Charles County Municipal Stormwater Restoration Plan

Plan to Achieve Stormwater Waste Load Allocations and Impervious Surface Restoration

Charles County, Maryland

December 2017

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Compliance document for Part IV.E.2.a. and b. of MS4 Discharge Permit #11-DP-3322.

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Prepared For

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Acknowledgements

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AFG	Accounting for Growth
BayFAST	Bay Facility Assessment Scenario Tool
BMP	Best Management Practices
CBP	Chesapeake Bay Program
CIP	Capital Improvement Plan
CSO	Combined Sewer Overflow
CWA	Clean Water Act
DEL	Delivered
EOS	Edge of Stream
EPA	U.S. Environmental Protection Agency
ESD	Environmental Site Design
LULC	Land use / Land cover
MAST	Maryland Assessment Scenario Tool
MBSS	Maryland Biological Stream Survey
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MEP	Maximum Extent Practicable
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
SHA	State Highway Administration
SPSC	Step Pool Storm Conveyance
SSO	Sanitary Sewer Overflow
SW to MEP	Stormwater to the Maximum Extent Practicable
SW-WLA	Stormwater Wasteload Allocation
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
WIP	Watershed Implementation Plan
WLA	Wasteload Allocation
WQA	Water Quality Assessment
WWTP	Wastewater treatment plant

1 Introduction and Background

1.1 Purpose

Charles County, along with other large jurisdictions in Maryland, has been operating its municipal separate storm sewer system (MS4) under a National Pollutant Discharge Elimination System (NPDES) permit issued by the Maryland Department of the Environment (MDE). In recent years these permits and other stormwater regulations have been changing rapidly. The County's permit requires compliance with pollutant load limits from both the Chesapeake Bay Total Maximum Daily Load (TMDL) and local TMDLs and restoration of untreated impervious surfaces. The suite of allowable stormwater treatment options has also expanded beyond conventional stormwater best management practices (BMPs) to include alternatives such as street sweeping, catch basin cleaning, stream restoration, and tree planting.

On December 26, 2014, Charles County received a new NPDES MS4 Discharge Permit (11-DP-3322 MD0068365) from MDE that includes requirements for watershed restoration activities, specifically preparation of a restoration plan within the first year of the permit term (Section IV.E.2). To address this requirement, Charles County has developed this Restoration Plan that:

- Demonstrates ways to meet the Total Maximum Daily Load (TMDL) Stormwater Wasteload Allocations (SW-WLAs) approved by U.S. Environmental Protection Agency
- Illustrates a strategy to provide additional stormwater runoff management on impervious acres equal to 20% of the impervious area for which runoff is not currently managed to the Maximum Extent Practicable (MEP)
- Educates and involves residents, businesses, and stakeholders in achieving measurable water quality improvements
- Establishes a reporting framework for annual reporting under the County's MS4 permit
- Provides an evaluation and adaptive management process for developing actions to be taken if permit requirements are not met
- Identifies the funding needed to implement the Restoration Plan

1.2 Plan Development

MDE has prepared several guidance documents to assist municipalities with preparation of TMDL restoration plans. This plan is developed following the guidance detailed in the following documents with modifications as necessary:

- General Guidance for Developing a Stormwater Wasteload Allocation (SW-WLA) Implementation Plan (MDE, 2014d)
- Guidance for Using the Maryland Assessment Scenario Tool (MAST) to Develop Stormwater Wasteload Allocation Implementation Plans for Local Nitrogen, Phosphorus, and Sediment TMDLs (MDE, 2014b)
- Guidance for Developing Stormwater Wasteload Allocation Implementation Plans for Nutrient and Sediment Total Maximum Daily Loads (MDE, 2014e)
- Guidance for Developing a Stormwater Wasteload Allocation Implementation Plan for Bacteria Total Maximum Daily Loads (MDE, May 2014a)
- Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated (MDE, 2014c)
- Draft Maryland Trading and Offset policy and Guidance Manual, Chesapeake Bay Watershed (MDE, 2016)

It is noted that the Restoration Plan is an important first step; however, the MS4 permit calls for an iterative and adaptive plan for implementation. If new methods of stormwater treatment are identified, or better approaches to source control are found, the plans can be extended and updated to take the changes into account. Similarly, if some elements of the plans are not as successful as expected, adaptations and improvements will be incorporated in future updates. Plans may also change if pollutant removal crediting methods are modified in the future.

1.3 Charles County MS4 Permit

Section 402(p) of the Clean Water Act required the Environmental Protection Agency (EPA) to add MS4 discharges to the NPDES permit program. In 2002, EPA directed permit writers to include WLA requirements in NPDES permits, including those for MS4 discharges. Charles County is one of five medium jurisdictions in Maryland that is regulated by a NPDES MS4 Discharge Permit (Section 402(p) of the Water Quality Act of 1987 and NPDES Permit Application Regulations for Storm Water Discharges of November 16, 1990). Charles County's first permit went into effect on May 1, 1997 and the County received its third permit on December 26, 2014 (11-DP-3322 MD0068365). This third permit includes the following new requirements related to Restoration Plans, impervious surface treatment, and TMDLs among others.

Permit Requirements

One objective of this plan is to meet the County's MS4 NPDES permit requirement to restore 20% of the County's impervious surface area that has not already been restored to the MEP per permit section PART IV.E.2.a. Another objective is to develop restoration plans for local TMDLs, specifically each SW-WLA approved by EPA, prior to the effective date of the permit, per permit section PART IV.E.2.b. Plans must be developed within the first year of permit issuance. Charles County's final permit was issued on December 26, 2014 therefore the restoration plans was to be complete by December 26, 2015. An extension was granted by MDE and Charles County's plan is now due on June 30, 2016.

The following specific permit sections and language apply:

PART IV. Standard Permit Conditions

E. Restoration Plans and Total Maximum Daily Loads

2. Restoration Plans

a. Within one year of permit issuance, Charles County shall submit an impervious surface area assessment consistent with the methods described in the MDE document "Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated, Guidance for National Pollutant Discharge Elimination System Stormwater Permits" (MDE, June 2011 or subsequent versions). Upon approval by MDE, this impervious surface area assessment shall serve as the baseline for the restoration efforts required in this permit.

By the end of this permit term, Charles County shall commence and complete the implementation of restoration efforts for twenty percent of the County's impervious surface area consistent with the methodology described in the MDE document cited in PART IV.E.2.a. that has not already been restored to the MEP. Equivalent acres restored of impervious surfaces, through new retrofits or the retrofit of pre-2002 structural BMPs [Best Management Practices], shall be *based upon the treatment of the WQv criteria and associated list of practices defined in the 2000 Maryland Stormwater Design Manual. For alternate BMPs, the basis for calculation of equivalent impervious acres restored is based upon the pollutant loads from forested cover.*

b. *Within one year of permit issuance, Charles County shall submit to MDE for approval a restoration plan for each stormwater WLA approved by EPA prior to the effective date of the permit. The County shall submit restoration plans for subsequent TMDL WLAs within one year of EPA approval. Upon approval by MDE, these restoration plans will be enforceable under this permit. As part of the restoration plans, Charles County shall:*

    i. *Include the final date for meeting applicable WLAs and a detailed schedule for implementing all structural and nonstructural water quality improvement projects, enhanced stormwater management programs, and alternative stormwater control initiatives necessary for meeting applicable WLAs;*

    ii. *Provide detailed cost estimates for individual projects, programs, controls, and plan implementation;*

    iii. *Evaluate and track the implementation of restoration plans through monitoring or modeling to document the progress toward meeting established benchmarks, deadlines, and stormwater WLAs; and*

    iv. *Develop an ongoing, iterative process that continuously implements structural and nonstructural restoration projects, program enhancements, new and additional programs, and alternative BMPs where EPA approved TMDL stormwater WLAs are not being met according to the benchmarks and deadlines established as part of the County's watershed assessments.*

Further, the permit requires continual outreach to the public regarding the development of its watershed assessments and restoration plans and requires public participation in the TMDL process (permit section PART IV.E.3.a-d).

The permit requires an annual progress report presenting the assessment of the NPDES stormwater program based on the fiscal year. A TMDL assessment report including complete descriptions of the analytical methodology used to evaluate the effectiveness of the County’s restoration plans and how these plans are working to achieve compliance with EPA approved TMDLs is a component of the annual report. The assessment includes: estimated net change in pollutant load reductions from water quality improvement projects; a comparison of the net change to targets, deadlines, and applicable WLAs; cost data for completed projects; cost estimates for planned projects; and a description of a plan for implementing additional actions if targets, deadlines, and WLAs are not being met (permit section PART IV.E.4.a-e).

In addition to the standard permit conditions described above, the County is also required to address additional programmatic conditions specific to the Chesapeake Bay TMDL as outlined below:

PART VI. Special Programmatic Conditions

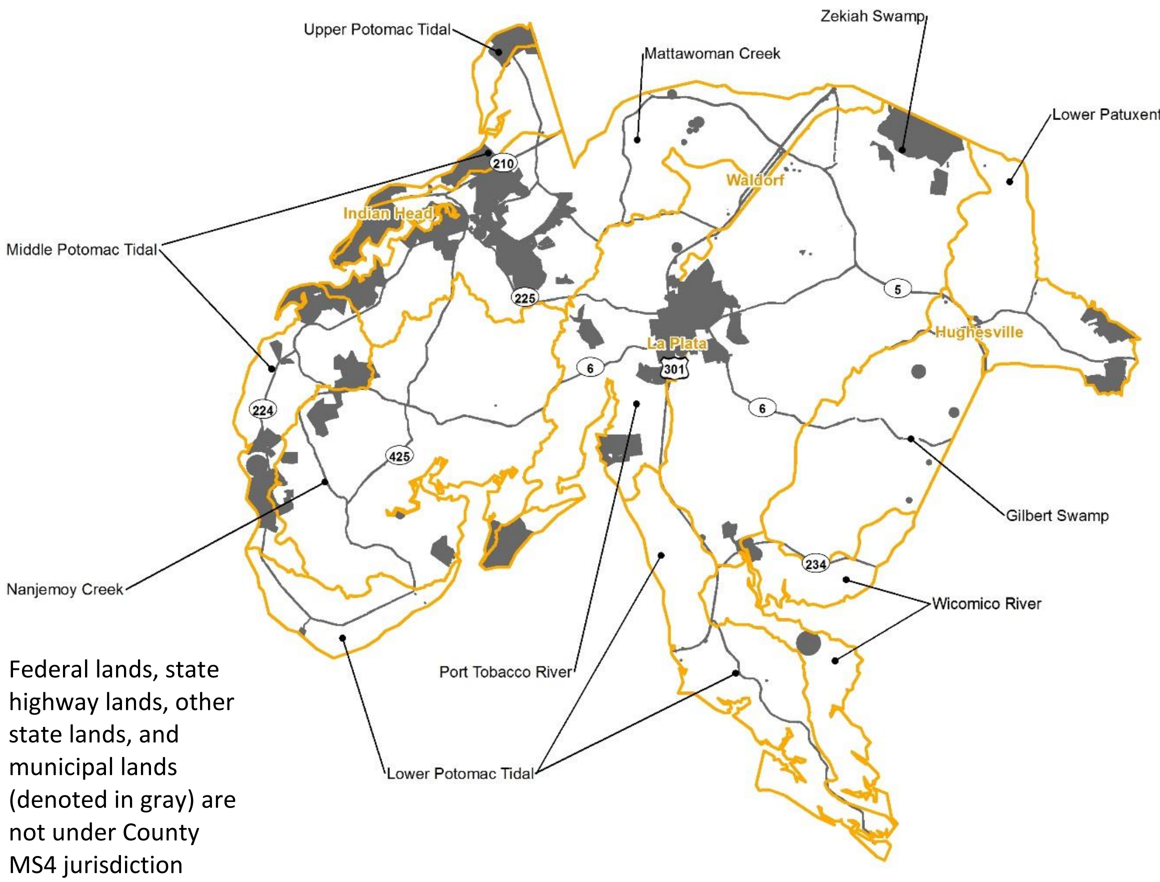
A. Chesapeake Bay Restoration by 2025

A Chesapeake Bay TMDL has been developed by the EPA for the six Bay States (Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia) and the District of Columbia. The TMDL describes the level of effort that will be necessary for meeting water quality criteria and restoring the Chesapeake Bay. This permit is requiring compliance with the Chesapeake Bay TMDL through the use of a strategy that calls for the restoration of twenty percent of previously developed impervious land with little or no controls within this five year permit term as described in Maryland's Watershed Implementation Plan. The TMDL is an aggregate of nonpoint sources or the load allocation (LA), and point sources or WLA, and a margin of safety. The State is required to issue NPDES permits to point source discharges that are consistent with the assumptions of any applicable TMDL, including those approved subsequent to permit issuance.

Urban stormwater is defined in the Clean Water Act (CWA) as a point source discharge and will subsequently be a part of Maryland's WLA. The NPDES stormwater permits can play a significant role in regulating pollutants from Maryland's urban sector and in the development of Chesapeake Bay Watershed Implementation Plans. Therefore, Maryland's NPDES stormwater permits issued to Charles County and other municipalities will require coordination with MDE's Watershed Implementation Plan and be used as the regulatory backbone for controlling urban pollutants toward meeting the Chesapeake Bay TMDL by 2025.

1.4 MS4 Permit Coverage

Under previous permits, MDE considered the area within the Charles County Development District as regulated area. MDE now considers the MS4 Permit for Charles County to be the entire county with the exception of lands which have their own NPDES stormwater permits (Figure 1) including federal lands, state highway lands, other state lands, and municipal lands. NPDES regulated industrial facilities are also excluded from the County's permit coverage. MDE notes that the inclusion of private and non-urban land in the MS4 permit is based on the rationale that stormwater management for private property in Maryland is locally administered for plan approval, inspection, and enforcement, and that these facilities are inherently a part of a locality's storm drain system. The County's SW-WLA responsibilities are only for those areas included in the MS4 area, as well as County properties within municipal boundaries.



Federal lands, state highway lands, other state lands, and municipal lands (denoted in gray) are not under County MS4 jurisdiction

Figure 1. County Watershed and MS4 Permit Area

1.5 Anticipated Growth

Future urban sector growth and the anticipated increase in urban loads that may result are expected to be controlled by two elements: stormwater management to the MEP that is required with new development, and anticipated "Accounting for Growth" policies. This Restoration Plan is developed to treat the reduction required from the initial baseline year load, calibrated to the current Bay model. Based on coordination with MDE, TMDL restoration planning should focus on the untreated and undertreated areas associated with the urban footprint at the time of the TMDL baseline. Future loads and loads potentially added to the urban sector since the baseline year to present are not accounted for here as they are addressed under other programs. MDE has requested in restoration plan development guidance (MDE, 2014d) that jurisdictions begin estimating potential additional loads, therefore estimates are included in section 1.5.2.

1.5.1 Offsetting Loads from Future Growth

Growth and development is expected to occur throughout Charles County, and depending on when and where this growth occurs, pollutant loading from urban stormwater sources may also increase. It is anticipated that new development will make use of Environmental Site Design (ESD) stormwater treatment according to MDE's Stormwater Regulations.

Maryland's 2007 Stormwater Management Act went into effect in October of 2007, with resulting changes to COMAR and the 2000 Maryland Stormwater Design Manual in May of 2009. The most significant changes relative to watershed planning are in regard to implementation of ESD. The 2007 Act defines ESD as "using small-scale stormwater management practices, nonstructural techniques, and better site planning to mimic natural hydrologic runoff characteristics and minimize the impact of land development on water resources."

The following section discusses projected land use loads with the application of stormwater BMPs to the maximum extent practicable (SW to the MEP). TMDL modeling efforts to estimate future loads include the application of SW to the MEP to represent ESD treatment for new development in the watershed. SW to the MEP will control 50%, 60%, and 90% of nitrogen, phosphorus, and sediment loads, respectively, for new development.

