	20.3%	38.2%	-

Loads outside of the Town of LaPlata.

*No target reduction for sediment. It is anticipated that by achieving the phosphorus goal, enough sediment will be removed to improve water quality.

7.1.2 Planned Implementation

Table 42 compares implementation of existing BMPs with planned levels of implementation described in sections 4, 5, and 6 of this report. This increase in implementation will achieve the proportional 2025 target reductions for the Port Tobacco watershed (Table 43).

TABLE 42: BMP IMPLEMENTATION - CURRENT 2013 AND PLANNED LEVELS FOR THE PORT TOBACCO

BMP	Unit	2013 Current Implementation	Planned Implementation*
BaySaver	acre	0.3	
Bioretention**	acre	6.8	15.3
Created Wetland	acre	0	5.5
Downspout Disconnection – Homeowner Practice	# of homes participating	0	2,039
Dry extended detention pond	acre	75.0	
Dry Pond	acre	713.6	
Dry Well	acre	33.7	
ESD Practices***	acre	10.2	10.6
Filtering practices	acre	0.03	3.8
Hydrodynamic structures	acre	2.1	
Infiltration basin	acre	7.1	
Infiltration trench	acre	46.8	
Inlet Cleaning	# of pipes	115	
Level Spreader	acre	2.0	
Oil grit separator	acre	14.0	
Pond Reclassification	acre	0	138.9
Rain Barrels – Homeowner	# of homes	0	531

BMP	Unit	2013 Current Implementation	Planned Implementation*
Practice	participating		
Rain Gardens – Homeowner Practice	# of homes participating	0	531
Reforestation	acre	0	82.2
Septic Pump outs	Pump outs	0	130
Septic Upgrades	Upgrade	0	4
Shallow marsh	acre	33.0	
Shoreline erosion	feet	0	2,432
Step pool stormwater conveyance systems	acre	0	17.0
Stream restoration	linear feet	0	18,769
Street Sweeping	miles swept	4.6	
Submerged Gravel Wetland	acre	0	35.3
Surface sand filter	acre	16.0	
Swale	acre	4.3	536.2
Underground detention	acre	12.0	
Wet extended detention pond	acre	1.0	
Wet Pond**	acre	1,063.7	17.6

* Planned implementation for the following strategies are Vista retrofit sites and include only additional impervious acres treated: created wetland, pond reclassification, and submerged gravel wetland. One Vista dry swale retrofit site is included in the planned implementation column for swale (3.3 acres of additional impervious treatment).

** Includes stormwater retrofit acres: 13.8 acres dry pond to bioretention; 17.6 acres dry pond to wet pond

*** ESD strategies listed as 'Current Implementation' include all practices completed in 2013 and 2014 and programmed practices that will be implemented in 2015. ESD strategies listed as 'Planned Implementation' are Vista retrofit sites.

As shown in Table 43, planned implementation in the Port Tobacco watershed results in sediment reductions that exceed sediment loads by 250,138 lbs/yr. This is largely due to an estimated reduction of 333,184 lbs/yr solely from 2,432 ft of proposed shoreline erosion control. Shoreline erosion control has a very high sediment removal of 137 lbs/ft. Background loading in MAST does not differentiate between land use loads and instream loads. Therefore, instream nutrient and sediment loads for Charles County may not be captured in the model; which, results in higher load reductions when applying a BMP that has a high sediment removal.

Progress and planned reductions within the Port Tobacco watershed will contribute 4.0% and 13.6% of Countywide nitrogen and phosphorus reduction goals, respectively.

TABLE 43: PORT TOBACCO RIVER PLANNED REDUCTIONS

Bay TMDL Progress	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Port Tobacco Progress			
2010 Baseline Loads	31,835	2,618	636,554
2013 Progress Loads	33,301	2,610	605,525
2013 Progress Reductions	(1,467)	8	31,001
2025 Target Loads	25,372	1,618	-
2025 Target Reductions*	6,462	1,000	-
2025 Planned Loads**	24,866	220	(250,138)
2025 Planned Reductions	8,435	2,391	855,663
2025 Target Percent Reduction*	20.3%	38.2%	-
2025 Planned Percent Reduction Achieved	21.9%	91.6%	139.3%
Countywide Progress			
2010 Baseline Loads	175,896	17,598	6,492,537
2013 Progress and 2025 Planned Reductions**	6,968	2,398	886,664
2025 Target Percent Reduction*	20.3%	38.2%	-
2025 Planned Percent Reduction Achieved**	4.0%	13.6%	13.7%

Loads outside of the Town of LaPlata.

*No target reduction for sediment. It is anticipated that by achieving the phosphorus goal, enough sediment will be removed to improve water quality.
**Includes reductions achieved in the Port Tobacco watershed only. Additional data will be added to the Countywide Progress in subsequent watershed plans as they are developed. Additional loads from growth projected through 2025 are not included in 2025 planned results.

7.2 IMPERVIOUS CREDIT

As a requirement of the NPDES MS4 Discharge Permit issued by MDE to Charles County on December 26, 2014, the County must treat 20% of remaining baseline untreated impervious acres by 2019. Impervious acres treated within the Port Tobacco watershed will count towards this goal.

Table 44 shows impervious treatment achieved by planned strategies described in this report for the Port Tobacco watershed.

TABLE 44: PORT TOBACCO RIVER IMPERVIOUS ACCOUNTING

Port Tobacco Impervious Accounting	
Port Tobacco Impervious Estimate*	1,030.8 acres
Impervious Treated	384.7 acres
Impervious Treated Percent	37%
Impervious Untreated	646.1 acres
Impervious Untreated Percent	63%
Port Tobacco Potential Impervious Treatment	
Operational Practices	7.5 acres
Septic Pump Outs	3.9 acres
Septic Upgrades	0.5 acres

Homeowner Practices	81.4 acres
Structural Practices	374.4 acres
Vista Retrofit Projects	196.2 acres
Total Potential Impervious Treatment	**663.8 acres**
Port Tobacco Summary of Projected Progress	
Impervious Untreated	646.1 acres
Total Potential Impervious Treatment	663.8 acres
Percent of Untreated Impervious Treated (Port Tobacco Only)	**103%**

*Impervious acres include County and private lands outside the Town of LaPlata and is based on 2011 aerial photos (Vista, Draft 2015a).

7.3 COST

A summary of project costs by project category is provided in Table 45. Costs for restoration projects include the planning, design, surveying, environmental permitting, agency review, and construction costs and were estimated using a variety of sources. King and Hagan (2011) cost estimates were used for many restoration project types, including stream restoration and all stormwater management projects, except SPSC which was calculated using actual costs from previous KCI projects. Cost estimates from the Charles County Phase II Watershed Implementation Plan Strategy (LimnoTech, 2013) were used to estimate the cost for shoreline erosion control projects. Street sweeping and inlet cleaning costs were calculated using costs from fiscal year 2014 County data. Trash clean-up costs were assumed to be $1,000 per clean-up site. Cost per rain barrel was assumed to be $85. Rain gardens were assumed to be $25/ sq ft of rain garden and an estimated cost of $10/ downspout extension was used to calculate costs for downspout disconnection. While some costs of these homeowner practices may be the responsibility of individual homeowners, the County is currently working with partners to subsidize costs and is in the process of securing additional funding for further support. Costs for Vista retrofit sites are included in the Stormwater Management project type section of the table below using the ID 'PTR-C'. Details on concept cost estimates for these sites may be found in Vista, 2015b.

TABLE 45: SUMMARY RESTORATION PROJECT COSTS

Project Type	Restoration Site ID	Total Initial Cost	Total Cost Over 20 Years
Stream Restoration	PT_SR_1	$1,824,060	$2,328,010
	PT_SR_2	$2,478,735	$3,163,558
	PT_SR_3	$516,000	$658,560
	PT_SR_4	$109,650	$139,944
	PT_SR_5	$2,057,550	$2,626,008
	PT_SR_6	$2,564,520	$3,273,043
	PT_SR_7	$269,610	$344,098
	PT_SR_8	$479,880	$612,461
	PT_SR_9	$1,806,000	$2,304,960
	Total	**$12,106,005**	**$15,450,641**
Shoreline Erosion Control	**Total**	**$753,920**	**$753,920**
Stormwater Management	PT_SWM_1	$230,709	$272,951
	PT_SWM_2	$66,718	$77,658

Project Type	Restoration Site ID	Total Initial Cost	Total Cost Over 20 Years
	PT_SWM_3	$30,872	$35,934
	PT_SWM_4	$298,066	$424,202
	PT_SWM_5	$228,467	$325,150
	PT_SWM_6	$778,928	$1,108,557
	PT_SWM_7	$212,904	$303,002
	PT_SWM_8	$47,202	$58,305
	PT_SWM_9	$650,919	$926,376
	PT_SWM_10	$82,906	$96,499
	PT_SWM_11	$14,691	$17,100
	PT_SWM_12	$11,760	$13,688
	PT_SWM_13	$220,398	$262,641
	Subtotal	$2,874,541	$3,922,061
	PTR-C-1	$362,500	
	PTR-C-2	$591,500	
	PTR-C-3	$42,000	
	PTR-C-4	$60,000	
	PTR-C-4A	$60,000	
	PTR-C-5	$256,000	
	PTR-C-6	$301,500	
	PTR-C-7	$161,500	
	PTR-C-8	$736,000	
	PTR-C-9	$257,000	
	PTR-C-10	$42,000	
	PTR-C-11	$472,500	
	PTR-C-12	$67,500	
	PTR-C-13	$500,000	
	PTR-C-14	$36,000	
	Subtotal	$3,946,000	$4,735,200
	Total	**$6,820,541**	**$8,657,261**
Reforestation	PT_TP_1	$21,605	$37,454
	PT_TP_2	$10,178	$17,644
	PT_TP_3	$120,463	$208,827
	PT_TP_4	$8,238	$14,281
	PT_TP_5	$636,241	$1,102,953
	PT_TP_6	$107,753	$186,794
	Total	**$904,478**	**$1,567,954**
Street Sweeping	**Total**	**$564**	**$11,273**
Inlet Cleaning	**Total**	**$2,990**	**$59,800**
Trash Clean-ups	PT_TC_1	$1,000	
	PT_TC_2	$1,000	
	PT_TC_3	$1,000	
	PT_TC_4	$1,000	
	PT_TC_5	$1,000	
	PT_TC_6	$1,000	
	PT_TC_7	$1,000	
	Total	**$7,000**	**$7,000**

Project Type	Restoration Site ID	Total Initial Cost	Total Cost Over 20 Years
Homeowner Practices	Rain Barrel Total	$308,780	
	Rain Garden Total	$1,815,125	
	Downspout Disconnection Total	$5,312	
	Total	**$2,129,216**	**$2,129,216**
Septic Practices	Pump Outs	$32,500	$650,000
	Upgrades	$39,000	
	Total	**$71,500**	**$689,000**
	Total	**$22,796,214**	**$29,326,065**

- Additional costs to calculate total cost over 20 years not provided for Vista retrofit sites (stormwater BMPs coded 'PTR-C'). A 20% factor was applied to estimate the additional cost needed over time.
- Annual practices cost over 20 years calculated by multiplying initial costs by 20 years. Annual practices include street sweeping, inlet cleaning, and septic pump outs. Cost over 20 years for annual practices does not account for inflation.

8 Prioritization

A complete description of the prioritization methods is included in Appendix D. This section provides a brief summary of the method. The prioritization involved a matrix made up of a series of parameters, or metrics, which evaluated each project and allowed for discrimination between the facilities. There are three categories of metrics, project benefits, project constraints, and project costs. Metrics were selected using a pairwise comparison by the project team by comparing pairs of metrics to evaluate which has greater importance. From this analysis, the weight of each chosen metric was calculated. Next, the projects were scored for each metric. Quantitative metrics were scored based on results of the preliminary design and cost estimates (e.g. impervious area treated, pollutant removal). Other metrics were scored more qualitatively based on professional judgment and assessment of each project site (e.g. access constraints, public visibility/education/outreach). Each project was ranked based on the total score and the final prioritization was determined. The final prioritized list of projects is presented in Table 46 and 48. Vista retrofit sites were not included in the prioritization.

TABLE 46: PORT TOBACCO PRIORITIZATION RANKING BY PROJECT TYPE

Project ID	Project Type	Benefits Rank	Constraints Rank	Cost Rank	Total Score	Final Rank
PT_SR_1	Stream Restoration	9	33.5	22	65	29.5
PT_SR_2	Stream Restoration	2	32	23	57	23
PT_SR_3	Stream Restoration	8	29	16	53	16.5
PT_SR_4	Stream Restoration	14	29	17	60	25
PT_SR_5	Stream Restoration	3	35	26	64	27.5
PT_SR_6	Stream Restoration	1	29	24	54	20

Project ID	Project Type	Benefits Rank	Constraints Rank	Cost Rank	Total Score	Final Rank
PT_SR_7	Stream Restoration	7	21	25	53	16.5
PT_SR_8	Stream Restoration	4	19	18	41	4
PT_SR_9	Stream Restoration	11	33.5	20	65	29.5
PT_TP_1	Reforestation	27	2.5	30	60	24
PT_TP_2	Reforestation	15	2.5	27	45	9
PT_TP_3	Reforestation	12	2.5	35	50	13
PT_TP_4	Reforestation	22	2.5	29	54	18
PT_TP_5	Reforestation	23	11	32	66	31.5
PT_TP_6	Reforestation	24	6	34	64	27.5
PT_SEC_1	Shoreline Erosion Control	10	17	11	38	1
PT_SWM_1	SPSC	5	15	19	39	2
PT_SWM_2	Bioretention	28	18	28	74	34
PT_SWM_3	Bioretention	34	14	15	63	26
PT_SWM_4	Swale	21	25	8	54	20
PT_SWM_5	Swale	18	25	9	52	15
PT_SWM_6	Swale	16	25	14	55	22
PT_SWM_7	Swale	19	25	10	54	20
PT_SWM_8	Wet Pond	17	36	13	66	31.5
PT_SWM_9	Swale	13	25	12	50	14
PT_SWM_10	Bioretention	20	16	36	72	33
PT_SWM_11	Bioretention	33	31	31	95	36
PT_SWM_12	Bioretention	32	22	33	87	35
PT_SWM_13	SPSC	6	20	21	47	10.5
PT_TC_1	Trash Cleanup	30	9	4	43	8
PT_TC_2	Trash Cleanup	35	9	4	48	12
PT_TC_3	Trash Cleanup	36	7	4	47	10.5
PT_TC_4	Trash Cleanup	31	5	4	40	3
PT_TC_5	Trash Cleanup	29	9	4	42	6
PT_TC_6	Trash Cleanup	26	12.5	4	42	6
PT_TC_7	Trash Cleanup	26	12.5	4	42	6

TABLE 47: PORT TOBACCO PRIORITIZATION FINAL RANKING

Project ID	Project Type	Final Rank
PT_SEC_1	Shoreline Erosion Control	1
PT_SWM_1	SPSC	2
PT_TC_4	Trash Cleanup	3
PT_SR_8	Stream Restoration	4
PT_TC_5	Trash Cleanup	6
PT_TC_6	Trash Cleanup	6
PT_TC_7	Trash Cleanup	6
PT_TC_1	Trash Cleanup	8
PT_TP_2	Reforestation	9
PT_SWM_13	SPSC	10.5
PT_TC_3	Trash Cleanup	10.5
PT_TC_2	Trash Cleanup	12
PT_TP_3	Reforestation	13
PT_SWM_9	Swale	14
PT_SWM_5	Swale	15
PT_SR_3	Stream Restoration	16.5
PT_SR_7	Stream Restoration	16.5
PT_TP_4	Reforestation	18
PT_SR_6	Stream Restoration	20
PT_SWM_4	Swale	20
PT_SWM_7	Swale	20
PT_SWM_6	Swale	22
PT_SR_2	Stream Restoration	23
PT_TP_1	Reforestation	24
PT_SR_4	Stream Restoration	25
PT_SWM_3	Bioretention	26
PT_SR_5	Stream Restoration	27.5
PT_TP_6	Reforestation	27.5
PT_SR_1	Stream Restoration	29.5
PT_SR_9	Stream Restoration	29.5
PT_TP_5	Reforestation	31.5

Project ID	Project Type	Final Rank
PT_SWM_8	Wet Pond	31.5
PT_SWM_10	Bioretention	33
PT_SWM_2	Bioretention	34
PT_SWM_12	Bioretention	35
PT_SWM_11	Bioretention	36

The project prioritization results provide a starting point for the County's planning process of project implementation. Table 48 presents the potential projects listed by final ranking. The highest ranked projects (lower final rank numbers) provide the greatest benefits with the least constraints and project costs, relative to all other potential projects. These projects should be first priority to achieve the greatest load reductions to meet Bay restoration goals. In general, there is a variety of high priority project types, including shoreline erosion control, SPSC, and stream restoration. Trash cleanup projects overall ranked very high due to their relatively low cost.

As noted in Section 7, the planned projects summarized above will have an implementation target of 2025 to align with Bay restoration goals. Feasibility studies of the planned strategies may reveal that some existing structures identified for retrofitting or enhancement or that new restoration strategies may not be feasible candidates for future projects and may be eliminated from consideration. The County will take an adaptive management approach and will reevaluate treatment needs as feasibility studies progress. The County will continue to track the overall effectiveness of the various BMP strategies and will adapt the suite of solutions based on the results. In addition, new technologies are continuously evaluated to determine if the new technologies allow more efficient or effective pollution control.

Support, cooperation, and participation from the citizens of Charles County are very important for the successful implementation of restoration projects, especially homeowner practices. Treatment in the Port Tobacco watershed is imperative for Bay restoration by providing the load reductions presented in Section 7.1.

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APPENDIX A – NEIGHBORHOOD SOURCE ASSESSMENT DATA

Site ID	Watershed	Subwater-shed	Date	Assessed by	Photo No.	Neighborhood / Subdivision / Streets	Area (acres)	HOA	LU Type
PT-01	Port Tobacco	NA	4/23/2014	MCC/SCN	2097-2099	Hampshire	28.0	Yes	Multifamily
PT-02	Port Tobacco	NA	4/23/2014	MCC/SCN		Wortwington and Greenhaven Run	92.0	Yes	Single Fam Detached
PT-03	Port Tobacco	NA	4/23/2014	MCC/SCN	2100	Hampshire - Westlake/New Forest Appts	25.0	No	Multifamily
PT-04	Port Tobacco	NA	4/23/2014	MCC/SCN		Dorchester	253.0	Yes	Single Fam Detached
PT-05	Port Tobacco	NA	4/23/2014	MCC/SCN	2111	Southwinds and Aspen Woods	44.0	Yes	Multifamily
PT-06	Port Tobacco	NA	4/23/2014	MCC/SCN	2101-2104	Westchester - Town Center South Westlake	21.0	No	Multifamily
PT-07	Port Tobacco	NA	4/23/2014	MCC/SCN		Maryland Gardens	78.0	Unknown	Single Fam Detached
PT-08	Port Tobacco	NA	4/23/2014	MCC/SCN		Waldorf Manor	55.0	No	Single Fam Detached
PT-09	Port Tobacco	NA	4/23/2014	MCC/SCN		Halley Estates, Capital Estates, Wallace Sub	137.0	Unknown	Single Fam Detached
PT-10	Port Tobacco	NA	4/23/2014	MCC/SCN		Hope Acres	72.0	Unknown	Single Fam Detached
PT-11	Port Tobacco	NA	4/23/2014	MCC/SCN	2112	Pheasant Farms	45.0	Unknown	Single Fam Detached
PT-12	Port Tobacco	NA	4/23/2014	MCC/SCN	2113, 2114	Warren J Willet Subdivision	128.0	Unknown	Single Fam Detached
PT-13	Port Tobacco	NA	4/23/2014	MCC/SCN	2118	Mt. Carmel	59.0	Unknown	Single Fam Detached
PT-14	Port Tobacco	NA	4/23/2014	MCC/SCN	2116, 2117	Mt. Carmel Estates	141.0	Unknown	Single Fam Detached
PT-15	Port Tobacco	NA	4/23/2014	MCC/SCN	2115	Stone Hill and Long Meade	319.0	Yes	Single Fam Detached

Site ID	Lot Size (acres)	Age (Decade)	% with Garages	% with Basement	Sewer Service	Infill Index	% Impervious Cover	% Lawn	% Landscaped	% Bare Soil	% Forest Canopy
PT-01	<1/4	1980s	0	0	Yes	No Evidence	50	40	5	0	5
PT-02	1/4	2000s	100	100	Yes	<5%	30	68	2	0	15
PT-03	<1/4	1990s	0	0	Yes	No Evidence	50	30	10	0	20
PT-04	1/4	1990s	90	30	Yes	No Evidence	30	50	5	0	15
PT-05	<1/4	1990s	0		Yes	No Evidence	60	25	5	0	10
PT-06	<1/4	2010s	0	0	Yes	<5%	70	20	5	0	5
PT-07	>1	1960s-90s		30	Yes	No Evidence	20	40	0	0	40
PT-08	>1	1960s-90s		50	No	<5%	8	20	2	0	70
PT-09	1	1970s		70	No	No Evidence	15	60	5	0	20
PT-10	>1	1970s	70	80	Yes	No Evidence	15	65	5	0	15
PT-11	>1	2000s	100	100	No	No Evidence	20	65	5	0	10
PT-12	>1	1960s-80s		60	No	5-10%	10	40	2	0	48
PT-13	1	1970s-80s	85	50	No	No Evidence	15	23	2	0	60
PT-14	>1	1970s-80s		40	No	No Evidence	10	15	0	0	75
PT-15	>1	2010s	100	100	No	No Evidence	10	13	2	0	75

Site ID	Land Cover Comments	% Non-target Irrigation	% High Lawn Mgmt	% Medium Lawn Mgmt	% Low Lawn Mgmt	Lawn Maintenance Comments	% Lots w/ Outdoor Pools	No. of Outdoor Pools
PT-01	No Bare Soil, used % Forest as part of 100%	0	0	60	40		0	0
PT-02	New construction in parts of neighborhood; did not classify this as bare soil	0	30	60	10		<5	5
PT-03	No Bare Soil, used % Forest as part of 100%	0	0	100	0		0	0
PT-04	No Bare Soil, used % Forest as part of 100%	0	5	60	35	Some "low" yards have bare spots	0	0
PT-05	No Bare Soil, used % Forest as part of 100%	0	2	50	48		0	0
PT-06	No Bare Soil, used % Forest as part of 100%	0	5	90	5		NA	2
PT-07	No Bare Soil, used % Forest as part of 100%	0	10	50	40		0	0
PT-08	No Bare Soil, used % Forest as part of 100%	0	2	78	20		<10	3
PT-09	No Bare Soil, used % Forest as part of 100%	0	8	42	50		>10	15
PT-10	No Bare Soil, used % Forest as part of 100%	0	5	60	35		>10	6
PT-11	No Bare Soil, used % Forest as part of 100%	0	50	45	5		30	8
PT-12	No Bare Soil, used % Forest as part of 100%	0	5	85	10		<10	2
PT-13	No Bare Soil, used % Forest as part of 100%	0	5	75	20		>10	7
PT-14	No Bare Soil, used % Forest as part of 100%	0	2	96	2		>10	20
PT-15	No Bare Soil, used % Forest as part of 100%	0	40	45	5		>10	15

Site ID	% Yards with Trash	% Impervious driveways, parking	Driveway Condition	% Clean Driveways	Sidewalks	Sidewalk Condition	% Clean Sidewalks	Distance, sidewalk to street	Pet Waste	Curb / Gutter	Curb / Gutter Condition	% Gutters not clean
PT-01	0	100	Clean	100	Yes - 2	Clean	100	10	No	Yes	Clean	
PT-02	0	100	Stained	95	Yes - 2	Clean	100	3	No	Yes	Sediment	20
PT-03	0	100	Clean	100	Yes - 2	Clean	100	0	No	Yes	Clean	0
PT-04	10	100	Clean	100	Yes - 2	Clean	100	2.5	Unknown	Yes	Clean	0
PT-05	0	100	Stained	80	Yes - 2	Clean	100	0	Unknown	Yes	Sediment/Organics	5
PT-06	0	100	Stained	75	Yes - 2	Clean	100	0	No	Yes	Clean	0
PT-07	5	90	Stained	98	No					No		
PT-08	5	85	Stained/Dirty	90	No					No		
PT-09	5	95	Clean	100	No					No		
PT-10	10	98	Stained	90	No					No		
PT-11	0	100	Stained	98	No					No		
PT-12	5	90	Clean	98	No					Yes	Sediment/Organics	100
PT-13	2	98	Dirty	80	No					No		
PT-14	2	100	Clean	100	No					No		
PT-15	0	100	Clean	100	No					No		

Site ID	% Down-spouts to SD / SS	% Down-spouts to IA	% Down-spouts to Pervious	% Down-spouts to Rain Barrels	Lawn Area D/S of Leader	Downspout Comments	SD Inlets	% Inlets Marked	Inlet Condition	Catch Basin Inspected	Basin ID
PT-01	5	5	90	0	No		Yes	0	Clean	No	
PT-02	0	15	85	0	No		Yes	0	Clean	No	
PT-03	0	25	75	0	No		Yes	0	Clean	No	
PT-04	0	10	90	0	No		Yes	25	Clean	No	
PT-05	0	50	50	0	No	Rain barrels may not be feasilbe in townhome community	Yes	0	Dirty	No	
PT-06	60	40	0	0	No		Yes	0	Clean	No	
PT-07	0	15	85	0	No		No			No	
PT-08	0	0	100	0	No		No			No	
PT-09	0	25	75	0	No		No			No	
PT-10	0	25	75	0	No		No			No	
PT-11	0	15	85	0	No		No			No	
PT-12	0	15	85	0	No		No			No	
PT-13	0	35	64	1	Yes		No			No	
PT-14	0	15	84	1	Yes		No			No	
PT-15	0	12.5	87.5	0	Yes		No			No	

Site ID	SW Pond	Pond Over-grown	Pond Surf Area (acres)	Common Open Space	Pet Waste	Dumping	Buffers Present	Buffer Encroach-ment	Pollution Severity	Restora-tion Index	Pollution Sources
PT-01	WET	No	>1	Yes	No	No	No		None	Moderate	
PT-02	WET/DRY	No	1	Yes	No	No	No		Moderate	Moderate	Sediment from new construction - but contained with ESC
PT-03	WET	No	>1	Yes	No	No	No		None	Moderate	
PT-04	WET	No	>1	No			No		Moderate	Low	
PT-05	WET	No	>1	Yes	No	No	No		None	Moderate	
PT-06	WET	Yes	>1	Yes	No	No	No		Moderate	Moderate	
PT-07	DRY	Yes	<1	No			No		None	Low	
PT-08	No			No			No		Moderate	Low	Bacteria
PT-09	No			No			No		Moderate	Low	Bacteria
PT-10	No			No			Yes	No	Moderate	Low	
PT-11	No			No			No		High	Low	Nutrients, Bacteria
PT-12	No			No			Yes	Yes	Moderate	Low	Nutrients, Sediment
PT-13	No			No			No		Moderate	Low	
PT-14	No			No			No		Moderate	Low	
PT-15	WET/DRY	No	1	Yes	No	No	No		Moderate	Moderate	Nutrients

Site ID	Potential Action	Notes
PT-01	BayScaping, tree planting, retrofits	Retrofit potential - bioretention and bioswale; Tree planting in open space/PA
PT-02	BayScaping, rain barrels, outreach on fertilizer, SD stencil	Relatively new neighborhood with erosion and sediment control in place in areas with new construction
PT-03	Tree planting, reforestation, bioretention, SD stencil	Retrofit at New Forest Ct. - small bioretention (pic #2100).
PT-04	BayScaping, SD stenciling	
PT-05	Bioretention, BayScaping, SD stencil	Possible retrofit (bioretention) at end of Jacksenhole Place (pic #2111)
PT-06	Reforestation, bioswale, SD stencil	
PT-07	Pond retrofit	
PT-08	BayScaping	
PT-09	BayScaping, rain barrels	
PT-10	BayScaping, rain barrels	
PT-11	Rain barrels, outreach on fertilizers, retrofit	Possibly convert grass swales as bioswales, but this may be used for parking (pic #2112)
PT-12	BayScaping, buffer enhancement, bioretention	
PT-13	Rain barrels, rain gardens/BayScaping, bioretention	Bioretention to treat Cedar Ct. (pic #2118)
PT-14	Rain barrels, rain gardens/BayScaping, bioretention	
PT-15	Rain barrels, rain gardens/BayScaping, pond retrofit, tree planting	Many houses are not draining to road but to BMPs (pic #2115)