Anticipated "Accounting for Growth" policies will address the residual load (Total Nitrogen (TN): 50%, Total Phosphorus (TP): 40%, Total Suspended Solids (TSS): 10%, and bacteria: 30%) that is potentially uncontrolled by development-based stormwater controls. As required by the State's Watershed Implementation Plan (Bay Restoration Plan) Maryland is developing an Accounting for Growth (AFG) policy that will address the expected increase in the State's pollution load from increases in population growth and new development. While not currently a fully formed policy, the State's plan, as of the *Final Report of the Workgroup on Accounting for Growth in Maryland* (August 2013) focuses on two elements: 1) the strategic allotment of nutrients loads to large wastewater treatment plants, upgraded to the best available technology; and 2) the requirement that all other new loads must be offset by securing pollution credits.

1.5.2 Estimates of Future Growth

As stated in the MDE guidance document General Guidance for Developing a Stormwater Wasteload Allocation (SW-WLA) Implementation Plan, Section 1.h. (MDE, 2014d):

New urban areas that have been developed since TMDL allocations were set imply loads beyond the original SW-WLA (i.e., additional urban footprint within a watershed). This can confound the process of accounting for load reductions to meet the allocations. MDE is working to develop methods to deal with this issue. However, MDE is also recommending that within the SW-WLA implementation plans, local jurisdictions estimate this potential new urban load as the next step in a longer-term process to address the issue.

Therefore, Charles County has developed a basic estimate of increases in loads relative to the Bay TMDL at the Countywide scale, and for the two watersheds with SW-WLA, Mattawoman, and Indian Creek.

To estimate increases in loads over time for TN, TP and TSS, an analysis was completed using a combination of MAST modeled loads and projected loading estimates in addition to estimates based on recent growth patterns. The estimates were completed at the Countywide scale (i.e., sum of all watersheds) and for the Mattawoman Creek watershed. The average percent change in County Phase I MS4 urban land use acres (impervious and pervious acres) was calculated as the average percent change observed between MAST land use acres from 2010 through 2015. There was a 1.7% annual average Countywide increase in County Phase I MS4 urban land use acres observed between 2010 and 2015 (Table 1) and an average annual percent change of 0.8% for Mattawoman Creek (Table 4).

The pace of growth in loads is consistent with growth projections outlined in Charles County's Water Resources Element (WRE) (Charles County, 2011). The WRE is built upon projections developed by Maryland Department of Planning (MDP) in 2008. These projections indicate that County population will reach approximately 204,200 by the year 2030, which follows an annual increase of approximately 1.7 percent per year.

Of this growth, the proposed 2016 Charles County Comprehensive Plan indicates as of 2011, approximately 24,200 housing units are already in the pipeline as approved preliminary plans, other approved development projects and other envisioned projects. Projects with preliminary plan approval prior to May 4, 2010, were given grandfathering from current stormwater codes to allow them to be built under the stormwater codes of the original approval. However, the Stormwater Management Administrative Waiver expires on May 4, 2017, so unless the sediment and erosion control construction for the stormwater management facilities is completed and accepted by the County the current regulations will apply. Because of the pending waiver expiration, it is likely a portion of the projected housing units will be developed under current stormwater management regulations, which requires Environmental Site Design (ESD) to the maximum extent practical.

Projected TN, TP, and TSS Edge of Stream (EOS) and Delivered (DEL) loads were calculated by applying the average percent change observed between MAST loading results for County Phase I MS4 urban land (impervious and pervious acres) from 2010 through 2015 to loads of the previous year by watershed and Countywide.

Charles County average percent change in County Phase I MS4 background pollutant loads are shown in Table 2 which ranges from 1.5% to 1.9%. Average percent change in County Phase I MS4 background loads for watersheds with listed local TMDL pollutants are shown in Table 4 with an average percent change of 0.8% for Mattawoman Creek. In this manner, a 1.5% annual increase in TSS-EOS Countywide loads and a 0.8% annual increase in TP-EOS loads in Mattawoman Creek would be expected from 2015 to 2025 if development were to occur at the same rate and be implemented without BMPs. Because new development will implement BMPs under Maryland's stormwater regulations, the resultant loading increases were reduced by 50% for TN, 60% for TP, and 90% for TSS based on the MAST removal rates for nutrients and sediment treated by stormwater treatment to the maximum extent practicable (SW to the MEP). Projected loading with application of SW to the MEP was incorporated in both Bay and local TMDL modeling and is shown in Table 3 and Table 4. These additional loads are cumulative since 2015; for example, 2017 additional land use loads consists of additional loads for 2016 growth and 2017 growth.

Table 1. Charles County Average Annual Percent Change in County Phase I MS4 Urban Land Use Acres

County Phase I MS4 - Urban Land Use Acres	
2010	41,012
2015	44,515
Total % Change	8.5%
Average Annual % Change	1.7%

Table 2. Charles County Average Percent Change in County Phase I MS4 Background Pollutant Loads

No BMP County Phase I MS4 Urban Land Use Loads	TN EOS-lbs/yr	TN DEL-lbs/yr	TP EOS-lbs/yr	TP DEL-lbs/yr	TSS EOS-lbs/yr	TSS DEL-lbs/yr
2010	251,573	190,464	22,530	19,791	6,669,712	7,474,268
2015	272,801	208,247	24,304	21,415	7,159,666	8,061,608
Average % Change	1.7%	1.9%	1.6%	1.6%	1.5%	1.6%

Table 3. Additional Estimated Future Loads for Charles County Bay TMDL

Additional Land Use Loads - With SW to MEP	TN EOS-lbs/yr	TN DEL-lbs/yr	TP EOS-lbs/yr	TP DEL-lbs/yr	TSS EOS-lbs/yr	TSS DEL-lbs/yr
2017 Estimate	4,604	3,889	306	281	21,038	25,340
2019 Estimate	9,207	7,778	613	562	42,076	50,680
2025 Estimate	23,019	19,444	1,531	1,406	105,189	126,699

Additional loads are cumulative since 2015

Table 4. Mattawoman Creek Nutrient Local TMDLs – Estimated Future Increases in Land Use and Pollutant Loads

Year	MS4 Urban Land Use Acres	TN EOS-lbs/yr	TP EOS-lbs/yr
2010	12,173	74,838	6,782
2015	12,681	77,951	7,059
Total % Change	4.2%	4.2%	4.2%
Average Annual % Change	0.8%	0.8%	0.8%
Additional Land Use Loads - With SW to MEP		**TN EOS-lbs/yr**	**TP EOS-lbs/yr**
	2017 Estimate	2,626	176
	2019 Estimate	7,230	482
	2025 Estimate	21,041	1,401

Additional loads are cumulative since 2015

The average percent change in bacteria loads in the Indian Creek watershed was derived based on the number of septic systems in the watershed and the annual average percent increase in septic systems over time, extrapolated forward. Based on septic system GIS data, at the end of 2001, the TMDL baseline year, there were 299 residential dwelling units with septic systems. This number increased to 486 at the end of 2014, the last year data were available, an increase of 187 over the 13 year period (Table 5).

Table 5. Indian Creek Estimated Growth in Septic System Units

Year	New Units	Cumulative Total	Annual Percent Increase
2001	22	298	7.9%
2002	46	344	15.4%
2003	27	371	7.8%
2004	20	391	5.4%
2005	15	406	3.8%
2006	12	418	2.9%
2007	5	423	1.2%
2008	9	432	2.1%
2009	11	443	2.5%
2010	15	458	3.4%
2011	7	465	1.5%
2012	4	469	0.9%
2013	7	477	1.5%
2014	9	486	1.9%

Using a 10 year period from 2004 to 2014, there is an average 2.5% increase per year in new septic systems. Extrapolating the number of units forward to 2025 based on an annual increase of 2.5% results in a total 549 units as of 2019, the end of the current permit term, and 635 by 2025 (Table 6).

Table 6. Estimate Number of New Septic System Units

Year	New Units	Cumulative Total
2015-2019	63	549
2020-2025	86	635

1.6 Impairments, Water Quality, and Land Use/Land Cover

1.6.1 Impairments

Sources of water quality impairments vary across the landscape. The most common impairments in the urban environment are nutrients (nitrogen and phosphorus), sediment, bacteria, and impairment to the biological condition of streams. Impairments can have different implications for management. Impairments that cause a water body to not meet its designated use require the responsible jurisdiction to address the impairment to enable that water body to meet its designated use once again. The mechanism for this in Maryland is through the development and implementation of TMDLs.

1.6.2 Water Quality

Use Designations

Use classes for Maryland streams are defined in the Code of Maryland Regulations (COMAR) 26.08.02.02. For each use class there are several designated uses. Use Class I has the following designated uses: growth and propagation of fish (not trout), other aquatic life and wildlife; water contact sports; leisure activities involving direct contact with surface water; fishing; agricultural water supply; and industrial water supply. Use Class II refers to tidal waters and contains all of the designated uses of Use Class I with the addition of: propagation and harvesting of shellfish; seasonal migratory fish spawning and nursery use; seasonal shallow-water submerged aquatic vegetation use; open-water fish and shellfish use; and seasonal deep-channel refuge use. Use Class III contains all of the designated uses of Use Class I with the addition of the growth and propagation of trout. Use Class IV contains all of the designated uses of Use Class I and is also capable of supporting adult trout for a put-and-take fishery. Use classes with the '-P' suffix contain all of the designated uses of the use class with the addition of public water supply. Therefore, Use Class III-P has the designated uses of Use Class I with the addition of growth and propagation of trout, and public water supply.

The spatial extent for stream and impoundment use classes is defined in COMAR 26.08.02.08. A map of stream and impoundment use class for Charles County is presented in Figure 2. Use Classes within Charles County include Use Class I, Class I-P, and Class II. Use Class I streams within Charles County are defined as: tributaries to the Lower Patuxent River, Potomac River, Mattawoman Creek, Port Tobacco River, Wicomico River, Nanjemoy Creek not designated Use Class II, Zekiah Swamp and all tributaries, and Gilbert Swamp and all tributaries. The one Use Class I-P stream within Charles County is an unnamed tributary to Zekiah Swamp Run between the confluence with Piney Branch and Stoner Creek. Use Class II streams within Charles County are defined as: Lower Patuxent River and tributaries not designated Use Class I, Potomac River and tributaries not designated Use Class I, Mattawoman Creek and tributaries not designated Use Class I, Port Tobacco River and tributaries not designated Use Class I, Wicomico River and tributaries not designated Use Class I, and Nanjemoy Creek and tributaries not designated Use Class I. There are no Use Class II-P, III, III-P, IV, or IV-P streams in Charles County. Two impoundments in Charles County (Myrtle Grove Lake and Gilbert Run Lake) are listed at Use Class I.

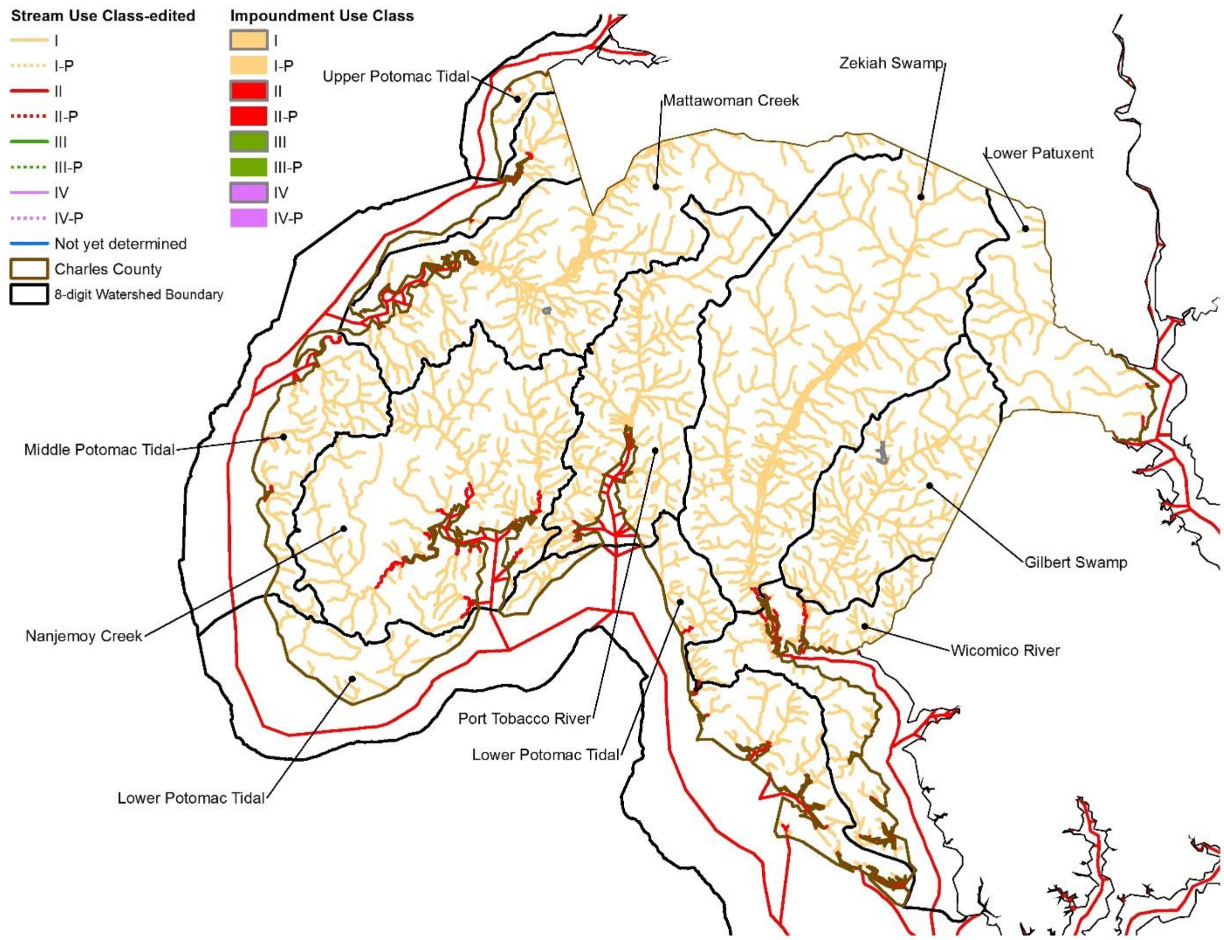


Figure 2. Charles County Stream and Impoundment Designated Use Classes

303(d) Impairments

According to Maryland's final 2014 list of impaired waters (MDE, 2015a), several segments within Charles County are listed for water quality impairments. A complete list of impairments for Charles County is shown in Table 13. Charles County contains ten Category 4a stream segments which include those waters that are not meeting their use designation but for which a TMDL has been developed to address impairments. Category 4a waters include four watersheds listed for sediment, seven watersheds listed for phosphorus, seven watersheds listed for nitrogen, one watershed listed for bacteria, and three watersheds listed for PCBs. Category 5 waters, which include those waters that are not meeting their use designation and require a TMDL, include five watersheds listed for an unknown pollutant (i.e., cause unknown), one watershed listed for chlorides, one watershed listed for low pH, one watershed listed for total suspended solids, one watershed listed for fecal coliform, one watershed listed for enterococcus, and two watersheds listed for PCB in fish tissue.

1.6.3 Biological Condition

The condition of Charles County's watersheds, as indicated by Benthic Index of Biotic Integrity (BIBI) scores, is shown in the following map of Maryland Biological Stream Survey (MBSS) stream monitoring results (Figure 3). While stream conditions vary across the county, degradation is more common where the urban area is more dense or older. This reflects, in part, the history of urban and suburban development prior to effective stormwater management regulations. Stream condition is generally better in the more rural parts of the county, but stream degradation still occurs in these areas as a likely result of large lot development and legacy agricultural impacts. By reducing the adverse effects of stormwater runoff throughout the county, this Restoration Plan should improve the condition of County streams and watersheds over time.

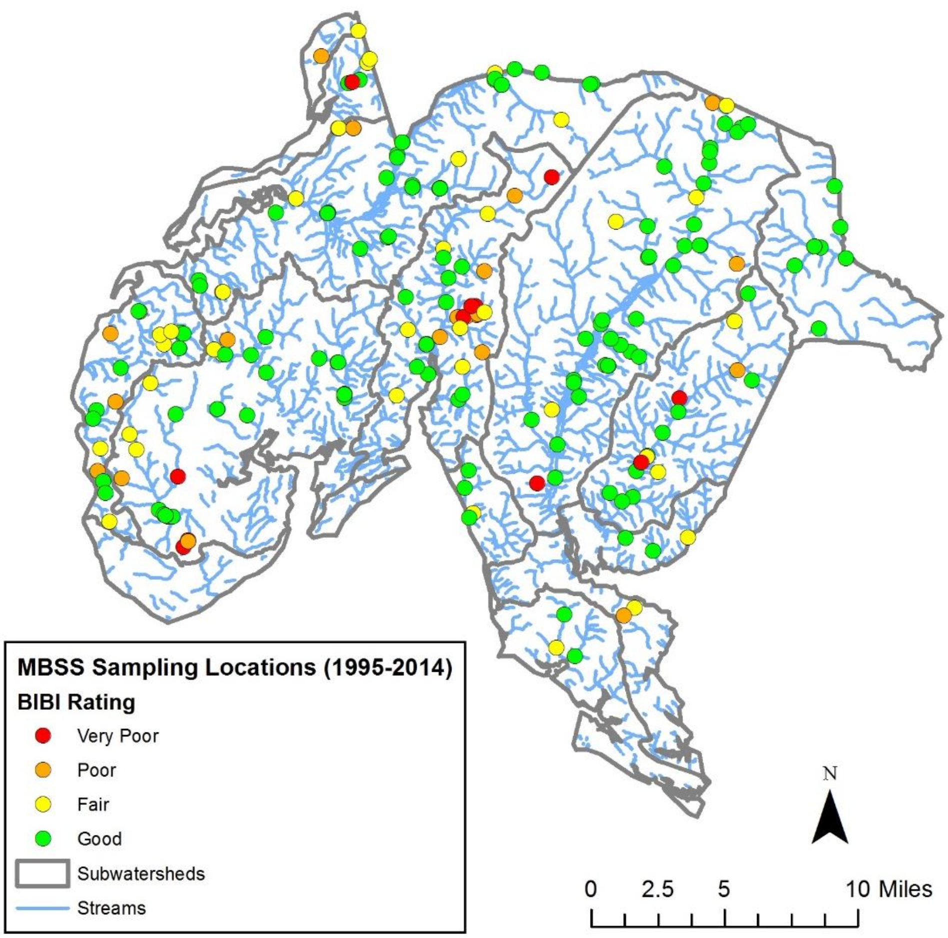


Figure 3. Condition of Charles County streams as indicated by sampling of benthic macroinvertebrate communities at random locations by Maryland DNR (1995 - 2014)

1.6.4 Land Use/Land Cover

The type and density of various land uses can have a dramatic effect on water quality and stream habitat. Forested areas slow stormwater flow and allow water to gradually seep into soils and drain into streams. Vegetation and soils bind nutrients and pollutants found within stormwater—improving water quality as it infiltrates the ground. Developed areas, with a high percentage of impervious surfaces (buildings, paved roads, parking lots, etc.), do not reduce either the volume or flow of stormwater—increasing the amount of pollutants entering streams. Increased storm flow affects stream habitat negatively by increasing bank erosion and decreasing instream and riparian habitat. Agricultural land, if managed incorrectly, can also impair streams with increases nutrients and bacteria.

Land use / land cover (LULC) data from Maryland Department of Planning (MDP, 2010) is presented in Figure 4. Data presented in the figure and tables below were used to characterize the County and show potential pollution sources. These LULC data were not used in the calculations of loads and load reduction, which were based instead on the land-river segment scale from the Chesapeake Bay Program Partnership Watershed Model.

Existing Land Use/Land Cover

According to 2010 LULC data (Table 7), the largest category in Charles County is forest (55.5%) followed by urban, or developed land (24.8%) and agriculture (16.3%). Developed land largely consists of residential (low-density 11.2%, large lot subdivisions (large lot agriculture 1.5%, large lot forest 4.8%, and medium-density 2.9%). Residential areas as a total make up 21.1% of the County.

Land use / land cover data are summarized by watershed in Table 8. The watershed in Charles County with the largest percentage of urban land is Mattawoman Creek (39.5%) followed by Patuxent River Lower (38.9%) and Port Tobacco River (33.0%). The watershed with the least amount of urban land is Wicomico River (7.5%), followed by Potomac River Lower Tidal (12.7%), and Nanjemoy Creek (14.7%). Potomac River Middle and Upper Tidal (72.7% and 72.6%, respectively) are the watersheds with the largest portion of forested land. Wicomico River (35.0%) and Gilbert Swamp (25.9%) are the watersheds with the largest amount of agricultural lands.

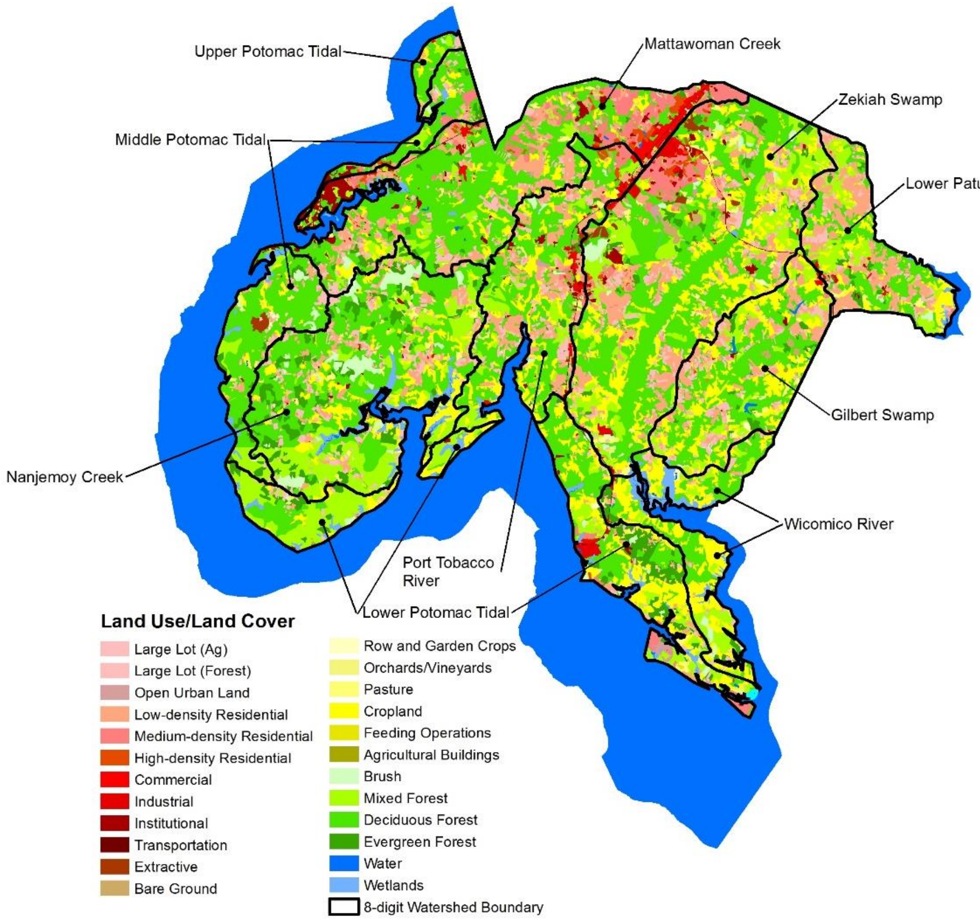


Figure 4. Countywide Land Use/Land Cover (MDP, 2010)

Table 7. Countywide Land Use/Land Cover (MDP, 2010)

Land Use / Land Cover	Acres	Percent
Urban	**73,220.1**	**24.8%**
Large lot subdivision (agriculture)	4,374.9	1.5%
Large lot subdivision (forest)	14,269.1	4.8%
Low-density residential	33,142.3	11.2%
Medium-density residential	8,637.1	2.9%
High-density residential	1,803.2	0.6%
Open urban land	912.7	0.3%
Commercial	3,185.5	1.1%
Industrial	1,234.2	0.4%
Institutional	4,027.2	1.4%
Extractive	1,039.5	0.4%
Transportation	594.4	0.2%
Agriculture	**48,189.4**	**16.3%**
Cropland	43,214.8	14.6%
Pasture	4,009.3	1.4%
Orchards/vineyards/horticulture	72.3	0.0%
Row and garden crops	390.8	0.1%
Feeding operations	390.9	0.1%
Agricultural building	111.4	0.0%
Forest	**163,840.0**	**55.5%**
Deciduous forest	108,565.1	36.8%
Evergreen forest	12,998.2	4.4%
Mixed forest	36,583.4	12.4%
Brush	5,693.3	1.9%
Water	**2,178.9**	**0.7%**
Other	**7,791.2**	**2.6%**
Wetlands	6,419.2	2.2%
Bare ground	1,372.0	0.5%
Total	**295,219.6**	**100.0%**

Table 8. Land Use/Land Cover (MDP, 2010) and Impervious Cover (2011) by Watershed

Watershed	Urban		Agriculture		Forest		Water		Other		Imperviousness	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Gilbert Swamp	6,208.3	25.0%	6,427.1	25.9%	11,800.3	47.5%	204.1	0.8%	217.5	0.9%	1,010.7	4.1%
Mattawoman Creek	17,614.5	39.5%	3,275.6	7.3%	22,836.8	51.2%	219.3	0.5%	674.2	1.5%	4,323.5	9.7%
Nanjemoy Creek	6,868.1	14.7%	5,791.7	12.4%	32,042.1	68.4%	246.2	0.5%	1,891.1	4.0%	903.3	1.9%
Patuxent River Lower	7,009.9	38.9%	2,575.6	14.3%	8,018.7	44.5%	75.8	0.4%	325.0	1.8%	839.8	4.6%
Port Tobacco River	9,263.8	33.0%	4,444.1	15.8%	13,977.3	49.8%	100.6	0.4%	304.1	1.1%	1,961.5	7.0%
Potomac River L Tidal	3,826.8	12.7%	6,717.3	22.3%	17,698.8	58.7%	675.9	2.2%	1,236.6	4.1%	945.2	3.1%
Potomac River M Tidal	3,250.2	16.7%	1,132.8	5.8%	14,145.3	72.7%	353.3	1.8%	587.7	3.0%	621.5	3.2%
Potomac River U Tidal	314.9	15.4%	190.6	9.3%	1,486.9	72.6%	44.2	2.2%	10.2	0.5%	48.1	2.3%
Wicomico River	1,201.6	7.5%	5,588.8	35.0%	7,212.5	45.2%	234.9	1.5%	1,708.4	10.7%	388.7	2.4%
Zekiah Swamp	7,662.1	27.1%	2,045.9	18.5%	4,621.3	53.1%	24.7	0.0%	836.5	1.3%	3,841.5	5.9%

1.7 Watershed Planning Approach

This plan is developed within the context of on-going watershed management planning, restoration, and resource protection being conducted by Charles County. Watershed assessments and impervious surface restoration plans have been completed for portions of the County and additional assessments are scheduled for the future.

Information synthesized and incorporated into this plan draws upon the sources listed below with updates and additions where necessary to meet the specific goals of the SW-WLAs and impervious restoration goals.

In addition, the plan draws upon the County's Charles County Phase II Watershed Implementation Plan Strategy (WIP) (LimnoTech, 2013).

1.7.1 Watershed Assessments

This section describes Charles County's watershed-based planning process to address watershed impairments. Charles County initiated its current watershed assessment approach in 2014 with the Port Tobacco Watershed assessment. Table 9 lists the completed watershed assessments and those that are planned. In 2016, Charles County is planning to complete watershed assessments similar to those completed in 2014 and 2015 in Zekiah Swamp, Gilbert Swamp, and Wicomico River watersheds. Data and results from the Port Tobacco, Mattawoman, and Lower Patuxent assessments were completed in time to be available to support this restoration plan. Results, projects, and programs identified in the upcoming assessments will be incorporated into future updates to the plan.

Table 9. Watershed Assessment Schedule

Year	Included County Watersheds	Status
2014	Port Tobacco	Completed 2015
2015	Mattawoman Creek Lower Patuxent River	Completed 2016
2016	Zekiah Swamp Gilbert Run Wicomico River	To be complete 2016
2017	Potomac River Upper Potomac River Middle Potomac River Lower Nanjemoy Creek	To be complete 2017

The following assessments were conducted throughout the watersheds:

- Upland Assessments
- Nutrient Synoptic Survey
- Stream Corridor Assessment

The primary goal of the assessments is to identify impacted, untreated and degraded areas in need of treatment and restoration. A desktop analysis was first conducted to identify those areas that had the highest potential for both impairment and restoration. The evaluation included land use, previous stream assessment results, impervious surface data, stormdrain network mapping, and location and type of existing BMPs.

The upland assessments included both the Neighborhood Source Assessment (NSA) and Hotspot Site Investigations (HSI). Upland pollution sources and restoration opportunities were identified following the methodology detailed in the Center for Watershed Protection's Unified Subwatershed and Site Reconnaissance Manual (CWP, 2004).

Synoptic water quality sampling was performed across the watersheds. Grab samples were collected from each site for laboratory analysis of water quality parameters and stream discharge measurements were collected in order to calculate instantaneous baseflow pollutant loads.

Stream corridor assessments (SCA) were conducted throughout the watersheds, using standard SCA protocols outlined in Stream Corridor Assessment Survey: SCA Survey Protocols (Yetman, 2001). The field team collected information on channel alternation, 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). 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 outfall stabilization, riparian buffer enhancement or replacement, stream restoration, BMP retrofit, or new stormwater management opportunities. Table 10 displays the number of HSI and NSA sites, synoptic sites, and SCA reaches assessed in each watershed completed to date.

Table 10. Upland Assessment Sites, Synoptic Sites, and SCA Reaches Assessed per Watershed

Year	Watershed	HSI Sites	NSA Sites	Synoptic Sites	SCA Reaches (miles)
2014	Port Tobacco	26	15	47	8
2015	Mattawoman Creek	21	10	51	6
2015	Lower Patuxent	1	4	14	2

Results of the desktop and field watershed assessments were compiled and 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;

- Reforestation;
- Environmental site design;
- Street sweeping;
- Storm drain cleaning (inlet or catch basin cleaning);
- Trash clean-up;
- Homeowner practices (rain barrels, rain gardens, downspout disconnect)

1.7.2 Impervious Surface Restoration Assessment

The County initiated a series of NPDES MS4 Retrofit Studies to specifically identify structural stormwater projects that would result in progress towards meeting the 20% impervious surface restoration goal. Assessments were completed previously in the County's Development District in 2004, 2007 and 2011. More recent assessments were initiated in 2014 in the Mattawoman, Port Tobacco, Nanjemoy, Zekiah, and Potomac River watersheds. In addition the County completed more targeted assessments at a variety of sites, at a variety of scales to further identify projects. These include assessments at several County school properties, in specific neighborhoods and residential subdivisions, at parks and at other Charles County owned properties.

Results of these assessments are included in this restoration plan. These primary sources include:

- Subwatersheds within Charles County Development District (KCI, 2004; KCI, 2007; KCI, 2011)
- Acton-Hamilton Watershed NPDES Watershed Restoration Concept Study (Vista, 2015)
- Stormwater Management Assessments (various school properties) (GMB, 2014a-d)
- Stormwater Management Assessments (Ruth Swann Park) (GMB, 2014e)
- Lower Patuxent River (BayLand, 2014a)
- Countywide Shoreline Management (BayLand, 2014b)
- Mattawoman Creek (Vista, 2015b)
- Port Tobacco River (Vista, 2015c)
- Upper Zekiah Swamp (BayLand, 2015a)
- Countywide Retrofit Plan for 20% Treatment (Vista, 2015d)
- Stormwater Management Assessment, Potomac River Watershed Residential Subdivisions (GMB, 2015f)
- Potomac River & Nanjemoy Creek Watersheds MS4 Retrofit Investigation (BayLand, 2015b)
- Waldorf Urban Development Corridor Concept (70%) SWM Master Plan Report (BAI, 2016)

1.8 Best Management Practices

This section describes the stormwater BMPs that are being used by Charles County currently and are planned for additional implementation.