APPENDIX B – HOT SPOT INVESTIGATION DATA

Site ID	Watershed	Subwater-shed	Date	Assessed by	Photo No.	Site Name	Category	NPDES Status	Operation Description	Vehicle Operations	Vehicle Types	No. of Vehicles	Vehicle Activities	Vehicle Storage	Vehicle Runoff Div Method	Spills / Leakage	Notes	Uncovered Fueling	Connected Fueling	Notes	Outdoor Washing	Wash Discharge to Storm Drain
PT-01	Port Tobacco	NA	4/23/2014	MCC/SCN	2105-2109	Willett Construction	Commercial	Unregulated	Construction materials/equipment	Yes	Construction	15	MAINT/REP/FUEL/STORE	Yes	No	No	oil drum storage	Yes	No	No storm drains	Unknown	No
PT-03	Port Tobacco	NA	4/24/2014	MCC/SCN	2200-2204	Wawa	Commercial, Transport-Related	Unregulated	Gas station, store	Yes	Cars fueling	Varies	FUEL	No	No	No		No	No		No	
PT-06	Port Tobacco	NA	4/24/2014	MCC/SCN	2140-2142	CVS Pharmacy	Commercial	Unregulated	Pharmacy, retail	No												
PT-09	Port Tobacco	NA	4/24/2014	MCC/SCN	1801-1802	Unkown Business	Commercial	Unregulated	Junk yard, equipment storage	Yes	Trucks, construction equipment, old cars	Many	STORE	Yes	No	Unknown	Area fenced in	Unknown	No	No storm drains	Unknown	
PT-10	Port Tobacco	NA	4/24/2014	MCC/SCN	1799-1800, 1803-1805, 2205-2207	McConnel Pool Servies Inc, Fuel Oil Inc	Commercial	Unregulated	Pool and fuel	Yes	Tanker trucks	8	FUEL/STORE	Yes	No	Unknown	Vehicle storage - pic #1799/1800	Unknown	No	No storm drains	Unknown	No
PT-16	Port Tobacco	NA	4/24/2014	MCC/SCN	2186-2189	Austin Paving and Sealing	Industrial	Unregulated	Paving supplies	Yes	Construction	12	FUEL/STORE	Yes	Unknown	Unknown	Fenced area on private road	Yes	No	No storm drains	Unknown	No
PT-17	Port Tobacco	NA	4/24/2014	MCC/SCN	2185, 2190-2194	Chutes International	Commercial	Unregulated	Construction company	Yes	Trucks	6	JUNK	Unknown	Unknown	Unknown	Area fenced in	Unknown	Unknown		Unknown	Unknown
PT-18	Port Tobacco	NA	4/24/2014	MCC/SCN	2164-2169	Allen Scott Floring + Multi use/rented garages	Commercial	Unkown	Multi-use commercial, rented garage	No												
PT-24	Port Tobacco	NA	4/24/2014	MCC/SCN	2157-2159	Mexico Restaurant	Commercial	Unregulated	Restaurant	No												
PT-25	Port Tobacco	NA	4/24/2014	MCC/SCN	2160-2161, 2163	Multi-use Shopping Center on Middle Port Lane	Commercial	Unregulated	Vet, nail salon, daycare, funeral home	No												
PT-26	Port Tobacco	NA	4/24/2014	MCC/SCN	2152-2156	Multi-use Shopping Center on Crain Thwy	Commercial	Unregulated	Nail salon, restaurants, plumbing suppy store, electronics retailer, B+G Electric	Yes	Fleet	2+	JUNK	No	No	No	More vehicles behind fenced in area - could not assess	No	No		No	
PT-27	Port Tobacco	NA	4/24/2014	MCC/SCN	2143-2144, 2150, 2151	Used to be Southern MD Electric - For Lease	Commercial	Unregulated	Office and Warehouse posted for lease. Used to be Electric co-op	Yes	Unknown - possibly permit parking	20	FUEL/PARKED	No	No	No	pic #2143 + 2150	Yes	No	No storm drains	No	
PT-28	Port Tobacco	NA	4/24/2014	MCC/SCN	2170, 2184	Waste Management of Southern MD	Industrial	Unregulated	Waste management. Dumpsters, trash trucks	Yes	Fleet	20+	STORE	Yes	Unknown	Unknown	Area fenced off. Vehicle activity unknown	Unknown	No	No storm drains	Unknown	No
PT-29	Port Tobacco	NA	4/24/2014	MCC/SCN	2181, 2183	Belair Road Supply	Commercial, Transport-Related	Unregulated	Materials/Supplies. Transportation	Yes	Fleet	UNK	FUEL	Unknown	Unknown	Unknown	Area fenced off. Fuel tank/pump - pic #2183	Yes	No	No storm drains	Unknown	
PT-30	Port Tobacco	NA	4/24/2014	MCC/SCN	2171-2174	Reliable Contracting	Commercial	Regulated	Contracting supplies and storage	Yes	Fleet	UNK		Unknown	Unknown	Unknown	Area fenced off	Unknown	No	No storm drains	Unknown	No
PT-31	Port Tobacco	NA	4/24/2014	MCC/SCN	2175-2176, 2179-2180	Multi-use on Hackett Place	Commercial	Unregulated	McClean Controls, Rail supply, Sheet metal	No												
PT-33	Port Tobacco	NA	4/24/2014	MCC/SCN	2162	The Roof Center	Commercial	Unregulated	Roofing materials	Yes	Fleet	>6	UNK	Unknown	Unknown	Unknown	Area fenced off	Unknown	Unknown	Area fenced off	Unknown	Unknown
PT-35	Port Tobacco	NA	4/24/2014	MCC/SCN	2123, 2131-2132	A+P Auto Salvage	Commercial	Unregulated	Auto Service Garage	Yes	Stored/broken vehicles	24	REPAIR/JUNK/STORE	Yes	No	Yes	some oil/grease stains	No	No		Unknown	No
PT-36	Port Tobacco	NA	4/24/2014	MCC/SCN	2124	Builders First Source and Paul Davis Remodeling	Industrial	Unregulated	Commercial material	Yes	Construction	UNK	STORE	Yes	Unknown	Unknown	Area fenced in	Unknown	Unknown		Unknown	No
PT-37	Port Tobacco	NA	4/23/2014	MCC/SCN	2127-2129	Facchina Construction Company, Inc.	Industrial	Unregulated	Material Storage	No												
PT-38	Port Tobacco	NA	4/23/2014	MCC/SCN	2126	Hash Construction, Inc.	Industrial	Unregulated	Construction equipment and materials	Yes	Construction	10	MAINT/FUEL/STORE	Yes	Unknown	Unknown		No	No	No storm drains	Unknown	Unknown
PT-39	Port Tobacco	NA	4/23/2014	MCC/SCN	2133, 2126, 2139	Enterprise Rent-a-car	Commercial, Transport-Related	Unregulated	Rental car facility	Yes	Fleet	6	WASH/STORE	Yes	No	Unknown		No	No		Yes	Yes
PT-40	Port Tobacco	NA	4/24/2014	MCC/SCN	2195-2199	Multi-use on Theodore Green Blvd and Southern Business Park Drive	Commercial	Unregulated	Multiple businesses: screen printing, house cleaners, contractors, suppliers (welding), etc.	Yes	Fleet	6	STORE	Yes	No	Yes	oil and grease stains	No	No		Unknown	
PT-41	Port Tobacco	NA	4/23/2014	MCC/SCN	2122	S+M Body Shop and Boat Repair	Commercial	Unregulated	Car repair	Yes	Stored/broken	12	REPAIR/STORE	Yes	Unknown	Yes	oil/grease on asphalt	No	No		Unknown	No
PT-42	Port Tobacco	NA	4/23/2014	MCC/SCN	2125, 2130	C+B Installation	Industrial	Unregulated	Installation Material	Yes	Fleet	6	STORE	Yes	No	Unknown	Area fenced in	Unknown	No	No storm drains	Unknown	No
PT-43	Port Tobacco	NA	4/24/2014	MCC/SCN	2145-2149	Multi-use: Tattoo, Music Store, Liquor Store	Commercial	Unregulated	Multi-use commercial	No												

Site ID	Notes	Outdoor Materials	Loading	Stored Outside	Material Description	Storage Area	Connected Storage	Staining	No Cover	Liquid Storage Contain- ment	Labels Missing	Waste Mgmt	Type	Dumpster	Dumpster Notes	Connected	Div Methods Lacking	Notes	Physical Plant	Building Age	Building Condition	Discharge to MS4	Parking Lot Age
PT-01	No storm drain, sheetflow	Yes	Yes, Not Directly Connected	Liquid/Solid	oil drums, construction scraps - concrete, metal	PERVIOUS	No	Yes	Yes	No	Unknown	Yes	Construction		No dumpster on property	No	N/A	fuel station has secondary containment but barrels do not; sheet flow	Yes	1970s	Clean	No	N/A
PT-03		No										Yes	Garbage	Overflowing	Trash bags in small cans - need dumpster	Yes	Yes	pic #2200 + 2203	Yes	2000s	Clean	No	2000s
PT-06		No										Yes	Garbage	Overflowing	Lid open - pic #2140	Yes	Yes	Diversion methods lacking - pic #2142	Yes	2000s	Clean	No	2000s
PT-09		Yes			Could not assess property - aerials show material storage	PERVIOUS	No	Unknown	Yes	Unknown	Unknown	No							No				
PT-10		Yes	Yes, Not Directly Connected	Liquid/Solid	Tanks, barrels, bricks	IMPERVIOUS	No	Yes	Yes	No	Yes	No							Yes	2000s	Clean	Yes	2000s
PT-16		Yes	Yes, Not Directly Connected	Liquid/Solid	Fuel tanks, gravel, sand. Fueling pic #2188	PERVIOUS AND IMPERVIOUS	No	Yes	Yes	No	Unknown	Yes	Garbage		Did not see dumpster on site visit - dumpster present in aerials	No	N/A	Waste management unknown	Yes	1980s	Clean	No	1980s
PT-17		Yes	Yes, Directly Connected	Liquid/Solid	Metal and oil tanks stored - pic #2194 and #2190+2185. Inlets drain to dry pond - pics #2192 and #2193	IMPERVIOUS	No	Unknown	Yes	No	Unknown	Yes	Garbage		Lid closed	No	N/A	Sheet flow to dry pond	Yes	1980s	Clean	No	1980s
PT-18		Yes	Yes, Not Directly Connected	Liquid/Solid	Barrels, debris - pic #2165 + 2166	IMPERVIOUS	Yes	Yes	Yes	No	Yes	Yes	Garbage		Lid closed	No	N/A		Yes	1960s	Clean	No	1960s
PT-24		No										Yes	Garbage	Leaking	Stains on ground - pic #2158	No	N/A	Drains to BMP	Yes	1990s	Clean	No	1990s
PT-25		No										Yes	Garbage		Lid closed	No	N/A		Yes	1970s	Clean	No	1970s
PT-26		Yes	Yes, Not Directly Connected	Solid	Materials stored in fenced area (pic #2154) - could not asses in field, used aerials	IMPERVIOUS	No	Unknown	Yes	Unknown	Unknown	Yes	Garbage	No cover/Open Lid	Lid open. See pic #2153	No	N/A		Yes	1980s	Clean	No	1980s
PT-27		No										Yes	Garbage		Lid closed	No	N/A		Yes	1970s	Clean	No	1970s
PT-28	No storm drains	Yes	Yes, Not Directly Connected	Solid	Containers. Could not access back of property - used aerials.	PERVIOUS AND IMPERVIOUS	No	Unknown	Yes	Unknown	Unknown	Yes	Garbage	No cover/Open Lid	Multiple dumpsters stored onsite - various stages of use from empty to full	No	N/A		Yes	1960s	Clean	No	1960s
PT-29		Yes	Yes, Not Directly Connected	Liquid/Solid	Pipes and pavers; fuel tank - pic #2181 +2183	IMPERVIOUS	No	Unknown	Yes	No	Yes	Yes	Garbage		Lid closed	No	N/A		Yes	1970s	Clean	No	1980s
PT-30	No storm drains	Yes	Yes, Not Directly Connected	Solid	Pipes, stones, concrete, metal	PERVIOUS	No	Unknown	Yes	Unknown	Unknown	No							Yes	1980s	Clean	No	1980s
PT-31		Yes	Yes, Not Directly Connected	Solid	Bricks, pipes, metal - pic #2179, 2175-2176	PERVIOUS	No	Unknown	Yes	Unknown	Unknown	No							Yes	1990s	Clean	No	2000s
PT-33	Area fenced off	Yes	Yes, Directly Connected	Solid	Wrapped pallets	IMPERVIOUS	Yes	Unknown	Yes	Unknown	Unknown	Yes			Cannot tell - area fenced				Yes	1970s	Clean	No	1970s
PT-35	No storm drains	Yes	Yes, Not Directly Connected	Solid	Cars, pieces of cars	IMPERVIOUS	No	Yes	Yes	No	Unknown	No							Yes	1980s	Clean	No	1980s
PT-36	No storm drains	Yes	Yes, Not Directly Connected	Solid	Containers, equipment. Could not access back of property - used aerials.	PERVIOUS AND IMPERVIOUS	No	Unknown	Yes	Unknown	Unknown	No							Yes	1980s	Clean	No	1980s
PT-37		Yes	Yes, Not Directly Connected	Solid	Metal, junk	PERVIOUS	No	Unknown	Yes	Unknown	Unknown	Yes	Construction	Overflowing	Dumpster has open lid. Waste includes garbage	No	N/A	See pic #2127, 2128; no storm drains	Yes	1970s	Clean	No	1970s
PT-38	Area fenced off	Yes	Yes, Not Directly Connected	Liquid/Solid	Metal, pipes, equipment	PERVIOUS AND IMPERVIOUS	No	Unknown	Yes	Unknown	Unknown	No							Yes	1970s	Clean	No	1970s
PT-39	Pic #2136, 2137, 2139	No										Yes	Garbage	No cover/Open Lid	pic #2138	Yes	Yes		Yes	1990s	Clean	No	1990s
PT-40		Yes	Yes, Directly Connected	Solid	See pic #2197 - fenced storage behind building, could not access	IMPERVIOUS	Yes	Unknown	Yes	Unknown	Unknown	Yes	Garbage	Overflowing	Dumpster rusted - pic #2195-2197	No	N/A		Yes	1970s	Dirty	No	1970s
PT-41	No storm drains	Yes	Yes, Not Directly Connected	Solid	cars, pieces of cars, boats	IMPERVIOUS	No	Yes	Yes	Yes	Unknown	Yes	Garbage		Material is stored outside dumpster	No	N/A	No storm drains	Yes	1970s	Clean	No	1970s
PT-42	No storm drains	Yes	Yes, Not Directly Connected	Liquid/Solid	metal drums stored on pallets	PERVIOUS AND IMPERVIOUS	No	Unknown	Yes	Yes	No	No							Yes	1980s	Stained	No	1980s
PT-43		Yes	No	Liquid/Solid	Tires; Possibly gas or oil - pic #2147 - 2149	IMPERVIOUS	No	No	Yes	No	Yes	Yes	Garbage	No cover/Open Lid	Gas on ground - pic #2149	No	N/A		Yes	1950s	Stained	No	1970s

Site ID	Parking Lot Condition	Parking Lot Condition Notes	Parking Lot Material	Down-spouts to IA	Down-spouts to MS4	Notes	Stains to MS4	Turf/Land-scaping	% Forest Canopy	% Lawn	% Land-scaped	% Bare Soil	Turf Mgmt	% Non-target Irrigation	Drain to MS4	Organics on IA	Noets	MS4	SWM Practices	SWM Practices	Private SD	Gutter Sediment (1-5)	Gutter Organics (1-5)	Gutter Litter (1-5)	Catch Basin Inspected	Basin ID	Inlet Condition	Hotspot Status
PT-01		no parking lot; gravel lot	Gravel	None Visible	No	construction vehicle had dirt on wheels	No	No							No	No	materials stored on unmaintained grass/dirt/gravel	No	No		No				No			Potential
PT-03	Stained	Stained with oil/gas	Paved/Concrete	Yes	Yes	Piped pic # 2203	No	Yes	0	85	15	0	Medium	0	Yes	No	Drain to pond (pic #2201) and grass lot (pic #2204)	Yes	Yes	Dry pond - pic #2201	Yes	2	1	2	No			Potential
PT-06	Stained	Oil/grease stains in 30% of spots	Paved/Concrete	Unknown	Yes	Piped pic # 2141	No	Yes	5		95	0	Low	0	Yes	No	All mulched trees in islands	Yes	No		Unknown	3	2	1	No			Potential
PT-09		No access to lot	Unknown	Unknown	Unknown		Unknown	No										No	No		No				No			Potential
PT-10	Stained	Stained, dirty, and breaking up - pic #1804	Paved/Concrete	Yes	No	No storm drains	No	Yes	0	90	10	0	High	0	No	No		Yes	Yes	Grass swale - pic #1804, 1805	No				No			Potential
PT-16	Stained		Paved/Concrete	Yes	No	No storm drains	No	No										No	No		No				No			Potential
PT-17	Breaking up	Pic #2191	Paved/Concrete	Yes	No		No	Yes	10	90	0	0	Medium	0	No	No		Yes	Yes	Dry pond - pics #2192 and #2193	Yes	2	2	1	No			Potential
PT-18	Breaking up	Stained, dirty, and breaking up - pic #2164 + 2168	Paved/Concrete	Yes	No	Drains to grass swale	No	Yes	5	95	0	0	Low	0	Yes	Yes	pic #2169	Yes	Yes	Grass swale - pic #2169	Yes	3	4	2	No			Potential
PT-24	Breaking up	Breaking up - pic #2157. Stained behind building near dumpster	Paved/Concrete	Yes	No	No storm drains; drains to grass swale and dry pond	No	Yes	5	90	5	0	Medium	0	No	No		Yes	Yes	Could not asses in field - checked GIS: grass swale and dry pond	No	1	1	1	No			Low
PT-25	Stained	Oil/grease stains in 10% of lot. Breaking up along back/west side of building	Paved/Concrete	Yes	No	Drains to BMP @ Crain Thwy	No	Yes	20	80	0	0	Low	0	Yes	No		Yes	Yes	Grass swale - pic #2160 and #2163	Yes	2	1	1	No			Low
PT-26	Stained	Oil/grease stains in 10% of lot	Paved/Concrete	Yes	No	Drain to wet pond	No	Yes	20	20	60	0	Medium	0	Yes	Yes	Mulch pic #2155	Yes	Yes	Wet pond - pic #2152	No				No			Potential
PT-27	Dirty	Parking lot in front of building. Behind building is 100% gravel	Paved/Concrete	Yes	No	Flows to wet pond - pic#2151	No	Yes	5	60	35	0	Medium	0	Yes	No		Yes	Yes	Wet pond - pic #2151	No	4	3	2	No			Potential
PT-28	Dirty	Dirty and breaking up	Paved/Concrete	None Visible	No	Parking lot partially gravel		Yes	20	80	0	0	Medium	0	No	No		Yes	Yes	Verified wet pond in GIS	No				No			Potential
PT-29	Dirty		Paved/Concrete	Yes	No	Sheet flow to swale	No	Yes	0	100	0	0	Low	0	No	No		Yes	Yes	Grass swale at Theodore Green Blvd	No				No			Potential
PT-30	Clean		Paved/Concrete	No	No	No storm drains	No	Yes	0	70	30	0	Medium	0	No	No		Yes	Yes	Dry pond - see GIS	No				No			Low
PT-31	Dirty	Sediment	Paved/Concrete	Yes	No	No storm drains		Yes	15	80	5	0	Medium	0	No	No		Yes	Yes	Dry ponds/swales - pic#2180	No				No			Low
PT-33	Clean		Paved/Concrete	Yes	No	Drains to BMP	No	No										Yes	Yes	Wet pond - see GIS	Yes	1	1	1	No			Low
PT-35	Stained		Paved/Concrete	Yes	No		No	No										No	No		No							Potential
PT-36	Clean		Paved/Concrete	Yes	No	No storm drains		No									40% of property bare soil - from aerials	No	No		No							Potential
PT-37	Dirty		Paved/Concrete	Yes	No			No									50% of property bare soil - from aerials	No	No		No							Potential
PT-38	Clean	Somewhat stained	Paved/Concrete	Yes	No			No										No	No		No							Potential
PT-39	Dirty	also breaking up in spots	Paved/Concrete	Yes	No		No	No										Yes	Yes	wet pond	Unknown							Potential
PT-40	Stained	Heavily stained (pic #2197-2199). Lot dirty and breaking up	Paved/Concrete	Yes	No		No	Yes	0	100	0	0	Medium	0	Yes	No		Yes	Yes	Drains through SW pipes to dry pond. Verified in GIS	Yes	1	1	1	No			Confirmed
PT-41	Stained		Paved/Concrete	No	No	No downspouts	No	No										No	No		No							Potential
PT-42	Clean		Paved/Concrete	Yes	No		No	No										No	No		No							Potential
PT-43	Stained	Stained and dirty - pic #2145	Paved/Concrete	Yes	No		No	No										No	No		No	2	2	2	No			Potential

Site ID	Potential Action	Notes
PT-01	Suggest follow-up	Disconnected sheetflow; >700ft forested buffer for stream
PT-03	Suggest follow-up and pervious area restoration	Need a dumpster. Tree planting at corner of Billingsley Rd and Crain Thwy.
PT-06	Suggest follow-up	Area of concern - overflowing dumpster draining to SD inlet in parking lot. Some sediment deposition observed around inlet
PT-09	Suggest follow-up. Check to see if hotspot is an NPDES non-filer. Schedule a review of storm water pollution prevention plan.	Could not properly access site. Majority of area fenced in. Ownership: "Industrial Investments LLC" (from GIS) is NOT part of auto store property
PT-10	Suggest follow-up, check to see if hotspot is an NPDES non-filer, schedule a review of storm water pollution prevention plan	No additional notes for this site
PT-16	Suggest follow-up. Check to see if hotspot is an NPDES non-filer. Schedule a review of storm water pollution prevention plan.	Connected sheet flow (~58ft) to stream. Could not properly access-site fenced in and on private road
PT-17	Suggest follow up.	Could not access fenced in area. Disconnected drainage to stream (230 ft from stream).
PT-18	Suggest follow-up. Check to see if hotspot is an NPDES non-filer	Multi-owner site
PT-24	No potential actions needed	Could not properly access site - spotted taking photo and had to leave
PT-25	No potential actions needed	No additional notes for this site
PT-26	Suggest follow-up.	Could not access fenced in area - analyzed fenced area using aerials.
PT-27	Suggest follow-up	Use of the property is unclear
PT-28	Suggest follow-up. Check to see if hotspot is an NPDES non-filer	Property fenced off. Used aerials to assist with assessment, confirmed BMP on property using GIS.
PT-29	Suggest follow-up. Check to see if hotspot is an NPDES non-filer	Most of property fenced off. Used aerials to assist with assessment. Fuel tank lacking secondary containment
PT-30	Suggest follow-up to verify conditions of NPDES Industrial permit	Area fenced off, referred to aerials. Confirmed BMP on property in GIS - dry pond. ~30ft from stream/wetland
PT-31	No potential actions needed	Material storage area fenced - referred to aerials. Confirmed BMP in GIS
PT-33	Suggest follow-up. Check to see if hotspot is an NPDES non-filer	Materials/vehicles/operation fenced off (pic #2162). Aerials used to assist assessment.
PT-35	Suggest follow-up. Check to see if hotspot is NPDES non-filer. Schedule a review of storm water pollution prevention plan	Disconnected sheet flow to stream behind building ~110ft
PT-36	Suggest follow-up. Check to see if hotspot is an NPDES non-filer	Property fenced off. Potential source of sediment
PT-37	Suggest follow-up. Check to see if hotspot is an NPDES non-filer. Schedule a review of storm water pollution prevention plan.	Disconnected sheet flow to stream (215 ft forest buffer). Potential source of sediment. Property fenced off.
PT-38	Suggest follow-up. Check to see if hotspot is an NPDES non-filer. Schedule a review of storm water pollution prevention plan.	Disconnected sheet flow (200ft forest buffer). Property fenced off
PT-39	Suggest follow-up. Check to see if hotspot is an NPDES non-filer. Schedule a review of storm water pollution prevention plan.	Car washing area draining directly to inlet (pic #2136)
PT-40	Suggest folow-up. Check to see if hotspot is NPDES non-filer	No access behind properties during inspection
PT-41	Suggest follow-up. Check to see if hotspot is an NPDES non-filer. Schedule a review of storm water pollution prevention plan.	Disconnected sheet flow to stream >500ft
PT-42	Suggest follow-up. Check to see if hotspot is an NPDES non-filer	Disconnected sheet flow to stream (190ft through forest buffer)
PT-43	Suggest follow-up	Junk stored behind building in gravel lot and woods (pic #2147-2148). Gas container on ground behind building (pic #2149)

APPENDIX C – STREAM CORRIDOR ASSESSMENT DATA

Inadequate Buffer

Site ID	Field Date	Photo	Photo 2	Bank	Unshaded	Width Left (ft)	WidthRight (ft)	Length Left (ft)	Length Right (ft)	Land Use Left	Land Use Right	Recently Established	Livestock	Severity	Correctability	Access	Wetland
001_IB001	7/30/2014	R001_IB001.jpg	R001_IB001_2.jpg	Both	Both	0	0	500	500	Other	Paved	No	No	3	4	2	4
001_IB002	7/30/2014	R001_IB002.jpg	R001_IB002_2.jpg	Left	Left	0	>50	1500	0	Other	Forest	No	No	3	4	2	5
002_IB001	7/30/2014	R002_IB001.jpg		Right	Neither	>50	20	0	500	Forest	Lawn	No	No	5	2	3	4
002_IB002	7/30/2014	R002_IB002.jpg		Left	Left	0	50	80	0	Crop Field	Forest	No	No	4	3	2	4
002_IB003	7/30/2014	R002_IB003.jpg	R002_IB003_2.jpg	Right	Neither	>50	25	0	1200	Forest	Crop Field	No	No	4	3	3	4
002_IB004	7/30/2014	R002_IB004.jpg	R002_IB004_2.jpg	Both	Both	5	5	150	150	Pasture	Pasture	No	No	3	3	2	0
002_IB005	7/30/2014	R002_IB005.jpg	R002_IB005_2.jpg	Both	Neither	25	25	1000	1000	Pasture	Pasture	No	No	4	2	3	5
002_IB006	7/30/2014	R002_IB006.jpg	R002_IB006_2.jpg	Both	Neither	25	15	1200	1200	Pasture	Pasture	No	Yes	3	3	3	5
002_IB007	7/30/2014	R002_IB007.jpg		Right	Neither	>50	20	0	200	Forest	Lawn	No	No	5	3	3	5
003_IB001	7/30/2014	R003_IB001.jpg	R003_IB001_2.jpg	Left	Neither	5	>50	200	0	Lawn	Forest	No	No	5	3	3	0
003_IB002	7/30/2014	R003_IB002.jpg		Both	Both	0	0	80	80	Lawn	Lawn	No	No	5	2	2	1
004_IB001	7/31/2014	R004_IB001.jpg		Both	Neither	15	20	150	150	Pasture	Paved	No	No	5	3	3	5
004_IB002	7/31/2014	R004_IB002.jpg	R004_IB002_2.jpg	Both	Neither	25	20	600	600	Lawn	Lawn	No	No	4	2	2	5
004_IB003	7/31/2014	R004_IB003.jpg		Right	Neither	>50	10	0	100	Forest	Lawn	No	No	5	5	3	5
004_IB004	7/31/2014	R004_IB004.jpg		Left	Left	0	>50	100	0	Lawn	Forest	No	No	4	2	2	4
004_IB005	7/31/2014	R004_IB005.jpg	R004_IB005_2.jpg	Left	Neither	10	>50	150	0	Lawn	Forest	No	No	4	2	2	5
005_IB001	7/31/2014	R005_IB001.jpg		Right	Neither	15	>50	300	0	Lawn	Forest	No	No	4	2	2	5
005_IB002	7/31/2014	R005_IB002.jpg		Right	Neither	>50	25	0	100	Forest	Lawn	No	No	5	2	2	5
006_IB001	8/17/2014	R006_IB001.jpg		Left	Neither	30	>50	300	0	Lawn	Shrubs & Small Trees	No	No	5	2	3	5
008_IB001	9/16/2014	R008_IB001.jpg		Right	Right	>50	10	0	100	Forest	Other	No	No	3	5	1	5
008_IB002	9/16/2014	R008_IB002.jpg		Both	Neither	15	10	600	60	Other	Forest	No	No	4	5	2	5
008_IB003	9/16/2014	R008_IB003.jpg	R008_IB003_2.jpg	Left	Neither	20	>50	350	0	Other	Forest	No	No	5	5	1	5