Many stormwater BMPs address both water quantity and quality, however, some BMPs are more effective at reducing particular pollutants than others. The stormwater practices listed below keep the focus on "green technology" to reduce the impacts of stormwater runoff from impervious surfaces. These BMPs were selected specifically for three reasons: 1) effectiveness for water quality improvement, 2) willingness among the public to adopt, and 3) implementable in multiple facility types without limitations by zoning or other controls.

These practices are consistent with those currently being implemented by Charles County as water quality improvement projects. The County has the technical expertise, operational capacity, and system resources in place to site, design, construct and maintain these practices.

The recommended practices are also consistent with those proposed in the County's Phase II Watershed Implementation Plan (WIP) for the Chesapeake Bay TMDL and in the County's comprehensive watershed planning efforts. Exceptions to this are dry ponds which include dry detention ponds and dry extended detention ponds. These practices are no longer considered for future implementation; however, there are many existing facilities that are still actively treating runoff throughout the County so they are described here as well.

The BMPs in this section are organized into structural practices and operational programs.

1.8.1 Structural Practices

Structural practices are those that have a physical setting, require design and construction to implement, and require maintenance over time to ensure they are functioning properly. Primary examples of structural practices are listed here with brief descriptions.

- **Bioretention** - An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. Rain gardens may be engineered to perform as a bioretention.
- **Bioswales** - An open channel conveyance that functions similarly to bioretention. Unlike other open channel designs, there is additional treatment through filter media and infiltration into the soil.
- **Dry Detention Ponds** - Depressions or basins created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow. MAST modeling includes hydrodynamic structures in this category. These devices are designed to improve quality of stormwater using features such as swirl concentrators, grit chambers, oil barriers, baffles, micropools, and absorbent pads to remove sediments, nutrients, metals, organic chemicals, or oil and grease from urban runoff.
- **Dry Extended Detention Ponds** - Depressions created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms. They are similar in construction and function to dry detention basins, except that the duration of detention of stormwater is designed to be longer, allowing additional wet sedimentation to improve treatment effectiveness.
- **Impervious Surface Reduction** - Reducing impervious surfaces to promote infiltration and percolation of runoff storm water. Disconnection of rooftop and non-rooftop runoff, rainwater harvesting (e.g., rain barrels), and sheetflow to conservation areas are credited as impervious surface reduction.
- **Infiltration** - A depression or trench to form a shallow basin where sediment is trapped and stormwater infiltrates into the soil. No underdrains are associated with infiltration basins and trenches, because by definition these systems provide complete infiltration. Design specifications require infiltration basins and trenches to be built in good soil; they are not constructed on poor soils, such as C and D soil types. Yearly inspections to determine if the basin

or trench is still infiltrating runoff are planned. Dry wells, infiltration basins, infiltration trenches, and landscaped infiltration are all examples of this practice type.

- **Outfall Enhancement with Step Pool Storm Conveyance (SPSC)** - The SPSC is designed to stabilize outfalls and provide water quality treatment through pool, subsurface flow, and vegetative uptake. The retrofits promote infiltration and reduce stormwater velocities. This strategy is modeled in MAST as SW to the MEP. Bacteria reductions for this practice are modeled as a sand filter.
- **Outfall Stabilization** - Outfall stabilization methods such as bioengineering, rip-rap, and grade control structures address erosion issues at outfalls and associated outfall channels.
- **Permeable Pavement -** Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain.
- **Stream Restoration -** Stream restoration in urban areas is used to restore the urban stream ecosystem by restoring the natural hydrology and landscape of a stream, help improve habitat and water quality conditions in degraded streams.
- **Stormwater Retrofits -** Stormwater retrofits may include converting dry ponds, dry extended detention ponds, or wet extended detention ponds into wet pond structures, wetlands, infiltration basins, or decommissioning the pond entirely to install SPSC (step pool storm conveyance).
- **Urban Filtering** - Practices that capture and temporarily store runoff and pass it through a filter bed of either sand or an organic media. There are various sand filter designs, such as above ground, below ground, perimeter, etc. An organic media filter uses another medium besides sand to enhance pollutant removal for many compounds due to the increased cation exchange capacity achieved by increasing the organic matter. These systems require yearly inspection and maintenance to receive pollutant reduction credit.
- **Urban Tree Plantings** - Urban tree planting is planting trees on urban pervious areas at a rate that would produce a forest-like condition over time. The intent of the planting is to eventually convert the urban area to forest. If the trees are planted as part of the urban landscape, with no intention to covert the area to forest, then this would not count as urban tree planting. The planting area must be at least 0.25 acres and have 100 trees per acre with at least 50% of the trees having a DBH (diameter at breast height) of 2 inches or greater (MDE, 2014c).
- **Vegetated Open Channels** - Open channels are practices that convey stormwater runoff and provide treatment as the water is conveyed, includes bioswales. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils.
- **Wet ponds or wetlands** - A water impoundment structure that intercepts stormwater runoff then releases it at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached pollutants. Until 2002 in Maryland, these practices were generally designed to meet water quantity, not water quality objectives. There is little or no vegetation within the pooled area nor are outfalls directed through vegetated areas prior to open water release. Nitrogen reduction is minimal, but phosphorus and sediment are reduced.

1.8.2 Operation and Programmatic Practices

Along with the standard set of structural BMPs listed above, treatment will also be provided through non-structural measures. These include programs that often require on-going implementation to maintain the treatment, load reduction and impervious surface credit. The following strategies are performed through the programs listed below:

Street Sweeping

Street sweeping is an operational program that the County is actively engaged in and will continue to perform. Street sweeping at regular intervals can remove pollutants from the pavement before it can be washed off into the storm drain system and into local waterways by rainfall. According to MDE's guidance document (2014a), mechanical street sweeping at a bi-weekly or twice monthly rate reduces the load on the swept area by TN 4% / TP 4% / TSS 10%. This frequent sweeping of the same street will reduce nitrogen and phosphorus as well as sediment.

New crediting guidance from the Chesapeake Bay Program (CBP, 2015) indicates that some credit can be obtained for sweeping at a frequency of at least 10 times per year for mechanical street sweeping; however, the credits are very low at 0.1% for TSS and 0% for TN and TP. Even mechanical sweeping at twice a week (100 times per year) is low in removal rates with 0.7% for TSS and 0% for TN and TP. Use of sweepers with Advanced Sweeping Technology (AST) yields much better removal according to the guidance, at up to TN 4% / TP 10% / TSS 21% for 100 times per year. AST is defined as sweepers classified as either Regenerative-Air Sweepers (RAS) or Vacuum Assisted Sweepers (VAS).

Currently, the County uses mechanical broom sweepers (MBS) for all of its street sweeping. The current frequency and technology used would not receive any credit under either of the guidance and crediting methods mentioned above; therefore the County has used a mass loading approach to calculate removal (Schueler et al., 2015). In this manner the mass of material removed by the sweeping is applied to values for pounds of pollutant reduced per dry ton of swept material to determine the overall removal. The reduction factors are from MDE guidance (MDE, 2014c) and are TN = 3.5 lbs/ton, TP = 1.4 lbs/ton and TSS = 420 lbs/ton. The impervious acre credit equivalency is 0.4 acres treated per ton of material removed.

Storm Drain Cleaning

Storm drain cleaning (also termed inlet cleaning, catch basin cleaning or vacuuming) is another operational program that the County actively performs in several watersheds and will continue to implement. Similar to street sweeping, catch basin cleaning can removal pollutants from storm drains before it can be washed into local waterways by rainfall. A mass loading approach using dry tons was used to determine reductions. Following MDE guidance (MDE, 2014c) the following factors were used per ton of material removed: TN = 3.5 lbs/ton, TP = 1.4 lbs/ton and TSS = 420 lbs/ton. The impervious acre credit equivalency is 0.4 acres treated per ton of material removed.

Septic Systems

Septic system maintenance (pump-outs), upgrades and waste water treatment plant connections are methods to reduce impacts from septic systems, especially for nitrogen as septic systems can be a major contributor of nitrogen. These septic practices are credited towards impervious surface reductions for NPDES MS4 impervious restoration; however credits for TN, TP and TSS reductions for septic system programs are not typically given by MDE for the urban stormwater sector for TMDL compliance. Pollution removal credits to the County for septic programs would typically fall under the waste water sector and are therefore not generally accounted for stormwater sector restoration plans which focuses on stormwater treatment. Because septic loads were not dealt with specifically in the Mattawoman TMDL as a unique source, the loads were distributed to other sectors including the stormwater section, therefore Charles County would like to include septic systems into the restoration plan for Mattawoman Creek. Refer to section 2.1 on Mattawoman Creek sources and the associated restoration plan for more details. The County is also using septic practice to meet the bacteria reductions required in the Lower Patuxent (Indian Creek) in section 2.2. The County is not counting septic practices towards the Bay TMDL progress. To summarize, Charles County is accounting for credit for impervious surface restoration, bacteria reduction, and Mattawoman Creek TN reductions for three septic system activities described here:

Septic Connection. This practice involves abandoning an existing septic system and connecting the wastewater source to public sewer. This reduces the bacteria load from both working and failed systems because the waste is sent into the sewer and treated at a wastewater treatment plant. For impervious area accounting, 0.39 equivalent acres would be credited for each septic system connected to a wastewater treatment plant (WWTP). Septic system connections have a load reduction effectiveness of 90% per connection for TN.

Septic Pumping. On average, septic tanks need to be pumped once every three to five years to maintain effectiveness. The pumping of septic tanks is one of several measures that can be implemented to protect soil absorption systems from failure. When septic tanks are pumped and sewage removed, the septic system’s capacity to remove pollutants from wastewater is increased. Septic pump-outs, that are part of a regular septic system maintenance program, provide 0.03 equivalent acres of restoration when a system is maintained and verified annually. However, there is no additional bacteria removal from pump-outs. Septic pump-outs have a load reduction effectiveness of 5% per pump-out for TN.

Septic Denitrification. This practice involves the replacement of traditional septic systems with more advanced systems that have additional nitrogen removal capabilities. An enhanced septic system can provide further treatment of nitrogen through processes that encourage denitrification of the wastewater. Denitrification systems do not improve bacteria reduction over conventional systems; however when installed to replace a failed conventional system there is a significant improvement. Septic upgrades to install enhanced septic denitrification technologies result in a permanent credit of 0.26 equivalent acres for each upgrade completed. Septic upgrades have a load reduction effectiveness of 50% per upgrade for TN.

Pet Waste Outreach

Pet Waste. Failure to clean up after a dog can cause both water quality and public health problems. Pet waste outreach programs include education efforts which increase public recognition about the water quality and health problems from consequences of dog waste. They may also include more active approaches including establishing dog parks and providing bags and disposal facilities in residential common areas.

ISA Baseline Reduction

Charles County has many lakes, impoundments, reservoirs and amenity ponds that are providing water quality volume reduction and pollution attenuation and treatment and therefore should be credited for impervious surface restoration and pollutant load reduction. These ponds will be brought up to standards and entered into the County's maintenance system. Credit will be taken as ISA baseline reductions since they were present during the 2000 baseline. Credit is calculated as 20% of the ISA treatment provided.

Homeowner Programs

Rain Barrel Program

Charles County currently operates a rain barrel program and provides financial assistance and incentives for property owners to implement the practice. A rain barrel is a small-scale conservation practice that collects and stores rooftop water runoff for future use to irrigate lawns, gardens and other non-potable water uses. By capturing water from downspouts that would otherwise discharge onto a paved surface, rain barrels can reduce the amount of runoff and pollutants reaching local streams and waterways. It is estimated that during summer months, nearly 40% of household water use is for lawn and garden watering. Using a rain barrel may save the average household up to 1300 gallons of water a year.

The County offers a program to quality residents for a 50% credit on their Watershed Protection and Restoration Fee (WPRF) by installing two rain barrels on their home, totaling 110 gallons of stormwater capture. The credit is good for three years and can be renewed if the system is verified to be operating correctly. Participants are asked to register their rain barrels using the University of Maryland's SMART Tool. http://extension.umd.edu/watershed/smart-tool Long term maintenance of rain barrels will be ensured through the application process for the WPRF credit. Every three years the homeowners will be required to conduct an inspection of their rain barrel(s) and report to the County that they are in operating condition in order to qualify for the credit.

Credit for rain barrels is given for pollutant reduction using land use loading rates with treatment percentages following removal curves in MDE guidance (MDE, 2014c). Impervious surface treatment is based on the roof square footage and inches of rainfall treated per rain barrel, with a 0.75 factor applied relating rain barrels to impervious surface treatment (Goulet and Schueler, 2014). The assumed number of homes to participate per assessed neighborhood and average roof size per neighborhood were used to determine the total impervious surface treated.

Rain Gardens and Pervious Paving

Charles County is encouraging homeowners to install and maintain rain gardens and pervious paving on their properties to address stormwater runoff. Credit of 50% off the WPRF is given for rain gardens capturing runoff from at least 800 square feet of impervious surface and for pervious pavement totaling at least 800 square feet. The credit is good for three years and can be renewed if the rain garden or pervious paving is maintained and functioning. The pollutant removal rates for rain gardens are dependent on the specific size and volume of the facility compared to the runoff to be treated. Pollutant removal rates for pervious pavement is calculated based on the area of pervious pavement and storage depth. Removal rates and impervious treatment are derived from Goulet and Schueler, 2014 and shown in the following section. Similar to rain barrels, the assumed number of homes to participate per assessed neighborhood and average roof size per neighborhood were used to determine the total impervious surface treated.

1.8.3 Implementation Levels

The County's identified structural projects have been organized in a tiered "Level" system to track their progress from project identification to concept, design, construction and completion. Appendix A includes the full Master list of County projects organized by Level and by watershed. Level 8 projects are considered alternates and lower priority than those identified in levels 2-7 based primarily on factors related to cost per impervious acre treated. Level 9 projects are those identified by KCI in 2015 and 2016 that will need to be added to the full prioritization to determine which projects are most feasible, beneficial and cost effective.

- Level 1 - Completed
- Level 2 – In Construction
- Level 3 – In Full Design
- Level 4 – County Maintenance / Alternative BMP Projects
- Level 5 – Existing SWM Facility Inspection/Upgrades
- Level 6 – Feasibility and Concept Design Projects (County NTP)
- Level 7 – Feasibility and Concept Design Projects (Med. Priority)
- Level 8 - Alternate Feasibility and Concept Design Projects
- Level 9 – Additional Sites Identified in KCI Watershed Assessment

1.8.4 Pollutant Reductions and Impervious Credits

The measured effectiveness and impervious equivalency for each of these practices may be found in Table 11 and Table 12.