SCA Scoring: Severity (1 = Most Severe, 5 = Minor); Correctability (1 = Minor/Easy, 5 = Major/Difficult); Accessibility (1 = Easily Accessible, 5 = Difficult to Access)

Channel Alteration

Site ID	Field Date	Photo	Photo 2	Photo 3	Type	BottomWidth (in)	Length (ft)	Perennial Flow	Sedimentation	Veg in Channel	Road Crossing	LengthAbove (ft)	LengthBelow (ft)	Severity	Correctability	Access
001_CA001	7/30/2014	R001_CA001.jpg			Rip-rap	120	25	No	Yes	Yes	No	0	0	5	5	1
003_CA001	7/30/2014	R003_CA001.jpg	R003_CA001_2.jpg	R003_CA001_3.jpg	Rip-rap	240	100	Yes	Yes	Yes	No	0	0	5	5	2
010_CA001	9/16/2014	R010_CA001.jpg			Rip-rap	80	75	No	No	No	No	0	0	5	4	3
010_CA002	9/16/2014	R010_CA002.jpg	R010_CA002_2.jpg		Rip-rap	60	150	No	Yes	Yes	Below	0	150	4	3	3

SCA Scoring: Severity (1 = Most Severe, 5 = Minor); Correctability (1 = Minor/Easy, 5 = Major/Difficult); Accessibility (1 = Easily Accessible, 5 = Difficult to Access)

Erosion Site

Site ID	Field Date	Photo	Photo 2	Photo 3	Type	Possible Cause	Length (ft)	Height (ft)	Land Use Left	Land Use Right	Infrastructure Threatened?	Severity	Correctability	Access
001_ES001	7/30/2014	R001_ES001.jpg			Widening	Other	500	4	Other	Paved	No	3	3	2
001_ES002	7/30/2014	R001_ES002.jpg	R001_ES002_2.jpg		Widening	Other	1000	3	Other	Forest	No	3	2	2
001_ES003	7/30/2014	R001_ES003.jpg	R001_ES003_2.jpg		Widening	Other	300	2	Other	Forest	No	5	3	2
001_ES004	7/30/2014	R001_ES004.jpg	R001_ES004_2.jpg		Downcutting	Below Channelization	100	5	Other	Forest	No	3	3	2
001_ES005	7/30/2014	R001_ES005.jpg	R001_ES005_2.jpg		Widening	Bend at steep slope	150	5	Forest	Forest	No	3	3	3
001_ES006	7/30/2014	R001_ES006.jpg			Widening	Bend at steep slope	50	9	Forest	Forest	No	2	4	3
001_ES007	7/30/2014	R001_ES007.jpg	R001_ES007_2.jpg		Widening	Bend at steep slope	100	6	Forest	Forest	No	3	4	3
001_ES008	7/30/2014	R001_ES008.jpg	R001_ES008_2.jpg		Widening	Land Use Change Upstream	350	4	Forest	Forest	No	3	4	4
002_ES001	7/30/2014	R002_ES001.jpg	R002_ES001_2.jpg		Widening	Land Use Change Upstream	500	4	Crop Field	Forest	No	4	4	3
002_ES002	7/30/2014	R002_ES002.jpg	R002_ES002_2.jpg		Widening	Land Use Change Upstream	350	5	Forest	Forest	No	3	4	4
002_ES003	7/30/2014	R002_ES003.jpg			Widening	Bend at steep slope	100	9	Forest	Crop field	No	3	5	4
002_ES004	7/30/2014	R002_ES004.jpg			Widening	Below Road Crossing	100	5	Forest	Forest	No	4	4	4
002_ES005	7/30/2014	R002_ES005.jpg			Widening	Below Road Crossing	30	6	Pasture	Pasture	No	4	3	2
002_ES006	7/30/2014	R002_ES006.jpg	R002_ES006_2.jpg	R002_ES006_3.jpg	Widening	Land Use Change Upstream	900	6	Forest	Forest	No	3	4	4
002_ES007	7/30/2014	R002_ES007.jpg			Widening	Bend at steep slope	70	12	Forest	Forest	No	2	4	4
002_ES008	7/30/2014	R002_ES008.jpg			Widening	Land Use Change Upstream	200	6	Forest	Forest	No	3	4	4
002_ES009	7/30/2014	R002_ES009.jpg			Widening	Bend at steep slope	50	15	Forest	Forest	No	2	4	4
002_ES010	7/30/2014	R002_ES010.jpg			Widening	Bend at steep slope	40	12	Forest	Pasture	No	2	4	4
002_ES011	7/30/2014	R002_ES011.jpg	R002_ES011_2.jpg		Widening	Livestock	200	5	Pasture	Pasture	No	4	3	4
002_ES012	7/30/2014	R002_ES012.jpg	R002_ES012_2.jpg		Widening	Bend at steep slope	150	8	Forest	Lawn	No	3	4	3
002_ES013	7/30/2014	R002_ES013.jpg	R002_ES013_2.jpg		Widening	Land Use Change Upstream	100	5	Forest	Lawn	No	3	4	4
003_ES001	7/30/2014	R003_ES001.jpg	R003_ES001_2.jpg		Widening	Land Use Change Upstream	150	3	Lawn	Forest	No	5	4	3
003_ES002	7/30/2014	R003_ES002.jpg			Downcutting	Pipe Outfall	200	9	Forest	Forest	No	2	4	4
003_ES003	7/30/2014	R003_ES003.jpg	R003_ES003_2.jpg		Downcutting	Pipe Outfall	200	5	Forest	Forest	No	3	4	4
004_ES001	7/31/2014	R004_ES001.jpg	R004_ES001_2.jpg		Widening	Other	120	8	Shrubs & Small Trees	Lawn	No	2	4	2
004_ES002	7/31/2014	R004_ES002.jpg	R004_ES002_2.jpg		Widening	Bend at steep slope	80	7	Lawn	Shrubs & Small Trees	No	2	3	2
004_ES003	7/31/2014	R004_ES003.jpg			Widening	Bend at steep slope	80	10	Lawn	Forest	No	1	3	2
004_ES004	7/31/2014	R004_ES004.jpg	R004_ES004_2.jpg		Widening	Land Use Change Upstream	300	5	Forest	Forest	No	3	3	4
004_ES004	7/31/2014	R004_ES004_3.jpg	R004_ES004_4.jpg		Widening	Land Use Change Upstream	150	5	Forest	Forest	No	3	4	3
004_ES005	7/31/2014	R004_ES005.jpg			Widening	Land Use Change Upstream	50	6	Forest	Forest	No	3	4	3
004_ES006	7/31/2014	R004_ES006.jpg			Widening	Land Use Change Upstream	200	5	Lawn	Forest	No	3	3	4
004_ES007	7/31/2014	R004_ES007.jpg			Widening	Land Use Change Upstream	70	7	Forest	Forest	No	2	4	4
004_ES008	7/31/2014	R004_ES008.jpg			Widening	Land Use Change Upstream	175	4	Forest	Forest	No	4	4	5
004_ES009	7/31/2014	R004_ES009.jpg			Widening	Bend at steep slope	100	8	Forest	Forest	No	3	5	5
004_ES010	7/31/2014	R004_ES010.jpg			Widening	Bend at steep slope	150	8	Forest	Forest	No	3	5	5
004_ES011	7/31/2014	R004_ES011.jpg			Widening	Land Use Change Upstream	150	4	Forest	Forest	No	4	4	5
004_ES012	7/31/2014	R004_ES012.jpg			Widening	Bend at steep slope	50	12	Forest	Forest	No	2	5	5
004_ES013	7/31/2014	R004_ES013.jpg			Widening	Bend at steep slope	40	7	Forest	Forest	No	3	4	5
004_ES014	7/31/2014	R004_ES014.jpg	R004_ES014_2.jpg	R004_ES014_3.jpg	Widening	Bend at steep slope	600	6	Forest	Forest	No	2	4	5
004_ES015	7/31/2014	R004_ES015.jpg			Widening	Bend at steep slope	40	8	Forest	Forest	No	3	4	5
004_ES016	7/31/2014	R004_ES016.jpg	R004_ES016_2.jpg		Widening	Bend at steep slope	300	7	Other	Forest	No	2	4	5
005_ES001	7/31/2014	R005_ES001.jpg	R005_ES001_2.jpg		Widening	Land Use Change Upstream	150	6	Forest	Lawn	No	2	3	3
005_ES002	7/31/2014	R005_ES002.jpg			Widening	Land Use Change Upstream	600	4	Forest	Forest	No	3	4	4
005_ES003	7/31/2014	R005_ES003.jpg			Widening	Land Use Change Upstream	40	6	Forest	Forest	No	3	4	3
005_ES004	7/31/2014	R005_ES004.jpg	R005_ES004_2.jpg		Widening	Land Use Change Upstream	650	6	Forest	Forest	No	3	4	4
005_ES005	7/31/2014	R005_ES005.jpg			Widening	Land Use Change Upstream	600	5	Forest	Forest	No	3	4	5
005_ES006	7/31/2014	R005_ES006.jpg	R005_ES006_2.jpg		Widening	Bend at steep slope	150	4	Forest	Forest	No	3	4	4
005_ES007	7/31/2014	R005_ES007.jpg			Widening	Land Use Change Upstream	400	4	Forest	Forest	No	4	4	5
005_ES008	7/31/2014	R005_ES008.jpg			Widening	Bend at steep slope	50	7	Forest	Forest	No	3	4	5

Site ID	Field Date	Photo	Photo 2	Photo 3	Type	Possible Cause	Length (ft)	Height (ft)	Land Use Left	Land Use Right	Infrastructure Threatened?	Severity	Correctability	Access
005_ES009	7/31/2014	R005_ES009.jpg			Widening	Land Use Change Upstream	175	3	Forest	Forest	No	4	3	5
006_ES001	8/17/2014	R006_ES001.jpg	R006_ES001_2.jpg		Widening	Land Use Change Upstream	500	3	Forest	Forest	No	4	3	4
006_ES002	8/17/2014	R006_ES002.jpg			Widening	Bend at steep slope	75	6	Forest	Forest	No	3	4	4
006_ES003	8/17/2014	R006_ES003.jpg			Widening	Land Use Change Upstream	120	4	Forest	Forest	No	3	4	4
006_ES004	8/17/2014	R006_ES004.jpg			Widening	Bend at steep slope	70	8	Forest	Forest	No	2	4	4
006_ES005	8/17/2014	R006_ES005.jpg			Widening	Land Use Change Upstream	175	4	Forest	Forest	No	3	4	4
006_ES006	8/17/2014	R006_ES006.jpg			Widening	Bend at steep slope	70	8	Lawn	Forest	No	2	5	4
006_ES007	8/17/2014	R006_ES007.jpg	R006_ES007_2.jpg		Widening	Land Use Change Upstream	120	4	Lawn	Forest	No	3	4	4
006_ES008	8/17/2014	R006_ES008.jpg			Widening	Bend at steep slope	60	15	Lawn	Forest	No	1	5	4
006_ES009	8/17/2014	R006_ES009.jpg	R006_ES009_2.jpg		Widening	Bend at steep slope	250	7	Forest	Forest	No	2	4	4
006_ES010	8/17/2014	R006_ES010.jpg	R006_ES010_2.jpg		Widening	Bend at steep slope	250	6	Forest	Forest	No	3	4	4
006_ES011	8/17/2014	R006_ES011.jpg			Widening	Bend at steep slope	40	6	Forest	Forest	No	3	4	4
006_ES012	8/17/2014	R006_ES012.jpg			Widening	Bend at steep slope	80	6	Forest	Forest	No	3	4	5
006_ES013	8/17/2014	R006_ES013.jpg			Headcutting	Bend at steep slope	25	7	Forest	Forest	No	3	4	5
006_ES014	8/17/2014	R006_ES014.jpg	R006_ES014_2.jpg		Downcutting	Below Road Crossing	200	4	Forest	Forest	No	3	4	3
006_ES015	8/17/2014	R006_ES015.jpg			Widening	Below Road Crossing	100	4	Forest	Forest	No	4	4	4
006_ES016	8/17/2014	R006_ES016.jpg	R006_ES016_2.jpg		Widening	Bend at steep slope	120	5	Forest	Forest	No	3	4	5
006_ES017	8/17/2014	R006_ES017.jpg			Widening	Bend at steep slope	70	8	Forest	Forest	No	2	4	5
006_ES018	8/17/2014	R006_ES018.jpg			Widening	Land Use Change Upstream	100	4	Forest	Forest	No	4	4	5
006_ES019	8/17/2014	R006_ES019.jpg			Widening	Bend at steep slope	100	8	Forest	Forest	No	2	4	5
006_ES020	8/17/2014	R006_ES020.jpg	R006_ES020_2.jpg	R006_ES020_3.jpg	Downcutting	Land Use Change Upstream	250	5	Forest	Forest	No	3	4	4
006_ES021	8/17/2014	R006_ES021.jpg	R006_ES021_2.jpg		Headcutting	Other	150	4	Forest	Forest	No	3	4	4
007_ES001	8/17/2014	R007_ES001.jpg			Widening	Land Use Change Upstream	250	3	Forest	Forest	No	4	3	5
007_ES002	8/17/2014	R007_ES002.jpg			Widening	Bend at steep slope	20	6	Forest	Forest	No	3	4	5
007_ES003	8/17/2014	R007_ES003.jpg	R007_ES003_2.jpg		Widening	Other	500	2	Forest	Forest	No	4	3	5
007_ES004	8/17/2014	R007_ES004.jpg			Widening	Bend at steep slope	20	5	Forest	Forest	No	4	4	5
007_ES005	8/17/2014	R007_ES005.jpg	R007_ES005_2.jpg		Widening	Land Use Change Upstream	400	4	Forest	Forest	No	4	4	3
008_ES001	9/16/2014	R008_ES001.jpg	R008_ES001_2.jpg		Widening	Below Road Crossing	300	5	Forest	Forest	Yes	3	3	2
008_ES003	9/16/2014	R008_ES003.jpg			Headcutting	Other	0	6	Other	Forest	Yes	2	3	2
008_ES002	9/16/2014	R008_ES002.jpg	R008_ES002_2.jpg		Widening	Livestock	350	6	Other	Forest	No	3	4	2
008_ES005	9/16/2014	R008_ES005.jpg			Headcutting	Pipe Outfall	20	6	Other	Forest	No	2	2	2
008_ES004	9/16/2014	R008_ES004.jpg			Headcutting	Land Use Change Upstream	200	8	Other	Forest	No	1	4	3
009_ES001	9/16/2014	R009_ES001.jpg	R009_ES001_1.jpg		Widening	Land Use Change Upstream	900	6	Forest	Forest	No	2	4	5
009_ES003	9/16/2014	R009_ES003.jpg			Headcutting	Land Use Change Upstream	50	6	Forest	Forest	No	2	4	5
009_ES004	9/16/2014	R009_ES004.jpg			Headcutting	Land Use Change Upstream	50	6	Forest	Forest	No	2	4	5
009_ES005	9/16/2014	R009_ES005.jpg			Headcutting	Land Use Change Upstream	40	5	Forest	Forest	No	3	4	5
009_ES002	9/16/2014	R009_ES002.jpg	R009_ES002_2.jpg		Downcutting	Land Use Change Upstream	1000	7	Forest	Forest	No	2	4	5
009_ES006	9/16/2014	R009_ES006.jpg			Headcutting	Land Use Change Upstream	100	5	Forest	Forest	No	3	4	5
009_ES007	9/16/2014	R009_ES007.jpg			Headcutting	Land Use Change Upstream	70	6	Forest	Forest	No	3	4	5
010_ES001	9/16/2014	R010_ES001.jpg	R010_ES001_2.jpg	R010_ES001_3.jpg	Widening	Pipe Outfall	400	0	Forest	Forest	No	2	4	4
010_ES002	9/16/2014	R010_ES002.jpg	R010_ES002_2.jpg		Downcutting	Below Channelization	200	8	Forest	Forest	No	2	3	4