Table 11. Typical Pollutant Reductions from Structural and Non-Structural BMPs

BMP	Nitrogen	Phosphorus	Sediment	Bacteria
Bioretention A/B soils	70%	75%	80%	65%
Bioretention C/D soils	25%	45%	55%	65%
Bioswales	70%	75%	80%	-4%
Dry Detention Ponds	5%	10%	10%	60%
Dry Extended Detention Ponds	20%	20%	60%	60%
Impervious Surface Reduction [1]	-	-	-	-
Infiltration w/ sand, veg.	85%	85%	95%	90%
Infiltration w/o sand, veg.	80%	85%	95%	90%
Outfall Enhancement with SPSC [2]	50%	60%	90%	70%
Permeable Pavement w/ sand, veg.	80%	80%	85%	58%
Permeable Pavement w/o sand, veg.	75%	80%	85%	-
Rain Barrels	28%	33%	0%	0%
Rain Garden	60%	70%	0%	0%
Septic Connections [3]	90%	0%	0%	varies
Septic Upgrades [3]	50%	0%	0%	varies
Septic Pump-outs [3]	5%	0%	0%	varies

BMP	Nitrogen	Phosphorus	Sediment	Bacteria
Storm Drain Cleaning	3.5 lbs/ton swept	1.4 lbs/ton swept	420 lbs/ton swept	-
Stream Restoration	0.08 lbs/ linear ft	0.07 lbs/ linear ft	44.88 lbs/ linear ft	-
Street Sweeping	3.5 lbs/ton swept	1.4 lbs/ton swept	420 lbs/ton swept	-
Urban Filtering	40%	60%	80%	58%
Urban Tree Plantings[1]	-	-	-	-
Vegetated Open Channels	45%	45%	70%	-
Wet Ponds or Wetlands	20%	45%	60%	84%

Sources: MDE, 2014c; Maryland Assessment Scenario Tool (MAST) documentation; International Stormwater BMP Database, Watershed Treatment Model

[1] Calculated as a land use change to a lower loading land use. [2] Outfall enhancement with SPSC modeled as SW to the MEP in MAST for nutrients and sediment and as sand filters for bacteria. [3] Septic practices are not counted towards the Bay TMDL progress. Septic practices are credited for impervious surface restoration, bacteria reduction, and Mattawoman Creek TN reduction.

Table 12. Impervious Acre Equivalent for Structural and Non-Structural BMPs

BMP	Treatment Unit	Impervious Acre Equivalent*
Bioretention A/B soils	WQv (provided)/WQv (required)	1.00
Bioretention C/D soils	WQv (provided)/WQv (required)	1.00
Bioswales	WQv (provided)/WQv (required)	1.00
Dry Detention Ponds	WQv (provided)/WQv (required)	0.00
Dry Extended Detention Ponds	WQv (provided)/WQv (required)	0.00
Impervious Surface Reduction	Per acre disconnected or removed	0.75
Infiltration	WQv (provided)/WQv (required)	1.00
Outfall Stabilization	WQv (provided)/WQv (required)	0.01
Permeable Pavement	WQv (provided)/WQv (required)	0.75
Rain Barrel	WQv (provided)/WQv (required)	0.75
Rain Garden	WQv (provided)/WQv (required)	1.00
Septic Connection	Per unit	0.39
Septic Pump-outs	Per unit (annual practice)	0.03
Septic Upgrades (denitrification)	Per unit	0.26
Step Pool Storm Conveyance (SPSC)	WQv (provided)/WQv (required)	1.00
Storm Drain Cleaning	Dry ton removed	0.40
Stream Restoration	Linear foot	0.01
Street Sweeping	Dry ton removed	0.00
Urban Filtering	WQv (provided)/WQv (required)	1.00
Urban Tree Plantings	Acres planted	0.38
Vegetated Open Channels	WQv (provided)/WQv (required)	1.00
Wet Ponds or Wetlands	WQv (provided)/WQv (required)	1.00

Source: MDE, 2014c

*Assuming full 1-inch rainfall treatment, full WQv is provided. Acres of impervious in BMP drainage area is multiplied by the equivalent acres to determine credited acres

2 Local TMDLs

Under the Federal Clean Water Act (CWA), the State of Maryland is required to assess and report on the quality of waters throughout the state. Where Maryland's water quality standards are not fully met, Section 303(d) of the CWA requires the state to list these water bodies as impaired waters. States are then required to estimate the maximum allowable pollutant load, or TMDL, that the listed water body can receive and still meet water quality standards. In this plan, the term 'local TMDL' is used to refer to TMDLs at the smaller 8 or 12-digit watershed scale, and to differentiate between the Chesapeake Bay TMDL which is implemented at the County scale.

Charles County has several watersheds where an EPA-approved quantitative assessment study (the TMDL) has established pollutant loading limits for waterbodies. These loading limits represent a maximum amount of a pollutant that the water body can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant (e.g., point sources or nonpoint sources). Pollutant loads from point and nonpoint sources must be reduced by implementing a variety of control measures. Responsibility for TMDL reductions is divided among various contributing jurisdictions within the area draining to the water body. The TMDL loading targets, or allocations, are also divided among the pollution source categories, which in this case includes non-point sources (termed load allocation or LA) and point sources (termed waste load allocation or WLA). The WLA consists of loads attributable to regulated process water or wastewater treatment and to regulated stormwater. For the purposes of the TMDL and consistent with implementation of the NPDES MS4 permit, stormwater runoff from MS4 areas is considered a point source contribution.

As a requirement of section PART IV.E.2.b of the NPDES MS4 Discharge Permit issued by MDE to Charles County, the County must develop restoration plans for each SW-WLA approved by EPA prior to the effective date of the permit. This applies to all current local TMDLs as well as any new TMDLs approved by EPA. Such new TMDLs could be developed for any watersheds in the County that have listed water quality impairments as shown in Table 13. Several County TMDL watersheds fall within neighboring counties; however, SW-WLAs assigned to jurisdictions outside of Charles County's Phase I MS4, which may also include, Phase II jurisdictions, Maryland State Highway Administration, and other NPDES regulated stormwater are not the responsibility of Charles County and are not addressed in the Restoration Plan. Charles County watershed boundaries and salinity levels of the water (Mesohaline, Oligohaline, and Fresh) are displayed in Figure 5.

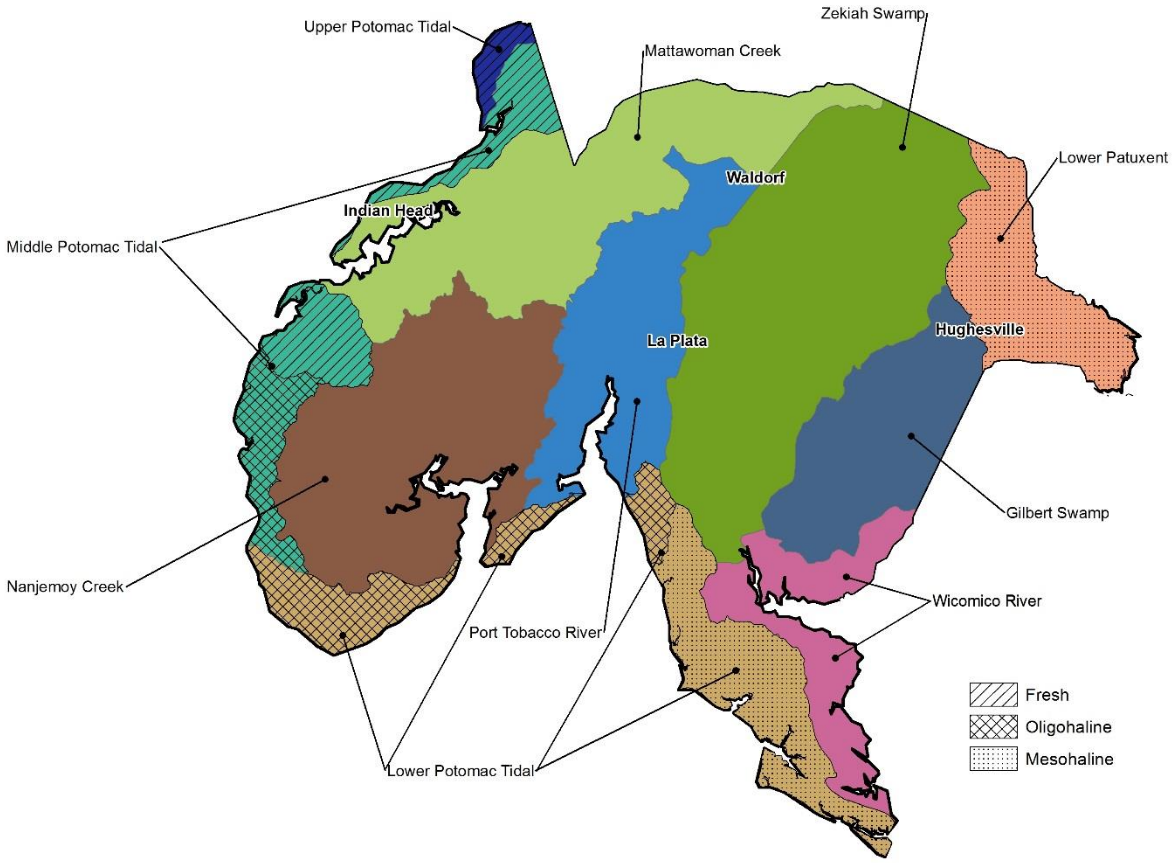


Figure 5: Charles County Watersheds and Potomac Sub-watersheds Salinity Levels

The statuses shown in Table 13 correspond to the following categories used by MDE to describe water quality impairment listings (MDE, 2015a):

- WQA – Category 2; waters meeting the standards for which they have been assessed based on a completed Water Quality Assessment (WQA)
- Insufficient data – Category 3; waters that have insufficient data or information to determine whether any water quality standard is being attained
- TMDL approved – Category 4a; waters that are still impaired have a TMDL developed that establishes pollutant loading limits designed to bring the water body back into compliance.
- Technological remedy – Category 4b; waters that are impaired but for which a technological remedy should correct the impairment.
- Impaired – Category 5; water bodies that may require a TMDL

Table 13. MDE Water Quality Impairment Listings and Status for Charles County (as of October 2015)

Impairment	Applicable Segment	Status	Approval Date
Mercury in Fish Tissue	Lower Patuxent River	WQA	
Chlorpyrifos	Lower Patuxent River	WQA	
PCB in Fish Tissue	Lower Patuxent River	Impaired	
Total Suspended Solids	Lower Patuxent River	Impaired	
Phosphorus	Lower Patuxent River Mesohaline	TMDL approved	2012
Fecal coliform bacteria	**Lower Patuxent River Mesohaline**	**TMDL approved**	**2005**
Nitrogen	Lower Patuxent River Mesohaline	TMDL approved	2012
Total Suspended Solids	Lower Patuxent River Mesohaline	TMDL approved	2012
Oil spill- PAHs	Lower Patuxent River Mesohaline	Technological remedy	
Cause Unknown	Lower Patuxent River Mesohaline	Impaired	
Cause Unknown	Potomac River Middle Tidal	WQA	
Lead	Potomac River Middle Tidal	WQA	
Chromium (total)	Potomac River Middle Tidal	WQA	
Cadmium	Potomac River Middle Tidal	WQA	
Copper	Potomac River Middle Tidal	WQA	
PCB in Fish Tissue	**Potomac River Middle Tidal**	**TMDL approved**	**2008**
PCB in Fish Tissue	**Potomac River Lower Tidal**	**TMDL approved**	**2008**
Fecal coliform	Lower Potomac River Mesohaline	Insufficient data	
Phosphorus	Lower Potomac River Mesohaline	TMDL approved	2012
Nitrogen	Lower Potomac River Mesohaline	TMDL approved	2012
Total Suspended Solids	Lower Potomac River Mesohaline	TMDL approved	2012
Fecal Coliform	Lower Potomac River Mesohaline	Impaired	
Cause Unknown	Lower Potomac River Mesohaline	Impaired	
Total Suspended Solids	Lower Potomac River Oligohaline	Insufficient data	
Nitrogen	Lower Potomac River Oligohaline	TMDL approved	2012
Phosphorus	Lower Potomac River Oligohaline	TMDL approved	2012
Cause Unknown	Lower Potomac River Oligohaline	Impaired	
Cause Unknown	Upper Potomac River Tidal Fresh	WQA	
Total Suspended Solids	Upper Potomac River Tidal Fresh	Insufficient data	
Phosphorus	Upper Potomac River Tidal Fresh	TMDL approved	2012
Nitrogen	Upper Potomac River Tidal Fresh	TMDL approved	2012
Mercury in Fish Tissue	Potomac River Upper Tidal	WQA	
Copper	Potomac River Upper Tidal	WQA	
PCB in Fish Tissue	**Potomac River Upper Tidal**	**TMDL approved**	**2008**
Cause Unknown	Potomac River Upper Tidal	Impaired	
Mercury in Fish Tissue	Wicomico River	WQA	
PCB in Fish Tissue	Wicomico River	WQA	
Cause Unknown	Wicomico River	WQA	
Cause Unknown	Gilbert Swamp	WQA	
Nitrogen	Gilbert Swamp	Insufficient data	

Impairment	Applicable Segment	Status	Approval Date
Lead	Zekiah Swamp	WQA	
Copper	Zekiah Swamp	WQA	
Selenium	Zekiah Swamp	WQA	
Zinc	Zekiah Swamp	WQA	
Cause Unknown	Zekiah Swamp	WQA	
Nitrogen	Zekiah Swamp	Insufficient data	
Phosphorus	Zekiah Swamp	Insufficient data	
Enterococcus	Port Tobacco River	WQA	
Nitrogen	Port Tobacco River Oligohaline	TMDL approved	2012
Phosphorus	Port Tobacco River Oligohaline	TMDL approved	2012
Total Suspended Solids	Port Tobacco River Oligohaline	TMDL approved	2012
Enterococcus	Port Tobacco River	Impaired	
Cause Unknown	Port Tobacco River	Impaired	
Cause Unknown	Nanjemoy Creek	WQA	
Nitrogen	Nanjemoy Creek	TMDL approved	2012
Phosphorus	Nanjemoy Creek	TMDL approved	2012
Total Suspended Solids	Nanjemoy Creek	TMDL approved	2012
Mercury in Fish Tissue	Mattawoman Creek	WQA	
Phosphorus	Mattawoman Creek	Insufficient data	
Total Suspended Solids	Mattawoman Creek	Insufficient data	
Cause Unknown	Mattawoman Creek	Insufficient data	
Low pH	Mattawoman Creek	Impaired	
Chlorides	Mattawoman Creek	Impaired	
PCB in Fish Tissue	Mattawoman Creek	Impaired	
Nitrogen	**Mattawoman Creek**	**TMDL approved**	**2012**
Phosphorus	**Mattawoman Creek**	**TMDL approved**	**2012**

Final approved TMDLs within Charles County with either an individual or aggregate SW-WLA, shown in bold text

Source: Maryland's Final 2014 Integrated Report of Surface Water Quality (MDE, 2015a)

There are currently four final approved TMDLs (Upper, Middle, and Lower Potomac PCB TMDL combined) within Charles County with either an individual or aggregate SW-WLA, shown in bold text in Table 13 above and also shown in Figure 6. Although there are many other TMDLs listed in Table 13, they do not have SW-WLAs assigned to the Charles County NPDES regulated stormwater point source and are therefore not addressed in the Restoration Plan. SW-WLAs assigned to Maryland State Highway Administration and other NPDES regulated stormwater are not the responsibility of Charles County and will not be addressed in this plan.

The final approved TMDLs include the following:

- Mattawoman Creek – Nutrients: Nitrogen and Phosphorus
  - 0214011 – Mattawoman Creek
- Lower Patuxent River (shellfish harvesting areas) – Fecal Coliform Bacteria
  - 021311010887 – Indian Creek

- Tidal Potomac River – PCBs (Polychlorinated Biphenyls)
    - 02140201 – Upper Potomac River
    - 02140102 – Middle Potomac River
    - 02140101 – Lower Potomac River

It is noted that the Lower Patuxent River bacteria TMDL is for the Indian Creek 12-digit subwatershed of Lower Patuxent River Mesohaline watershed. The SW-WLA is only for the Indian Creek portion of this watershed shown by the hatch pattern in the figure below.

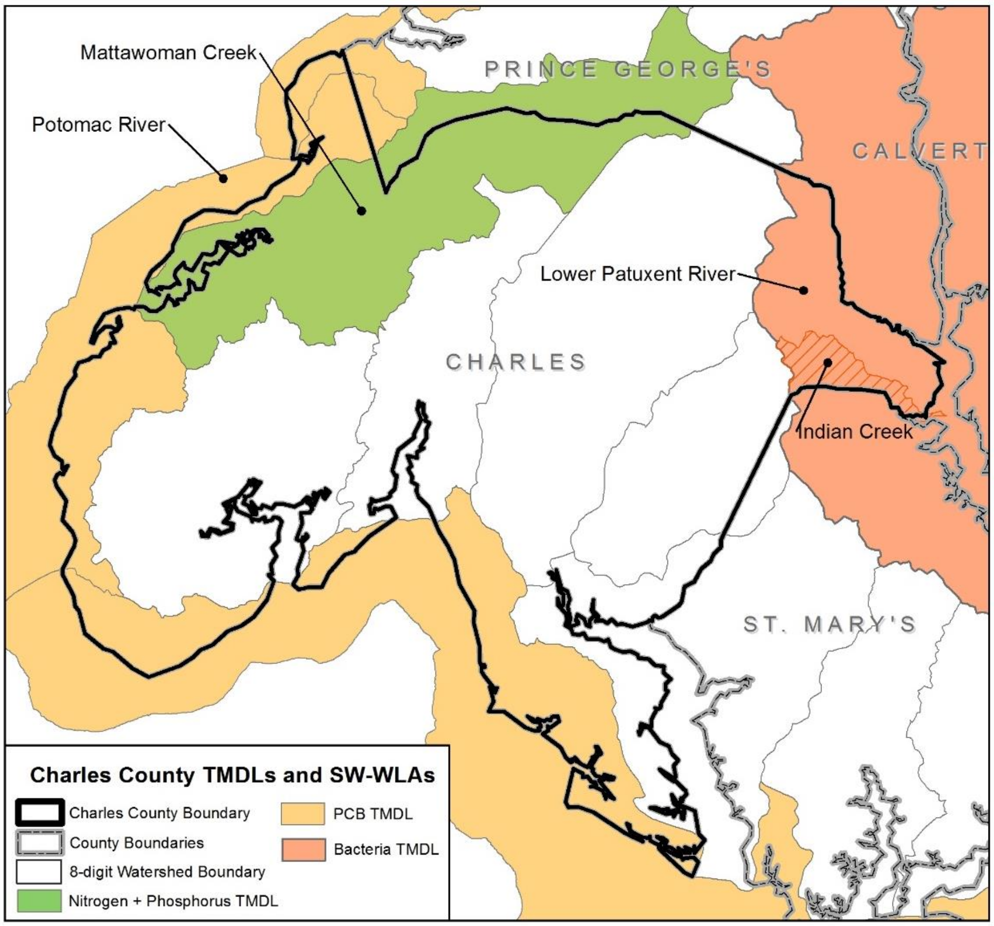


Figure 6: Charles County Local TMDLs with SW-WLAs

2.1 Mattawoman Creek TMDL for Nitrogen and Phosphorus

Mattawoman Creek Nutrients

Mattawoman Creek was first identified in 1996 as being impaired by nutrients and a TMDL for nitrogen and phosphorus was developed in 2004 (MDE, 2004b). The TMDL was approved by USEPA on January 5, 2005 and uses a baseline analysis year of 2000. The TMDL calls for an overall 40% load reduction from non-point sources with varying percentages of nitrogen reduction among the following source categories: 54% from urban stormwater, 54% from agriculture, and 20% from air deposition. The 40% phosphorous reduction is divided as follows: 47% from urban stormwater, 49% from agriculture and 20% from air deposition. This restoration plan deals with the urban stormwater loads and reductions of 54% reduction in nitrogen and a 47% reduction in phosphorus from the 2000 baseline urban stormwater loads. The Mattawoman Creek nutrient local TMDL SW-WLAs are for edge of stream annual loads (EOS-lbs/yr). An EOS load is the amount of a pollutant load that is transported from a source to the nearest stream annually.

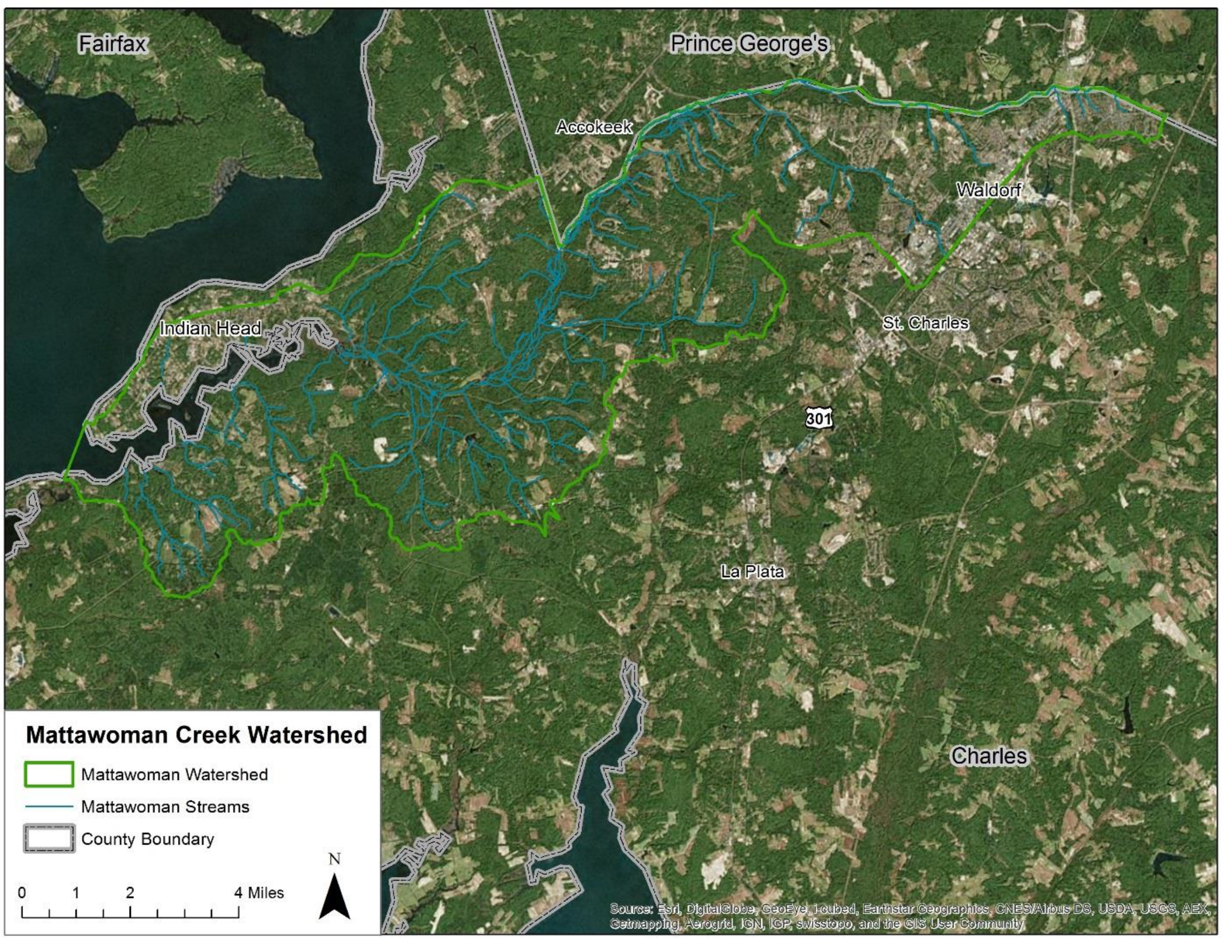


Figure 7: Mattawoman Creek Watershed

2.1.1 Sources

Nutrients are a pollutant of concern as an overabundance can cause algal blooms. Nitrogen is the limiting nutrient in the Chesapeake Bay, with high levels of nitrogen leading to algal blooms which cause decreased water clarity and light attenuation in the bay, as well as rob the bay of dissolved oxygen as algal blooms die and decompose at the bottom of the water column. Phosphorus is the limiting nutrient in freshwater systems and can lead to algal blooms in lakes and reservoirs with the same impacts as algal blooms in the Chesapeake Bay but also can have an impact on drinking water if the bloom occurs in a reservoir that is used as a water source for municipal drinking water. Sources of nutrients include agricultural runoff, urban stormwater, municipal wastewater treatment plants, phosphorus bound to sediments supplied to the system, and discharge from upstream impoundments.

An approved TMDL exists for nitrogen and phosphorus for Mattawoman Creek. Including land area in both Charles and Prince George's Counties, the two largest sources of nitrogen to Mattawoman Creek as identified in the Mattawoman Creek TMDL (MDE, 2004b) are mixed agricultural (39.9%), and urban stormwater (39%); and, the two largest sources of phosphorus are urban stormwater (48.9%) and mixed agricultural (28.7%). As of 2005, there were four municipal wastewater treatment plants (WWTP) in the Mattawoman Creek watershed (Indian Head WWTP, Lackey High School, Brandywine Receiving Station, and the Lingafelt Residence). The TMDL calls for WWTPs to maintain their maximum permitted flows.

It is noted that the Mattawoman TMDL (MDE, 2004b) does not specifically include loads from septic systems, most likely because much of the wastewater in the watershed is processed by the County's municipal wastewater facilities noted above. However; Charles County's current GIS database of septic systems indicates 2,948 septic systems currently within the watershed. These systems are a major contributor of pollutant loading, particularly for nitrogen. Loads from septics, if not accounted for separately must be inherently distributed to the other source sectors (forest, agricultural, air deposition, wastewater, and urban) in the TMDL modeling and analysis. Because these loads are incorporated into the urban load, the County is therefore incorporating septic system programs into its suite of projects and programs to address the TMDL. Mattawoman septic systems are addressed further in sections 2.1.6 and 2.1.7.

2.1.2 Modeling Approach

A combination of models was used for baseline, progress, and planned pollutant load modeling for Bay and local TMDLs. They are described below. Each BMP provides impervious surface restoration as well as a reduction for nitrogen, phosphorus, and sediment, along with other pollutants.

Section 1.8 presents the suite of practices the County uses for current implementation and/or plans to use to address local TMDL and impervious restoration permit requirements. Section 4 presents information on how progress toward load reductions will be evaluated and how management plans will be adapted on an on-going basis.

BayFAST

The baseline pollutant loads for nutrient and sediment local TMDLs were determined using BayFAST (Bay Facility Assessment Scenario Tool). BayFAST functions similarly to MAST, which calculates pollutant loads and reductions calibrated to the Chesapeake Bay Program Partnership Watershed Model, but allows users to delineate facility boundaries (e.g., watershed, parcel, drainage area) and alter land use information within the delineated boundary depending on the model year. Local TMDL baseline loads were calibrated in BayFAST by modeling BMPs installed prior to the TMDL baseline year on top of baseline land use background loads. This ensures that the same set of baseline BMPs are used throughout future progress and planned scenarios. Local TMDL baseline scenario loads are provided in MAST; however, the functionality to edit baseline BMPs in the scenarios is not available.

Both the Watershed Model and MAST/BayFAST provide loads at two different scales: Edge-of-Stream (EOS) and Delivered (DEL). Delivered loads show reductions based on in-stream processes, such as nutrient uptake by algae or other aquatic life. Local TMDL plans focus on reducing load on the land, so EOS estimates are more appropriate and were used for nutrient and sediment modeling analysis.

Removal Rate Curve Equations

Pollutant load reductions for progress scenarios and planned projects were calculated using revised removal rate curve equations for runoff reduction (RR) and stormwater treatment (ST) practices prepared by Chesapeake Stormwater Network (MDE, 2014c). Reductions are calculated based on rainfall treatment, whether noted in project concepts or as an assumption of 1-inch treatment, and removal efficiencies per RR and ST practice (Table 14).

Table 14. Runoff Reduction and Stormwater Treatment Practices Removal Rate Reductions

Practice	Rainfall Treatment	Nitrogen Reduction	Phosphorus Reduction	Sediment Reduction
Runoff Reduction (RR)	1”	60%	70%	75%
Stormwater Treatment (ST)	1”	35%	55%	70%

2.1.3 Reduction Target Derivation

In order to derive the County MS4-specific SW-WLA load reduction targets, MDE’s published baseline values for each local TMDL need to be *disaggregated* and *calibrated* before the percent reduction is applied to calculate the load reduction required.

Some SW-WLAs are developed by MDE as an aggregate load including load contributions from multiple jurisdictions. Aggregate values must be first disaggregated to determine the portion of the load that each jurisdiction is responsible for.

Charles County’s TMDLs were developed by MDE at different periods in time using a variety of models. In order to use current models such as MAST (Maryland Assessment Scenario Tool), which is based on the current version of the Chesapeake Bay Model (v5.3.2), for analysis of load reductions, the baseline load needs to be translated or “calibrated” from the model used to develop the TMDL to the current model. According to the MDE guidance document *Guidance for Using the Maryland Assessment Scenario Tool to Develop Stormwater Wasteload Allocation Implementation Plans for Local Nitrogen, Phosphorus, and Sediment TMDLs* (MDE, 2014b), Section I, baseline nutrient and sediment loads and SW-WLAs must be calibrated to the model used to calculate load reductions:

Because all of Maryland’s approved local nutrient and sediment TMDLs were developed using watershed models other than MAST [Maryland Assessment Scenario Tool], the baseline and target loads from these TMDLs need to be translated into MAST loadings. This adjustment is required to account for potential *differences between models. This is a two-step process that involves 1) creating a MAST scenario that replicates the baseline year of the TMDL, and 2) applying the load reduction percentage from the TMDL to the MAST loading for the baseline year.*

The Mattawoman Creek nitrogen and phosphorus aggregate SW-WLAs were disaggregated using the BayFAST (Bay Facility Assessment Scenario Tool) model. BayFAST allows users to specify the watershed and jurisdiction to model; therefore, the results include only Charles County MS4 baseline loads and do not include other municipalities. The results then represent the disaggregated portion of the baseline load.

The baseline model includes County BMPs installed prior to the TMDL baseline year on top of baseline land use background loads. The County's inventory BMPs within the Mattawoman Creek watershed, installed prior to the 2000 baseline year, can be found in Appendix D. BayFAST functions similarly to MAST; which is described further in Section 3.2: Modeling Approach of this plan, however BayFAST allows users to delineate facility boundaries (e.g., watershed, parcel, drainage area) and alter land use information within the delineated boundary depending on the model year. A table displaying Charles County nutrient local TMDLs in Mattawoman Creek with baseline loads and SW-WLAs calibrated to BayFAST is included in Table 15. The general calibration procedure is as follows:

1. A facility boundary for the Mattawoman Creek 8-digit TMDL watershed within Charles County borders was delineated within BayFAST.
2. All default land use acreages were deleted and regulated pervious and impervious acres were replaced with MAST Local Base County Phase I MS4 urban pervious and impervious acres using the Compare Scenario tool in MAST for the 2000 baseline year of the Mattawoman Creek local TMDL. This approach inherently disaggregates County MS4 loads from the rest of the NPDES regulated area within the watershed.
3. County BMPs installed prior to the TMDL baseline year were then added to the model.
4. The reduction percentage published in the TMDL document was then applied to the calibrated baseline loads modeled in BayFAST to calculate a calibrated reduction in EOS-lbs/yr.
5. A calibrated SW-WLA was calculated by subtracting the calibrated reduction from the BayFAST baseline load.

Calibrated load reductions calculated based on TMDL percent reductions and baseline loads modeled in BayFAST using Charles County Phase I MS4 baseline pervious and impervious land use and baseline treatment are the target reductions used in the Restoration Plan for nutrient local TMDLs. These values are presented in bold in Table 15.

It is noted that the Mattawoman reduction of 54% will be very difficult to meet given that many stormwater BMPs individually achieve pollutant reduction efficiencies of less than 50%.