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Exposed Pipe

Site ID	Field Date	Photo	Purpose	Pipe Type	Type Description	Location of Pipe	Diameter (in)	Length (ft)	Discharge	Color	Odor	Severity	Correctability	Access
Site ID	FIELD_DATE	PHOTO												
001_EP001	7/30/2014	R001_EP001.jpg	Water Supply	Plastic		Exposed Across Bottom of Stream	4	8	No	NA	NA	5	5	2
009_EP001	9/16/2014	R009_EP001.jpg	Unknown	Smooth Metal		Above stream	4	15	No	NA	NA	5	5	5

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Fish Barrier

Site ID	Field Date	Photo	Blockage	Type	Reason	Water Drop (in)	Water Depth (in)	Severity	Correctability	Access
004_FB001	7/31/2014	R004_FB001.jpg	Total	Road Crossing	Too High	30	0	2	4	4

SCA Scoring: Severity (1 = Most Severe, 5 = Minor); Correctability (1 = Minor/Easy, 5 = Major/Difficult); Accessibility (1 = Easily Accessible, 5 = Difficult to Access)

Pipe Outfall

Site ID	Field Date	Photo	Photo 2	Outfall Type	Pipe Type	Location of Pipe	Diameter (in)	Channel Width (ft)	Discharge	Color	Odor	Severity	Correctability	Access
001_PO001	7/30/2014	R001_PO001.jpg		Stormwater	Plastic	Left Bank	8	0	No			5	5	2
001_PO002	7/30/2014	R001_PO002.jpg		Stormwater	Plastic	Left Bank	4	0	No			5	4	2
001_PO003	7/30/2014	R001_PO003.jpg		Stormwater	Plastic	Left Bank	4	0	No			5	5	2
001_PO004	7/30/2014	R001_PO004.jpg		Stormwater	Concrete Pipe	Left Bank	8	0	No			5	5	2
001_PO005	7/30/2014	R001_PO005.jpg		Stormwater	Plastic	Left Bank	4	0	No			5	5	2
001_PO006	7/30/2014	R001_PO006.jpg		Stormwater	Plastic	Left Bank	4	0	No			5	5	2
001_PO007	7/30/2014	R001_PO007.jpg		Stormwater	Plastic	Left Bank	4	0	No			5	5	2
001_PO008	7/30/2014	R001_PO008.jpg		Stormwater	Plastic	Left Bank	4	0	No			5	5	2
001_PO009	7/30/2014	R001_PO009.jpg		Stormwater	Plastic	Left Bank	4	0	No			5	5	2
002_PO001	7/30/2014	R002_PO001.jpg		Stormwater	Plastic	Right Bank	6	0	No			5	2	2
003_PO001	7/30/2014	R003_PO001.jpg		Stormwater	Plastic	Left Bank	4	0	No			5	1	1
003_PO002	7/30/2014	R003_PO002.jpg		Stormwater	Plastic	Left Bank	30	0	No	Clear	None	5	4	2
003_PO003	7/30/2014	R003_PO003.jpg		Stormwater	Concrete Pipe	Head of Stream	36	0	Yes	Clear	None	3	3	4
006_PO001	8/17/2014	R006_PO001.jpg		Stormwater	Plastic	Other	24	0	No			3	3	4
006_PO002	8/17/2014	R006_PO002.jpg		Stormwater	Other	Other	0	0	No			4	4	3
006_PO003	8/17/2014	R006_PO003.jpg		Stormwater	Concrete Pipe	Left Bank	18	0	No			5	2	2
006_PO004	8/17/2014	R006_PO004.jpg		Stormwater	Corrugated Metal	Right Bank	24	0	No			5	3	4
006_PO005	8/17/2014	R006_PO005.jpg		Stormwater	Corrugated Metal	Right Bank	24	0	No			4	2	3
007_PO001	8/17/2014	R007_PO001.jpg		Stormwater	Corrugated Metal	Left Bank	24	0	No			1	4	2
007_PO002	8/17/2014	R007_PO002.jpg		Stormwater	Plastic	Left Bank	24	0	No			5	2	3
007_PO003	8/17/2014	R007_PO003.jpg	R007_PO003_2.jpg	Stormwater	Corrugated Metal	Other	60	0	Yes	Clear	None	3	3	3
007_PO004	8/17/2014	R007_PO004.jpg		Stormwater	Plastic	Other	36	0	Yes	Clear	None	5	0	2
007_PO005	8/17/2014	R007_PO005.jpg		Stormwater	Corrugated Metal	Other	36	0	Yes	Clear	None	5	0	2
007_PO005	8/17/2014	R007_PO006.jpg		Stormwater	Concrete Pipe	Right Bank	12	0	Yes	Clear	None	5	0	4
008_PO001	9/16/2014	R008_PO001.jpg		Stormwater	Concrete Pipe	Right Bank	12	0	No			5	3	1
008_PO002	9/16/2014	R008_PO002.jpg		Stormwater	Corrugated Metal	Left Bank	15	0	No			4	3	2
008_PO003	9/16/2014	R008_PO003.jpg		Stormwater	Corrugated Metal	Right Bank	21	0	No			5	4	1
008_PO004	9/16/2014	R008_PO004.jpg		Stormwater	Corrugated Metal	Left Bank	24	0	No			2	2	2
010_PO001	9/16/2014	R010_PO001.jpg		Stormwater	Corrugated Metal	Head of Stream	42	0	Yes	Clear	None	5	5	3
010_PO002	9/16/2014	R010_PO002.jpg		Stormwater	Corrugated Metal	Head of Stream	18	0	No			3	3	2
010_PO003	9/16/2014	R010_PO003.jpg		Stormwater	Concrete Pipe	Head of Stream	24	0	No			4	5	3
011_PO001	9/16/2014	R011_PO001.jpg		Stormwater	Plastic	Left Bank	6	0	No			5	5	2

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Potential BMP

Site ID	Field Date	Photo	Photo 2	BMP Type	BMP Type 2	BMP Type 3	BMP Type 4	Comments
001_PB001	7/30/2014	R001_PB001.jpg		Other				daylight culverted channel
001_PB002	7/30/2014	R001_PB002.jpg		Bioretention/raingarden	Streamside grass buffers			capture stormwater from outfall along slope
002_PB001	7/30/2014	R002_PB001.jpg		Livestock exclusion fencing	Riparian buffer replacement	Water trough		evidence of cattle in stream
002_PB002	7/30/2014	R002_PB002.jpg		Livestock exclusion fencing	Water trough			cattle observed adjacent to stream with visible access
003_PB001	7/30/2014	R003_PB001.jpg	R003_PB001_2.jpg	Outfall stabilization	Stormwater management pond	Bioretention/raingarden		severe headcutting from overland flow reaching incised channel
004_PB001	7/31/2014	R004_PB001.jpg		Stormwater management pond	Bioretention/raingarden	Stabilization		heavy headcutting from sw runoff from development running down steep slope. possible SPSC opportunity
006_PB001	8/17/2014	R006_PB001.jpg		Outfall stabilization	Stream restoration			potential SPSC site to stabilize steep gullly
006_PB002	8/17/2014	R006_PB002.jpg		Outfall stabilization				severe erosion due to failing culvert pipe
006_PB003	8/17/2014	R006_PB003.jpg		Streambank stabilization	Outfall stabilization			severe headcutting from highway 301 runoff
006_PB004	8/17/2014	R006_PB004.jpg		Outfall stabilization	Streambank stabilization			severe headcutting and gully formation from RT 301 runoff. stabilization necessary to prevent erosion
006_PB005	8/17/2014	R006_PB005.jpg		Outfall stabilization	Streambank stabilization			bank erosion at outfall loacation
007_PB001	8/17/2014	R007_PB001.jpg	R007_PB001_2.jpg	Streambank stabilization	Outfall stabilization			severe erosion due to failed pipe outfall. threat to RT 301 infrastructure
007_PB002	8/17/2014	R007_PB002.jpg	R007_PB002_2.jpg	Outfall stabilization	Streambank stabilization			headcutting and infrastructure damage due to RT 301 runoff
007_PB003	8/17/2014	R007_PB003.jpg	R007_PB003_2.jpg	Outfall stabilization	Stormwater management pond			severe headcutting due to RT 301 runoff
007_PB004	8/17/2014	R007_PB004.jpg		Stormwater management pond	Outfall stabilization	Streambank stabilization		headcutting and downcutting in ditch draining RT 301. requires stabilization
008_PB001	9/16/2014	R008_PB001.jpg		Outfall stabilization	Stormwater management pond	Streambank stabilization		uncontrolled roadway runoff causing erosion. need stabilization
008_PB002	9/16/2014	R008_PB002.jpg		Stormwater management pond	Wetland creation	Bioretention/raingarden		dry detention basin could be retrofit
008_PB003	9/16/2014	R008_PB003.jpg		Outfall stabilization	Streambank stabilization			severe headcut below outfall
008_PB004	9/16/2014	R008_PB004.jpg		Streambank stabilization	Stream restoration			severe headcutting, potential for SPSC although intermittent channel
008_PB005	9/16/2014	R008_PB005.jpg	R008_PB005_2.jpg	Stormwater management pond	Bioretention/raingarden			minimal SWM for large parking lot causing severe headcutting DS
010_PB001	9/16/2014	R010_PB001.jpg	R010_PB001_2.jpg	Stormwater management pond	Bioretention/raingarden	Streambank stabilization	SPSC	runoff from imprvious surface causing severe downcutting

Representative Site

Site ID	Field Date	Photo	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation	Width Riffle (in)	Width Run (in)	Width Pool (in)	Depth Riffle (in)	Depth Run (in)	Depth Pool (in)	Bottom Type
001_RE001	7/30/2014	R001_RE001.jpg	Poor	Marginal	Poor	Marignal	Marginal	Poor	Poor	Poor	Poor	Poor	24	24	30	0	0	2	Gravel
001_RE002	7/30/2014	R001_RE002.jpg	Poor	Marginal	Poor	Marignal	Marginal	Poor	Poor	Poor	Marginal	Marginal	24	24	36	1	1	2	Gravel
001_RE003	7/30/2014	R001_RE003.jpg	Marginal	Suboptimal	Poor	Optimal	Marginal	Marginal	Poor	Suboptimal	Marginal	Optimal	36	36	48	1	1	4	Gravel
002_RE001	7/30/2014	R002_RE001.jpg	Suboptimal	Marginal	Suboptimal	Suboptimal	Marginal	Suboptimal	Marginal	Suboptimal	Suboptimal	Suboptimal	30	30	60	1	4	12	Gravel
002_RE002	7/30/2014	R002_RE002.jpg	Suboptimal	Suboptimal	Marginal	Optimal	Marginal	Suboptimal	Marginal	Suboptimal	Marginal	Optimal	48	48	80	2	4	10	Gravel
003_RE001	7/30/2014	R003_RE001.jpg	Marginal	Suboptimal	Marginal	Suboptimal	Suboptimal	Marginal	Marginal	Suboptimal	Poor	Suboptimal	36	36	36	1	2	4	Cobble
004_RE001	7/31/2014	R004_RE001.jpg	Suboptimal	Marginal	Suboptimal	Suboptimal	Marginal	Suboptimal	Marginal	Suboptimal	Marginal	Marginal	50	50	80	2	6	12	Gravel
004_RE002	7/31/2014	R004_RE002.jpg	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Marginal	Suboptimal	Marginal	Suboptimal	60	60	96	2	6	18	Gravel
004_RE003	7/31/2014	R004_RE003.jpg	Marginal	Optimal	Marginal	Optimal	Optimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Optimal	48	48	54	4	12	12	Other
005_RE001	7/31/2014	R005_RE001.jpg	Poor	Poor	Poor	Optimal	Marginal	Poor	Poor	Marginal	Poor	Suboptimal	12	12	24	0	0	6	Gravel
005_RE002	7/31/2014	R005_RE002.jpg	Poor	Marginal	Poor	Optimal	Marginal	Marginal	Poor	Suboptimal	Marginal	Optimal	24	24	48	1	1	8	Gravel
006_RE001	8/17/2014	R006_RE001.jpg	Marginal	Marginal	Marginal	Optimal	Marginal	Suboptimal	Marginal	Suboptimal	Poor	Suboptimal	48	48	60	1	2	12	Gravel
006_RE002	8/17/2014	R006_RE002.jpg	Poor	Poor	Poor	Suboptimal	Marginal	Marginal	Poor	Suboptimal	Suboptimal	Suboptimal	30	30	50	1	1	12	Gravel
006_RE003	8/17/2014	R006_RE003.jpg	Marginal	Poor	Marginal	Optimal	Marginal	Marginal	Poor	Marginal	Poor	Suboptimal	36	36	48	1	1	12	Gravel
007_RE001	8/17/2014	R007_RE001.jpg	Marginal	Suboptimal	Suboptimal	Optimal	Marginal	Suboptimal	Marginal	Suboptimal	Suboptimal	Optimal	24	24	48	1	4	12	Gravel
007_RE002	8/17/2014	R007_RE002.jpg	Suboptimal	Suboptimal	Marginal	Suboptimal	Marginal	Marginal	Marginal	Suboptimal	Suboptimal	Optimal	36	36	48	1	4	12	Gravel
007_RE003	8/17/2014	R007_RE003.jpg	Marginal	Suboptimal	Marginal	Suboptimal	Marginal	Marginal	Marginal	Suboptimal	Marginal	Suboptimal	24	24	36	1	2	9	Gravel
008_RE001	9/16/2014	R008_RE001.jpg	Marginal	Marginal	Poor	Marignal	Poor	Poor	Poor	Marginal	Marginal	Suboptimal	24	24	30	1	2	6	Gravel
008_RE002	9/16/2014	R008_RE002.jpg	Marginal	Marginal	Poor	Suboptimal	Marginal	Marginal	Poor	Marginal	Marginal	Marginal	24	24	39	1	2	6	Cobble
009_RE001	9/16/2014	R009_RE001.jpg	Poor	Poor	Poor	Optimal	Poor	Poor	Poor	Suboptimal	Poor	Optimal	0	0	0	0	0	0	Gravel
009_RE002	9/16/2014	R009_RE002.jpg	Poor	Poor	Poor	Suboptimal	Poor	Poor	Poor	Marginal	Poor	Optimal	12	12	12	1	1	4	Cobble
009_RE003	9/16/2014	R009_RE003.jpg	Poor	Optimal	Poor	Optimal	Suboptimal	Poor	Poor	Marginal	Marginal	Optimal	6	6	12	2	2	6	Other
010_RE001	9/16/2014	R010_RE001.jpg	Poor	Poor	Poor	Suboptimal	Poor	Poor	Poor	Marginal	Marginal	Optimal	6	6	6	1	2	4	Gravel
011_RE001	9/16/2014	R011_RE001.jpg	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Marginal	Marginal	Suboptimal	Suboptimal	Optimal	24	24	48	1	4	15	Gravel
011_RE002	9/16/2014	R011_RE002.jpg	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Marginal	Optimal	Suboptimal	Optimal	30	30	48	1	4	12	Gravel