Table 15. Mattawoman Creek (0214011) Disaggregated and Calibrated Local TMDL SW-WLAs and Load Reductions

Baseline Year	WLA Type	Baseline Model[1]	Pollutant	Unit	Published by MDE		Disaggregated and Calibrated		
					SW-WLA	Reduction %[2]	Baseline Load[3]	Reduction Load[4]	SW-WLA[5]
2000	Aggregate	WASP5.1	Nitrogen	EOS-lbs/yr	46,618	54%	56,526	**30,524**	26,002
2000	Aggregate	WASP5.1	Phosphorus	EOS-lbs/yr	5,213	47%	4,958	**2,330**	2,628

Target load reductions used in the Restoration Plan shown in bold text.

1) Baseline model used to create the TMDL. Water Quality Analysis Simulation Program version 5.1 (WASP5.1).
2) Published WLA and Reduction % from the MDE TMDL Data Center SW WLAs for County Storm Sewer Systems in Charles County and from TMDL documentation.
3) Baseline loads modeled in BayFAST using County BMPs installed prior to the TMDL baseline year on top of baseline land use background load.
4) Calibrated reductions calculated by applying the MDE published percent reduction to the BayFAST calibrated baseline loads.
5) Calibrated WLAs calculated by subtracting the calibrated reduction from the BayFAST calibrated baseline load.

2.1.4 Summary of Findings from 2015 Watershed Assessment

The Mattawoman Creek Watershed Assessment consisted of neighborhood source assessments, hotspot site investigations, nutrient synoptic survey, and stream corridor assessments.

Of the ten neighborhoods assessed, only two neighborhoods were determine to have a high pollution severity rating due to the potential for nutrient, bacteria, sediment, and oil and grease pollution. All other neighborhoods were found to have moderate pollution severity ratings. Opportunities for restoration actions including rain barrels, rain gardens, and downspout disconnections were identified in many of the neighborhoods. Of the 21 hotspot sites investigated, only one site was designated as having a high potential for pollutant discharge and 17 sites were designated as potential hotspots. Opportunities for stormwater BMPs were identified at these sites.

A total of 51 synoptic sites were sampled for water quality and discharge measurements throughout the watershed. One site had DO levels below the COMAR standard, 14 sites had pH values below the minimum threshold, and 5 sites had specific conductivity values exceeding the impairment threshold for Maryland benthic macroinvertebrates.

Nutrients including total nitrogen, nitrate/nitrite, and total phosphorus were generally found to be low and moderate at all sites. Orthophosphate concentrations were found to be excessive at 16 of the sites. Bacteria levels exceeding the standard for water contact recreation were found at 4 sites.

Field crews conducted stream corridor assessments on approximately 6.3 miles of streams. Erosion sites, pipe outfalls, and buffer breaks were the most widespread and frequent problems identified. The majority of points collected were categorized as moderate to minor severity. These assessments helped identify projects throughout the watershed including reforestation, stormwater BMPs, stream restoration, and outfall stabilization projects.

2.1.5 2015 Progress

Charles County maintains a database of stormwater urban BMP facilities and water quality and capital improvement projects (WQIP and CIP) in addition to tracking operational practices. Current restoration BMP implementation installed between 2000 (baseline condition) and 2015 to retrofit the untreated urban area developed prior to the 2000 baseline in the Mattawoman Creek watershed are shown in Table 16. Load reduction calculations per project have been modeled with a spreadsheet analysis.

Table 16: Current Restoration BMP Implementation from 2000 Baseline Through 2015 in the Mattawoman Creek watershed

Name	BMP Type	Drainage Area (ac)	Impervious (ac)	TN EOS lbs/yr	TP EOS lbs/yr	TSS EOS lbs/yr	Impervious Credit (ac)
Acton Lane Roadway	Wet Pond	32.51	17.39	51.5	8.7	3694.7	8.00
Bryans Road	Dry Swale	1.61	0.73	6.3	0.9	332.8	0.73
Bryans Road	Enhanced Filter	9.10	8.92				8.92
Fox Run	Step Pool Storm Conveyance	23.14	9.51	52.6	9.6	4160.5	9.51
Pinefield Pond	Wet Pond	51.00	22.30	116.9	22.0	9601.3	22.34

BMP	Unit	Current Implementation	TN EOS lbs/yr	TP EOS lbs/yr	TSS EOS lbs/yr	Impervious Credit (ac)
Septic Connections	# of connection	19	162.1	N/A	N/A	7.4
Septic Pump-outs	# of pump-out	163	77.2	N/A	N/A	4.9
Septic Upgrades	# of upgrade	17	80.6	N/A	N/A	4.4
Storm Drain Cleaning	# of pipes/ tons removed	183 pipes cleaned/ 26.7 tons removed	93.5	37.4	11,224.0	10.7
Street Sweeping	miles swept/ tons removed	101 miles swept/ 366.0 tons removed	1,281.0	512.4	153,720.0	146.4

Table 17. Mattawoman 2015 Nutrient TMDL Restoration Progress

	TN - EOS lbs/yr	TP - EOS lbs/yr
Baseline and Targets		
2000 Baseline Loads with BMPs	56,526	4,958
Target Percent Reduction	54.0%	47.0%
Calibrated Reduction	30,524	2,330
Calibrated WLA	26,002	2,628
2015 Progress Reductions		
Restoration Reduction (from baseline to 2015)	**1,921**	**591**
Restoration Reduction Percent	**3.4%**	**11.9%**
Reduction Remaining for Treatment	**28,602**	**1,739**

2.1.6 Restoration Plan

Stormwater Controls

Planned implementation for the Mattawoman Creek is summarized in Table 18. This represents essentially all of the projects and programs that have been identified for the watershed thus far from the variety of assessments conducted. This includes all of levels 2-9 of the projects identified by Vista, BayLand, KCI, GMB and other consultants working with Capital Services and Planning and Growth Management.

Table 18: BMP Implementation - Planned Levels

Structural Practices						
BMP	**Drainage Area (ac)**	**Impervious (ac)**	**TN EOS lbs/yr**	**TP EOS lbs/yr**	**TSS EOS lbs/yr**	**Impervious Credit (ac)**
Bioretention	25.11	16.46	92.7	16.9	6,518.1	13.60
Bioswale	4.23	2.30	10.2	1.2	401.9	2.30
Created wetland	1,286.41	334.80	1,165.0	279.6	106,057.9	62.60
Dry Swale	22.40	11.70	49.4	10.3	4,318.3	6.98
Micro-Bioretention	1.27	0.83	4.6	1.2	565.1	0.83
Grass Swale	16.90	1.51	4.3	0.4	104.2	1.63
Infiltration basin	54.05	20.12	202.3	26.2	9,434.6	3.29
Organic Filter	2.12	1.36	4.8	1.1	470.3	0.69
Pond Retrofit	32.97	15.85	64.0	9.2	3.558.2	12.05
Reforestation	30.93	0.00	116.7	7.6	1,344.8	11.75
Sheetflow to Conservation	58.29	18.80	110.3	17.5	6,531.6	14.98
Step Pool Stormwater Conveyance Systems	830.62	218.93	1,597.2	234.8	87,500.4	138.76

Structural Practices						
BMP	Drainage Area (ac)	Impervious (ac)	TN EOS lbs/yr	TP EOS lbs/yr	TSS EOS lbs/yr	Impervious Credit (ac)
StormFilter	31.28	12.83	28.6	5.7	2,238.4	6.43
Stream Restoration	10,434	10,434.00	782.6	709.5	156,510.0	104.34
Submerged Gravel Wetland	535.03	237.15	1,930.9	314.3	119,094.9	119.14
Wet Pond	203.78	65.57	432.2	69.5	27,820.1	39.32
Wet Swale	3.45	0.26	7.1	0.8	263.3	0.26

Operational and Homeowner Practices					
BMP	Projected Amount	TN EOS lbs/yr	TP EOS lbs/yr	TSS EOS lbs/yr	Impervious Credit (ac)
Downspout Disconnection - Homeowner Practice	581 homes participating	7.4	1.5	0.0	3.6
Rain Barrels - Homeowner Practice	2,430 homes participating	72.1	15.4	0.0	25.9
Rain Gardens - Homeowner Practice	581 homes participating	44.0	9.4	0.0	9.7
Storm Drain Cleaning	183 pipes cleaned/ 26.7 tons removed, plus Pinefield Drainage project	916.0	366.4	109,924.0	104.7
Street Sweeping	101 miles swept/ 366.0 tons removed	1,281.0	512.4	153,720.0	146.4

Septic Systems

Mattawoman Creek is largely a sewered watershed with municipal wastewater treating a proportion of the watershed; however Charles County estimates that there are 2,948 septic systems in the Mattawoman Creek watershed, which represents approximately 17% of the systems in the County. A comprehensive septic connection program, connecting a large percentage of Mattawoman systems would be anticipated to meet a significant portion of the Mattawoman nitrogen TMDL assigned to the urban stormwater sector. Because the Mattawoman TMDL document (MDE, 2004b) does not call for nutrient reductions from septics, connecting these septics to sewer may help reach the local TMDL as part of the SW-WLA. Figure 8 indicates the potential locations for septic system projects in the County. Refer to the Charles County Phase II Watershed Implementation Strategy (LimnoTech, 2013) for more information on the specific septic areas identified for connection to public sewer.

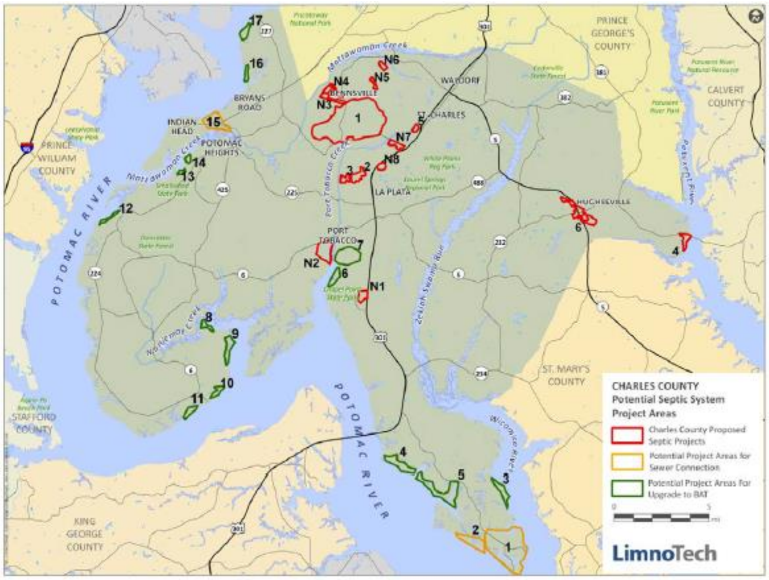


Figure 8. Potential Project Locations for Septic System BMPs (from LimnoTech, 2013).

Table 19 presents the number of septic connections, upgrades, and pump-outs necessary to achieve the planned septic reduction by septic system location (in the critical area, not within the critical area but with 1,000 feet of a perennial stream, and not with in the critical area and not within 1,000 feet of a perennial stream). In addition to the full suite of 96 stormwater projects and operational programs, these septic practices may help reach the local TMDL.

The stormwater portion of the plan (through 2025) is projected to be at 16.5% reduction with the full suite of 96 projects plus the operational programs including street sweeping and stormdrain cleaning continuing annually through the period. The TN reduction remaining at this stage is 21,177 lbs/yr. The 96 projects account for 7,425 lbs/yr of TN reduction. Using the relationship of lbs reduced per project from this group of 96 projects, if the County were to meet the full TN goal through additional implementation of projects in the stormwater sector it is estimated that another 274 stormwater projects similar to those already identified would be required for a total of approximately 370 projects. A comparison of costs for the two approaches is included in section 2.1.8.

The alternative approach utilizing septic connection reductions could achieve the overall TMDL goals at a lower cost. The feasibility of such a program is being investigated by the County. To achieve the additional 20,639 lbs/yr that is still required after the initial plan implementation is complete, it is expected that close to 2,037 septic connections, 555 upgrades, and 2,358 pump-outs would be required in the 2026-2035 period.

Table 19. Number of Planned Septic Practices in Mattawoman Creek

	Number of Practices- Annually			Number of Practices- Over Entire Period			
	In Critical Area	Not within critical area but within 1,000 ft. of a perennial stream	Not within critical area and not within 1,000 ft. of a perennial stream	In Critical Area	Not within critical area but within 1,000 ft. of a perennial stream	Not within critical area and not within 1,000 ft. of a perennial stream	Total
Planned Septic Practices 2016-2019							
2016-2019 Subtotal	**3**	**64**	**69**	**11**	**256**	**278**	**545**
Planned Septic Connections	0	2	2	0	7	8	15
Planned Septic Pump-outs	3	61	67	10	245	266	522
Planned Septic Upgrades	0	1	1	0	4	4	8
Planned Septic Practices 2020-2025							
2020-2025 Subtotal	**3**	**64**	**69**	**16**	**384**	**416**	**816**
Planned Septic Connections	0	2	2	0	11	12	23
Planned Septic Pump-outs	3	61	67	16	368	399	782
Planned Septic Upgrades	0	1	1	0	5	6	11
Planned Septic Practices 2026-2035							
2026-2035 Subtotal	**10**	**233**	**252**	**99**	**2,327**	**2,525**	**4,951**
Planned Septic Connections	4	96	104	41	957	1,039	2,037
Planned Septic Pump-outs	5	111	120	47	1,108	1,203	2,358
Planned Septic Upgrades	1	26	28	11	261	283	555
Total Planned Septic Practices 2016-2035							
2016-2035 Total	**15**	**361**	**391**	**126**	**2,966**	**3,219**	**6,312**
Planned Septic Connections	4	99	108	42	975	1,058	2,075
Planned Septic Pump-outs	10	233	253	73	1,721	1,868	3,662
Planned Septic Upgrades	1	28	30	11	270	293	574

2.1.7 Load Reductions Expected

Calculation of the load reductions to be achieved through full implementation of the levels 2-9 projects are presented in Table 20 below. This represents a total of 96 structural restoration projects in addition to the operational, programmatic, septic, and homeowner activities listed above.

Table 20. Mattawoman Creek Planned Load Reductions

	TN - EOS lbs/yr	TP - EOS lbs/yr
Baseline and Targets		
2000 Baseline Loads with BMPs	56,526	4,958
Target Percent Reduction	54.0%	47.0%
Calibrated Reduction	30,524	2,330
Calibrated WLA	26,002	2,628
2015 Progress Reductions		
Restoration Reduction (from baseline to 2015)*	**1,921**	**591**
Restoration Reduction Percent	**3.4%**	**11.9%**
Reduction Remaining for Treatment	**28,602**	**1,739**
Planned Reductions (2016 - 2019)		
Planned Reductions Subtotal	**4,311**	**901**
Planned Structural Reductions Level 2-3	4,021	875
Planned Homeowner Reductions	124	26
Planned Septic Practices	166	N/A
Planned Reductions (2020 - 2025)		
Planned Reductions Subtotal	**3,404**	**1,160**
Planned Structural Reductions Level 4-7	557	160
Planned Structural Reductions Level 8	1,436	205
Planned Structural Reductions Level 9	1,412	796
Planned Septic Practices	248	N/A
Tentative Reductions (2026-2035)		
Septic Practices	**20,704**	**N/A**
Total Reductions		
Reduction (Progress + Planned)	**9,884**	**2,652**
Reduction Percent (Progress + Planned through 2025)	**17.5%**	**53.5%**
Reduction Remaining for Treatment	**20,639**	**(322)**
Reduction (Progress + Planned through 2035)	**30,588**	**2,653**
Reduction Percent (Progress + Planned through 2035)	**54.1%**	**53.5%**

Table 21 presents the total number of planned septic connections, upgrades, and pump-outs necessary to achieve the local Mattawoman TMDL. A visual survey using aerial photography estimated that approximately 3% of the 2,948 existing Mattawoman septic systems are within the critical area. Using values from Charles County's Phase II WIP, the Countywide distribution of septic systems by location outside of critical area (not within the critical area but with 1,000 feet of a perennial stream, and not with in the critical area and not within 1,000 feet of a perennial stream) was used to estimate the distribution remaining existing Mattawoman septic systems. Using an average septic system load of 22.4 lbs TN/system/year and the delivery loss factor for each septic system location, the delivered TN load per system was calculated by location (Table 21) for Mattawoman septic systems. On average, the delivered TN load per septic system is 9.48 lbs/yr of TN. Septic connections, with a 90% reduction efficiency rate would achieve a reduction of 8.53 lbs/yr per connected system. Septic upgrades, with a 50% reductive efficiency rate would achieve a reduction of 4.74 lbs/yr of TN per upgrade and septic pump-outs, with a 5% reductive efficiency rate would achieve a reduction of 0.47 lbs/yr per pump-out.