Habitat Assessment Rankings (in order from worst to best condition) - Poor, Marginal, Suboptimal, Optimal

Trash Dumping

Site ID	Field Date	Photo	Type	Type Description	Truckloads	Other measure	Extent	Volunteer Project?	Owner Type	Severity	Correctability	Access
004_TD001	7/31/2014	R004_TD001.jpg	Residential	old appliances	1		Single Site	Yes	Private	4	2	2
004_TD002	7/31/2014	R004_TD002.jpg	Residential		3		Single Site	No	Private	5	3	2
004_TD003	7/31/2014	R004_TD003.jpg	Residential		2		Single Site	No	Private	4	4	4
004_TD004	7/31/2014	R004_TD004.jpg	Other	scrap metal	3		Single Site	No	Private	3	3	4
006_TD001	8/17/2014	R006_TD001.jpg	Residential		1		Single Site	Yes	Unknown	5	2	4
006_TD002	8/17/2014	R006_TD002.jpg	Residential		4		Large Area	Yes	Private	3	3	4
006_TD003	8/17/2014	R006_TD003.jpg	Tires		2		Single Site	Yes	Private	3	3	4
006_TD004	8/17/2014	R006_TD004.jpg	Other	appliances	2		Single Site	No	Private	3	3	2
006_TD005	8/17/2014	R006_TD005.jpg	Tires	mixed garbage	7		Large Area	No	Private	2	4	2
006_TD006	8/17/2014	R006_TD006.jpg	Residential		2		Single Site	Yes	Unknown	4	2	3
006_TD007	8/17/2014	R006_TD007.jpg	Tires		2		Single Site	Yes	Unknown	4	3	3
007_TD001	8/17/2014	R007_TD001.jpg	Tires	also garbage	2		Single Site	Yes	Unknown	3	2	2
007_TD002	8/17/2014	R007_TD002.jpg	Tires	also garbage	2		Single Site	Yes	Unknown	5	2	1
009_TD001	9/16/2014	R009_TD001.jpg	Other	rusty metal fencing	2		Single Site	Yes	Unknown	4	3	4

SCA Scoring: Severity (1 = Most Severe, 5 = Minor); Correctability (1 = Minor/Easy, 5 = Major/Difficult); Accessibility (1 = Easily Accessible, 5 = Difficult to Access)

Unusual Condition

Site ID	Field Date	Photo	Type	Description	Potential Cause	Comment	Severity	Correctability	Access
001_UC001	7/30/2014	R001_UC001.jpg	Unusual Condition	Excessive Algae	nutrients	pink, orange algal floc	5	Unknown	2
001_UC002	7/30/2014	R001_UC002.jpg	Unusual Condition	Other	headcutting	headcutting on small trib draining to reach on RB	5	3	3
002_UC001	7/30/2014	R002_UC001.jpg	Unusual Condition	Excessive Algae	cattle access		3	2	2
004_UC001	7/31/2014	R004_UC001.jpg	Unusual Condition	Other		dense stand of bamboo along LB	4	5	4
005_UC001	7/31/2014	R005_UC001.jpg	Unusual Condition	Other		beaver dam	5	2	4
005_UC002	7/31/2014	R005_UC002.jpg	Unusual Condition		beavers	beaver pond	5	3	4
005_UC003	7/31/2014	R005_UC003.jpg	Unusual Condition	Other	beavers	beaver pond	5	4	5
005_UC004	7/31/2014	R005_UC004.jpg	Unusual Condition	Other	beavers	beaver dam	5	4	5
007_UC001	8/17/2014	R007_UC001.jpg	Comment	Other		spring house and pond at headwaters	NA	NA	NA
008_UC001	9/16/2014	R008_UC001.jpg	Unusual Condition	Other	erosion	stream channel meandering toward roadway. threat to infrastructure	4	2	1
009_UC001	9/16/2014	R009_UC001.jpg	Unusual Condition	Other		blown-out road crossing with exposed culvert	3	5	5
010_UC001	9/16/2014	R010_UC001.jpg	Comment	Other		inline SWM basin	NA	NA	NA

SCA Scoring: Severity (1 = Most Severe, 5 = Minor); Correctability (1 = Minor/Easy, 5 = Major/Difficult); Accessibility (1 = Easily Accessible, 5 = Difficult to Access)

APPENDIX D – PRIORITIZATION METHODS

Project Prioritization Methods

To support County environmental manager's resource allocation decision making process, a prioritization was developed for the Port Tobacco subwatershed projects identified in this report. The results indicate which projects are the most beneficial and cost effective relative to the set of projects identified.

The prioritization involved a matrix made up of a series of parameters, or metrics, which evaluated each proposed project and allowed for discrimination between the projects. Each metric was scored for each project, either qualitatively or quantitatively as appropriate. Weighting factors were applied to metrics that were deemed the most critical, and the sum of the weighted scores determined the highest priority projects to implement.

The approach included scoring and ranking of the project benefits, constraints and costs. Including factors of feasibility and cost is necessary because the potential exists for the most beneficial project to also be relatively less feasible. It might be the most expensive project, have limited access, utility conflicts, or require disturbance to natural resources.

The following describes the methods used.

Metric Evaluation

The prioritization uses a series of metrics, or indicators, that describe various attributes of a project. A series of candidate metrics was developed for each of the three categories: Benefits, Constraints, and Cost. Metrics evaluated by the project team are listed in Table 1 with a brief description of each.

Table 1: Candidate Prioritization Metrics

Metric	Description
Project Benefits	
Quantity Control	Level of quantity control (cfs/ac)
Water Quality Treatment	Rainfall Depth Treated (in)
Pollutant Removal	TN, TP, and TSS removed (lb) based on modeling
Groundwater Recharge	Amount of recharge based on level of expected infiltration
Channel Protection	Based on proposed level of quantity control and downstream stability
Channel Stabilization	Level of channel stabilization provided will be dependent on channel condition and type of project
Water/Stream Temperature	Does project reduce receiving water temperature?
Instream Habitat Improvement	Does project provide or improve instream habitat?
Riparian Habitat Improvement	Does project provide or improve riparian habitat?
Wetland Habitat Improvement	Does project provide or improve wetland habitat?
Fish Passage	Does project reduce or eliminate barriers to fish passage?
Public Visibility/Education/Outreach	Is project in close proximity to public places?
Community Aesthetic Improvement	Does the project improve community appearance?
Public Safety Improvement	Is there a public safety issue that is addressed by the project?
Combined Benefit	Are there multiple projects in close proximity that together provide a larger cumulative benefit?
Impervious Area Treated	Area of impervious surface treated (acres)
Proximity to MS4	How close is the project to MS4 drainage?
Project Constraints	

Metric	Description
Access	Are there constraints to access – mature trees, infrastructure, steep slopes?
Permitting	Are there significant permitting issues – wetland/forest disturbance?
Maintenance Requirements	What is the level of maintenance involved – frequency, expense, equipment?
Ownership	Is ownership of the parcels involved held publicly or privately? Are private owners cooperative?
Adjacent Land Use	Are adjacent properties compatible with the type of potential project?
Design/Construction	Do the site layout, topography, elevations allow for a design that maximizes benefit and is constructible?
Public Safety	Does the project create a public safety hazard?
Existing Utility Conflicts	Are there existing underground or overhear utilities conflicting with the design? Are the private or public?
Fish Passage	Does the project introduce or make worse a barrier to fish passage?
Project Cost	
Cost	Total life cycle cost of the project
Cost per Impervious Area Treated	Total cost of the project divided by the impervious area treated, dollars per acre
Cost per Pollutant Removed	Total cost of the project divided by the amount of pollutant removed, dollars per lb of TP, TN, TSS

Candidate metrics were evaluated for inclusion based on the following attributes:

Discrimination Potential. Metrics will describe project attributes that assist in discriminating between projects. Selected metrics have the greatest discrimination potential relative to other candidate metrics. For example, if none of the projects have a utility conflict, use of this constraint metric will not be useful. However cost, because it varies from project to project, has a greater discrimination potential, and would therefore be selected.

Duplication. Selected metrics are not duplicative of one another. Results of the prioritization can be skewed if two or more metrics are evaluating very similar project factors.

Project Goals and Objectives. Selected metrics are linked to the overall project goal and objectives. The primary goals of the current projects are to maximize impervious surface treatment and pollutant removal, therefore metrics linked to those goals would be important to include. Secondary goals include items such as habitat improvement and stream channel protection. The linkage to project goals is also accounted for in the metric weighting which is described below.

Project Type. Selection metrics are relevant to the project types being implemented. For example, a suite of projects that do not influence fish passage would not be evaluated using that metric. A wide variety of project types are being recommended therefore a varied selection of evaluation metrics is used.

Relative Management Importance. The suite of candidate metrics was evaluated by County resource managers to determine the factors that were most important to them. To evaluate the suite, a pairwise comparison was used. Results of the comparison were also used to derive the metric weights.

Each metric was analyzed by the project team by comparing pairs of metrics to evaluate which has greater importance. The project team included representatives from Charles County Department of Planning and Growth Management and the Port Tobacco River Conservancy. Each metric is evaluated individually against all of the other metrics and the evaluator selects one by one, which metric has greater importance. The results are tabulated for each metric category (benefits, constraints, costs). Metrics with the greatest number of selections represent those that were felt overall to be the most important. Results are presented in Figures 1-3.

Figure 1: Project Benefits Metric

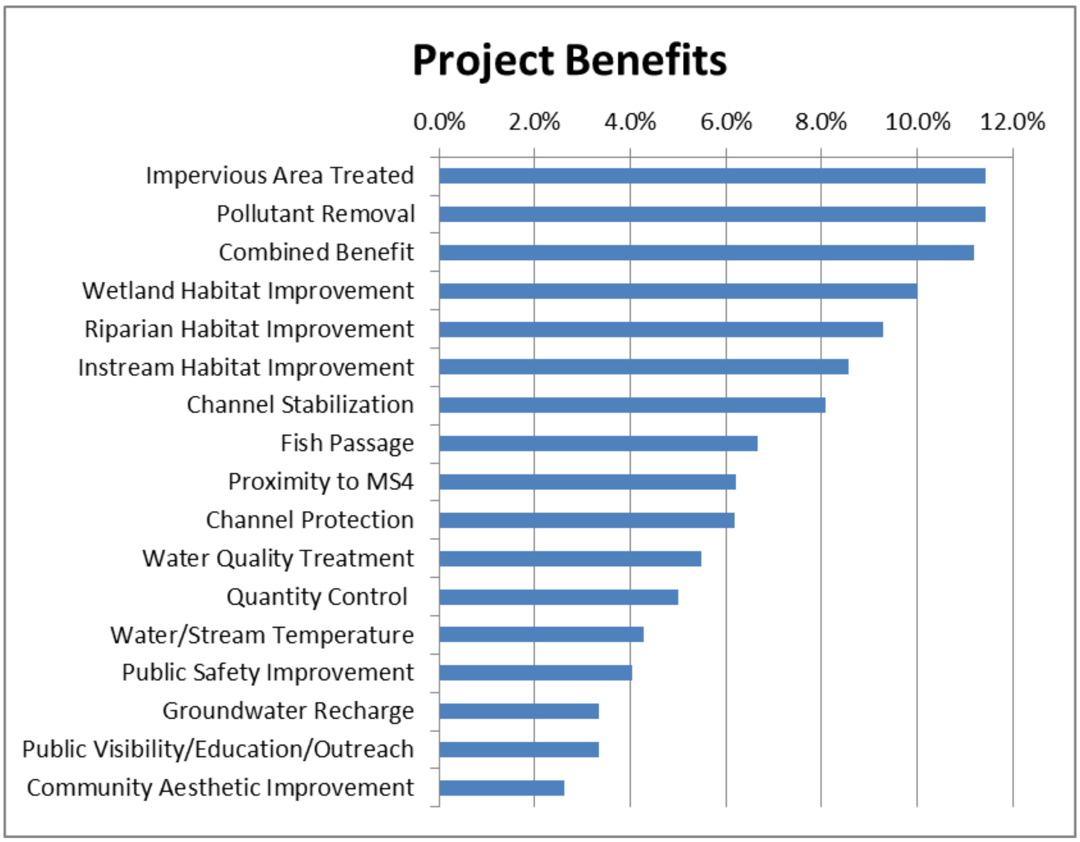


Figure 2: Project Constraints Metric Weights

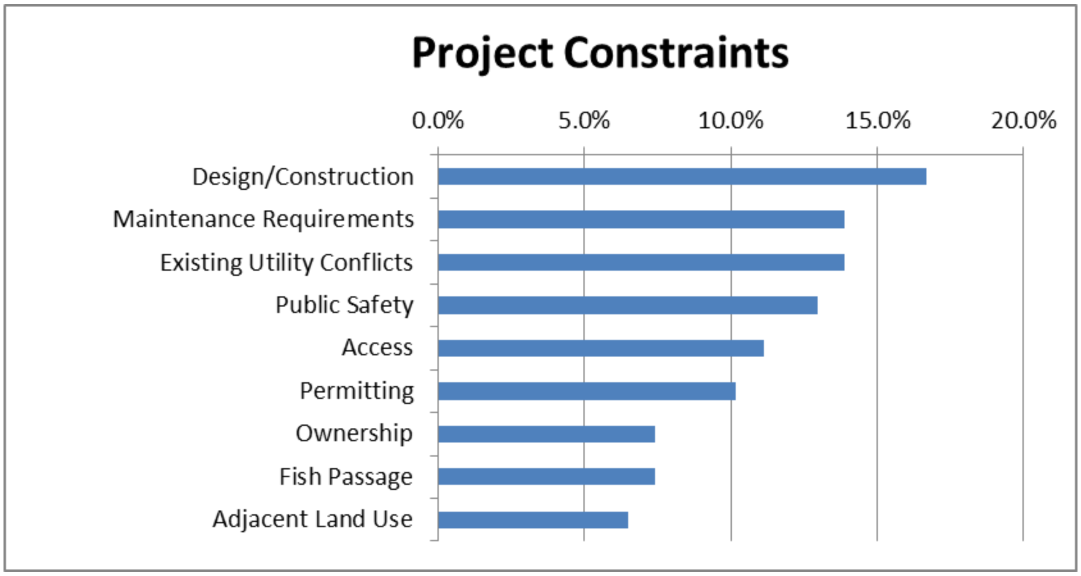
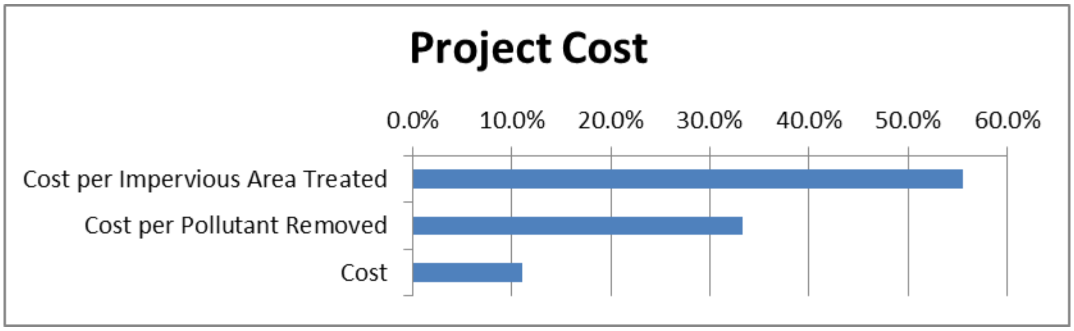


Figure 3: Project Cost Metric Weights



Metric Selection Results

Based on the evaluation described above, a final list of selected metrics was derived. Selected metrics are listed below in order of importance by category. Two constraint metrics (fish passage and public safety) and two benefits metrics (quantity control and public safety improvement) were not used due to their lack of discrimination potential between projects.

Project benefit:

- impervious area treated
- pollutant removal
- combined benefit
- wetland habitat improvement
- riparian habitat improvement
- instream habitat improvement
- channel stabilization
- fish passage

- proximity to MS4
- channel protection
- water quality treatment
- water/stream temperature
- groundwater recharge
- public visibility/education/outreach
- community aesthetics improvement

Project constraint:

- design/construction
- maintenance requirements
- existing utility conflicts
- access
- permitting
- ownership
- adjacent land use

Project cost:

- cost per impervious acre treated
- cost per pollutant removed
- total cost (full life cycle cost)

Metric Weighting Factors

Weighting factors were developed and applied to allow resource managers to impart the relative importance of the selected metrics into the prioritization. For example, if pollutant load reduction is far more critical in selection versus impervious surface treatment, then it would be more highly weighted. Weights were developed within each of the three categories (benefit, constraints, and cost). Results of the pairwise comparison were totaled and the proportion of the result for each metric of the total was used as the final weight (Table 2).

Table 2: Weighting Factor Results

Metric	Final Weight
Impervious Area Treated	10.6%
Pollutant Removal	10.6%
Combined Benefit	10.4%
Wetland Habitat Improvement	9.3%
Riparian Habitat Improvement	8.6%
Instream Habitat Improvement	7.9%

Metric	Final Weight
Channel Stabilization	7.5%
Fish Passage	6.2%
Proximity to MS4	5.7%
Channel Protection	5.7%
Water Quality Treatment	5.1%
Water/Stream Temperature	4.0%
Groundwater Recharge	3.1%
Public Visibility/Education/Outreach	3.1%
Community Aesthetic Improvement	2.4%
Total	100%
Design/Construction	20.9%
Maintenance Requirements	17.4%
Existing Utility Conflicts	17.4%
Access	14.0%
Permitting	12.8%
Ownership	9.3%
Adjacent Land Use	8.1%
Total	100%
Cost per Impervious Acre Treated	55.6%
Cost per Pollutant Removed	33.3%
Total Cost (full life cycle)	11.1%
Total	100%

Scoring

Quantitative metrics were scored based on results of the preliminary design and cost estimates (e.g. impervious area treated, pollutant removal). Other metrics were scored more qualitatively based on professional judgment and assessment of each project site (e.g. access constraints, public visibility/education/outreach).

Each project was assigned a score between 1 and 5 for each metric. Projects evaluated to have the most benefit received a score of 5, and those with the least benefit were given a score of 1. Constraints were evaluated in a similar fashion such that projects with more constraints were scored a 1, and those with the least were given a score of 5.

Project Benefits

Impervious acres restored was given the highest weight and scores were calculated by ranking the projects by impervious acres restored and then calculating the corresponding score.

Pollutant removal was given the second highest weight and pollutant removal scores were calculated by using the modeled total nitrogen, phosphorus, and sediment load reduction to rank each project. The ranking was then used to calculate a score for each project.

Combined benefit scores were calculated based on the number of projects within close proximity. Clustered projects received higher scores than isolated projects.

Wetland, riparian, and in-stream habitat scores were calculated based on the habitat benefit from each project. Generally, stream restoration projects received higher scores in these categories. Projects near or within wetlands got a higher wetland habitat score. Stream restoration and SPSC projects that would have tree planting associated with the project received higher scores for riparian habitat. All stream restoration projects received the highest score of 5 for in-stream habitat.

Channel stabilization was scored based on the type of project and level of increased channel stabilization anticipated. Stream restoration and SPSC projects were given scores of 5 and 4, respectively, however all other projects have no potential increased channel stability and were given scores of 1.

Projects that would address fish passage issues received higher scores for the fish passage metric. Only one stream restoration project (PT_SR_6) was associated with a fish passage issue, therefore this site received the highest score.

Scoring of the project proximity to MS4 gave higher scores to projects near MS4 drainage and lower scores to projects in agricultural land use.

Only the two SPSC projects (PT_SWM_1 and PT_SWM_13) would provide an increase in channel protection, therefore these projects were given the highest score of 5, and all other projects received scores of 1.

Water quality treatment scores were calculated by ranking the projects by rainfall depth treated and then calculating the corresponding score.

Water/stream temperature was scored based on project type. Stream restoration projects received higher scores if tree planting would be associated with the project. All reforestation projects received the highest score of 5. Stormwater management projects generally received moderate scores with the exception of the wet pond (PT_SWM_8), which would provide no benefit to water temperature.

Groundwater recharge was calculated for the stormwater management projects and scores were calculated based on these values. No other project type would provide groundwater recharge.

Public visibility/education/outreach was analyzed based on the proximity to a sidewalk, trail, parking lot, road, etc. and opportunity for interpretive signage.

Community aesthetic improvement scores were calculated based on the anticipated improvement of community appearance. Projects such as trash cleanups, stream restoration, and reforestation in highly visible areas received higher scores. Stormwater management projects were scored based on the project type and anticipated appearance of the facility and associated plantings.

Project Constraints

Design and construction constraints, such as site layout, topography, and elevations, were analyzed for each project. Projects that were identified as having steep slopes, nearby infrastructure, or other design and construction constraints received lower scores.

The degree of maintenance required for each project was estimated. Swales and biorentention projects generally require more maintenance and received lower scores, while trash cleanups, reforestation, and stream restoration projects generally require less maintenance and received higher scores.

Existing utility conflicts were assessed and scored. Majority of the projects did not have utility conflicts, however some sites were found to have underground and overhead electric, cable or telephone lines and subsequently received lower scores in this metric.

Ease of access was analyzed for each site. The presence of paved access roads or trails, or proximity to existing roads or parking lots was considered and scored accordingly.

Permitting requirements was evaluated for each project. Stream restoration and shoreline erosion control projects generally require extra permitting and received lower scores than the projects such as reforestation and trash cleanups.

Site ownership was identified and scored. Projects on private property received lower scores than those on public property.

Lastly, adjacent land use was determined and scored. Adjacent properties with land use not compatible with the project type received lower scores.

Project Costs

Project costs were calculated and ranked for each project in three categories: life cycle cost, cost per pollutant reduced, and cost per impervious area. Scores were calculated for each category and then averaged for the final project cost score.

Results

Weighting factors were applied to the scores for each metric. Total scores were then summed for each project for both the benefit and constraint categories and the projects ranked within each category. Projects were also ranked according to the cost metrics, including total project cost, cost per pollutant removed, and cost per impervious acre treated. A ranking for each metric category was assigned based on the results. The final ranking incorporates the results of the category rankings. The final prioritized list of projects is presented in Table 3.

Table 3: Port Tobacco Prioritization Ranking by Project Type

Project ID	Project Type	Benefits Rank	Constraints Rank	Cost Rank	Total Score	Final Rank
PT_SR_1	Stream Restoration	9	33.5	22	65	29.5
PT_SR_2	Stream Restoration	2	32	23	57	23
PT_SR_3	Stream Restoration	8	29	16	53	16.5
PT_SR_4	Stream Restoration	14	29	17	60	25
PT_SR_5	Stream Restoration	3	35	26	64	27.5
PT_SR_6	Stream Restoration	1	29	24	54	20
PT_SR_7	Stream Restoration	7	21	25	53	16.5
PT_SR_8	Stream Restoration	4	19	18	41	4
PT_SR_9	Stream Restoration	11	33.5	20	65	29.5
PT_TP_1	Reforestation	27	2.5	30	60	24
PT_TP_2	Reforestation	15	2.5	27	45	9
PT_TP_3	Reforestation	12	2.5	35	50	13
PT_TP_4	Reforestation	22	2.5	29	54	18
PT_TP_5	Reforestation	23	11	32	66	31.5
PT_TP_6	Reforestation	24	6	34	64	27.5
PT_SEC_1	Shoreline Erosion Control	10	17	11	38	1
PT_SWM_1	SPSC	5	15	19	39	2
PT_SWM_2	Bioretention	28	18	28	74	34
PT_SWM_3	Bioretention	34	14	15	63	26
PT_SWM_4	Swale	21	25	8	54	20
PT_SWM_5	Swale	18	25	9	52	15
PT_SWM_6	Swale	16	25	14	55	22
PT_SWM_7	Swale	19	25	10	54	20
PT_SWM_8	Wet Pond	17	36	13	66	31.5
PT_SWM_9	Swale	13	25	12	50	14
PT_SWM_10	Bioretention	20	16	36	72	33
PT_SWM_11	Bioretention	33	31	31	95	36
PT_SWM_12	Bioretention	32	22	33	87	35
PT_SWM_13	SPSC	6	20	21	47	10.5
PT_TC_1	Trash Cleanup	30	9	4	43	8
PT_TC_2	Trash Cleanup	35	9	4	48	12
PT_TC_3	Trash Cleanup	36	7	4	47	10.5
PT_TC_4	Trash Cleanup	31	5	4	40	3
PT_TC_5	Trash Cleanup	29	9	4	42	6
PT_TC_6	Trash Cleanup	26	12.5	4	42	6
PT_TC_7	Trash Cleanup	26	12.5	4	42	6

Table 4: Port Tobacco Prioritization Final Ranking

Project ID	Project Type	Final Rank
PT_SEC_1	Shoreline Erosion Control	1
PT_SWM_1	SPSC Priority	2
PT_TC_4	Trash Cleanup	3
PT_SR_8	Stream Restoration	4
PT_TC_5	Trash Cleanup	6
PT_TC_6	Trash Cleanup	6
PT_TC_7	Trash Cleanup	6
PT_TC_1	Trash Cleanup	8
PT_TP_2	Reforestation	9
PT_SWM_13	SPSC	10.5
PT_TC_3	Trash Cleanup	10.5
PT_TC_2	Trash Cleanup	12
PT_TP_3	Reforestation	13
PT_SWM_9	Swale	14
PT_SWM_5	Swale	15
PT_SR_3	Stream Restoration	16.5
PT_SR_7	Stream Restoration	16.5
PT_TP_4	Reforestation	18
PT_SR_6	Stream Restoration	20
PT_SWM_4	Swale	20
PT_SWM_7	Swale	20
PT_SWM_6	Swale	22
PT_SR_2	Stream Restoration	23
PT_TP_1	Reforestation	24
PT_SR_4	Stream Restoration	25
PT_SWM_3	Bioretention	26
PT_SR_5	Stream Restoration	27.5
PT_TP_6	Reforestation	27.5
PT_SR_1	Stream Restoration	29.5
PT_SR_9	Stream Restoration	29.5
PT_TP_5	Reforestation	31.5
PT_SWM_8	Wet Pond	31.5
PT_SWM_10	Bioretention	33
PT_SWM_2	Bioretention	34
PT_SWM_12	Bioretention	35
PT_SWM_11	Bioretention	36

Note: Lowest numerical value for each rank category is the highest ranked project