In addition to the planned stormwater projects and operational programs, it was calculated that a significant increase in septic practices would be necessary to meet the local TMDL. Planned septic practices from 2016-2025 continue at current rate of implementation with approximately 4 connections per year, 2 upgrades per year, and 130 pump out per year in the watershed. Planned septic practices for the 2026-2035 period include connection of 70% of the septic systems, pump-outs of 80% of the remaining un-connected septic systems, and upgrades to 65% of the septic systems not already connected or upgraded to meet the local TMDL load reduction goals. Prioritizing septic practices within the critical area will achieve the greatest load reduction while minimizing the costs.

Table 21: Planned Mattawoman Septic Practices

Location	In Critical Area	Not within critical area but within 1,000 ft. of a perennial stream	Not within critical area and not within 1,000 ft. of a perennial stream	Total
Number of Systems in County	1,178	7,623	8,266	17,067
Countywide Distribution	7%	45%	48%	100%
Assumed Mattawoman Distribution (based on visual survey of built properties in Critical Area)	3%	47%	50%	100%
Assumed Number of Systems in Mattawoman	88	1,386	1,474	2,948
Delivery Loss	20%	50%	70%	
Delivered TN load per system (lbs/yr)	17.89	11.18	6.71	9.48
Mattawoman Delivered Load (lbs/yr)	1,582	15,491	9,888	27,939
Mattawoman Connections 2016-2035				
Number Connections Needed	42	975	1,058	2,075
Connections Load Reduction (lbs/yr)	676	9,810	6,387	16,874
Mattawoman Upgrades 2016-2035				
Number Upgrades Needed	11	270	293	574
Upgrades Load Reduction (lbs/yr)	98	1,509	983	2,590
Mattawoman Pump-outs 2016-2035				
Number Pump-outs Needed	73	1,721	1,868	3,662
Pump-outs Load Reduction (lbs/yr)	65	962	627	1,654

2.1.8 Cost and End Date of Mattawoman TMDL Restoration

Based on the volume of work and cost to complete, particularly for the nitrogen reduction required, Charles County is projecting an end date of 2035 to meet the Mattawoman Creek TMDL.

Table 22 below provides the cost of the Mattawoman TMDL restoration based on completing the 96 projects in levels 2-9, continuing operational and septic programs, and adding a substantial septic connection program. The cost to implement the projects and programs identified currently in the Mattawoman Creek is estimated at over $100 million.

Annual costs of street sweeping in the Mattawoman Creek watershed is estimated at $27,837 and the annual cost of storm drain cleaning is $69,199 based on current County expenditures for those programs. Table 22 presents costs for these annual on-going practices for the various multi-year planning periods (indicated in the table headers) with added costs due to inflation over time.

At a cost of $42,330 unit cost per septic system connection from the County's Phase II WIP (LimnoTech, 2013) the cost for the septic connection portion of this scenario would be approximately $86.2 million. Including pump-outs and upgrades, at a cost of $117 per pump-out (Charles County data) and $13,000 per upgrade (MDE, 2011), the additional septic practices will cost a total of approximately $94.3 million.

Based on the estimation above that approximately 275 additional projects may be necessary, which is almost three times the currently planned implementation, the cost of these projects would escalate to $158 million dollars based on the average per project cost for projects already completed and planned. To achieve the goal by 2035, funding close to $8.4 million per year would be required for these additional projects. When added to the cost of projects and programs already identified ($40.7 million) the cost is $200 million or $10.5 per year until 2035. While a septic connection program cost is a very large sum ($94.3 million), it is about 60% of the projected cost of treating the same TN load in the stormwater sector. It is also foreseeable that finding enough suitable stormwater projects will simply not be feasible. It is very difficult to reach a 54% total nitrogen goal when many stormwater restoration practices achieve less than 50% reduction efficiency.

Table 22. Mattawoman TMDL Cost as Planned ($ in thousands)

Mattawoman Creek	
2015 Progress Impervious Restoration (Completed Projects)	
Level 1 Completed Projects	$4,341
Planned Impervious Restoration (Projects Funded in Prior FY Budgets)	
Level 2, 3 and 6 Already Funded	$16,340
Planned Impervious Restoration (2016-2019) (Funding FY17 to Dec FY25)	
Levels 3-7	$14,224
Operational Reductions Subtotal	$394
Street Sweeping	$113
Storm Drain Cleaning	$281
Septic Reductions Subtotal	$172
Upgrades	$98
Pump-outs	$74
Homeowner Reductions	$1,676
Planned Impervious Restoration (2020-2025) (Funding FY20 to Dec FY25)	
Level 8	$11,227
Level 9	$12,120
Operational Reductions Subtotal*	$651
Street Sweeping	$187
Storm Drain Cleaning	$465
Septic Reductions Subtotal	$258
Upgrades	$147
Pump-outs	$111
Cost Planned (2016 to 2025)	**$40,722**
Tentative Reductions (2026-2035)	
Septic Practices	**$94,294**
Cost of TMDL Restoration Complete and Planned	
Cost, Completed and Planned	**$155,697**

2.2 Lower Patuxent Bacteria TMDL (Indian Creek, Charles County, MD)

The Lower Patuxent River TMDL for fecal coliform bacteria was developed in 2004 and approved by USEPA on May 25, 2005. The TMDL addresses fecal coliform impairments for several restricted shellfish harvesting areas (MDE, 2004a). Because the only subwatershed listed in the TMDL within Charles County with a SW-WLA is Indian Creek, the discussion of the TMDL in this plan refers only to the Indian Creek subwatershed. The TMDL requires a 43.94% reduction from the 2001 baseline, based on the baseline and allowable loads of 261.5 and 146.6 billion most probable number per day (bn MPN/day), respectively.

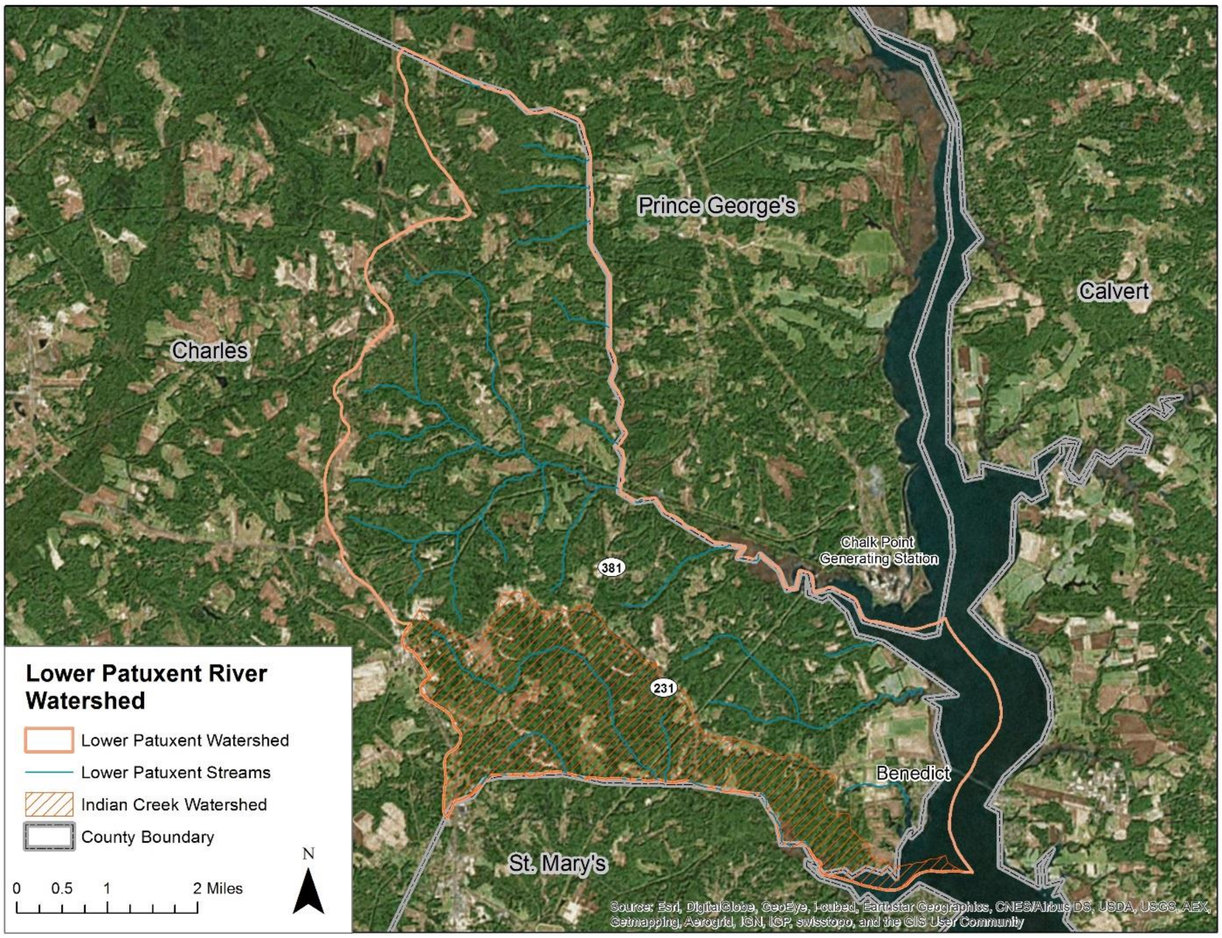


Figure 9: Lower Patuxent River Watershed

2.2.1 Sources

Fecal coliform (FC) bacteria are primarily found in the feces of warm-blooded animals and are another pollutant of concern. Bacteria in any waters can create a human health hazard and require water contact restrictions in streams, rivers, lakes, and the bay. Bacteria in tidal waters can contaminate shellfish. If detected above the water quality standard, these areas will be closed to shellfish harvesting.

MDE's TMDL analyses categorize bacteria sources into four types: human, domestic pets, wildlife, and livestock. Specific sources for each category are shown in the table below, which has been derived from

MDE's stormwater WLA bacteria guidance (MDE, 2014c) and Watershed Protection Techniques Article 17 (Schueler, 2000b) which describes the sources to be addressed for load reduction in an implementation plan, as follows:

Table 23: Bacteria Sources

Sector	MS4 Source	Non-Point Source
Human	Sanitary sewer illicit discharge Sanitary sewer exfiltration Homeless populations	Septic systems Sanitary sewer overflow (SSO) Combined sewer overflow (CSO) Recreational boating
Domestic Pets	Pets, urban areas	Pets, rural areas
Wildlife	Urban wildlife	Non-urban wildlife
Livestock		Agriculture, hobby farms CAFOs

One watershed in Charles County has an approved TMDL for bacteria for shellfish harvesting: the Lower Patuxent River watershed. The Indian Creek watershed is the only affected portion of the Lower Patuxent River within Charles County.

Bacteria Source Tracking (BST) analysis was not performed for this TMDL. Instead, the best available data was used to calculate sources of fecal coliform in the Lower Patuxent River basin. The calculations were based on the following input data and are calculations of watershed loads, not the loads based on instream concentrations used for the TMDL.

- Population, septic systems, and sewer coverage
- Factors for number of dogs and FC production per dog
- Wildlife habitat, density per acre, and FC production per animal
- Livestock census and FC production per animal

The largest sources of bacteria in the Indian Creek watershed reported in the TMDL were identified as livestock (64.7%) and wildlife (21.6%), followed by pets (12.9%) and human (0.8%). The sources are significant in relation to permit conditions. The TMDL only included domestic pets and urban wildlife as contributors to the SW-WLA subject to the permit. There are no sanitary sewers in the watershed so septic systems are the only human sources. While a priority for reduction, they are in a different source sector and are not subject to the NPDES MS4 permit.

Subsequent to issuing the TMDL, a BST analysis was completed which showed a different breakdown of sources than the TMDL assessment. The BST indicated a higher level of bacteria from human and domestic pets than the original assessment.

The bacteria sources listed as MS4 sources are all diffuse sources which enter the drainage system either through runoff or cross-connections. These sources can be treated either by stormwater BMPs or load reduction strategies. Loads from the non-point source list are either discrete sources which can only be addressed through a load reduction approach or diffuse rural sources that do not flow to storm drains.

2.2.2 Summary of Findings from Lower Patuxent Assessment

The Lower Patuxent Watershed Assessment consisted of neighborhood source assessments, hotspot site investigations, nutrient synoptic survey, and stream corridor assessments.

All of the neighborhoods assessed were found to have a moderate pollution severity rating for the potential for nutrient, bacteria, sediment, and oil and grease pollution. Opportunities for restoration actions including rain barrels, rain gardens, and downspout disconnections were identified in many of the neighborhoods. One hotspot site was investigated and was determined to be a potential hotspot.

A total of 14 synoptic sites were sampled for water quality and discharge measurements throughout the watershed. Two sites had pH values below the minimum threshold. Nutrients including total nitrogen and nitrate/nitrite were found to be low at all sites. Total phosphorus concentrations were high at 2 sites, moderate at 7 sites, and low at the remaining 3 sites. Orthophosphate was found to be excessive at all sites. Elevated bacteria levels were found at five sites.

Field crews conducted stream corridor assessments on approximately 1.5 miles of streams. Inadequate buffer and erosion were the most widespread and frequent problems identified. Point severity ranged from severe to minor, however no points received a rating of very severe. These assessments helped identify a stream restoration project in the watershed.

2.2.3 Modeling Approach

Bacteria loads were modeled with a spreadsheet analysis. Because of the high variability in loading, sources which are difficult to identify or quantify, unknown processes of die-off or growth, and lack of data, more sophisticated modeling does not provide a significantly better estimate of loads or reductions to justify the additional effort.

The information used in the TMDL to determine source contributions was sufficient to develop a load analysis for Charles County’s urbanized area representing the WLA and the rural area representing the LA. Loads from the source categories listed in Table 23 were estimated as follows:

Human Sources

Sanitary sewers: Illicit discharges, exfiltration, and overflows do not exist in the watershed and were not modeled.

Combined sewers: There are no combined sewers in the watershed, so overflows were not modeled.

Homeless population: Because of the low-density suburban nature of the land use in the watershed, it was assumed that loads from the homeless were negligible.

Recreational boating: There are no marinas or locations for boating in the watershed. Loads were assumed to be negligible.

Septic Systems: Sewage for the entire watershed is treated with septic systems. These were modeled with data from Charles County and from the TMDL. Loading estimates were based on the discharge from the septic system leach field, with no attempt to model decay or transport to the receiving water.

Both working and failed systems were modeled. For both, the loads from wastewater generated by the watershed population were required. The loading per person was derived from default data presented in the TMDL source analysis and worked out to 26.5 bn MPN/day.

Population on septic systems was calculated using the County's parcel data. Parcel data was clipped to the Indian Creek watershed, and the year built was used to determine that 325 parcels had the potential to contribute wastewater to septic systems. Population was estimated using data from the TMDL for the entire watershed, including both counties and all urban and rural area. The result was an average of 2.4 people per septic system.

Agricultural and residential parcels consisted of single-family residences. The commercial, institutional, and industrial uses included day care, taverns, and churches with a larger population of users; however, an assumption was made that these facilities would draw from the local population and would not add a significant amount of load from outside the watershed.

Table 24: Baseline Parcels and Population on Septic in 2001

Land Use	Number of Parcels	Population on Septic
Agricultural	13	31
Commercial	10	24
Commercial / Residential	13	31
Institutional	9	22
Industrial	4	10
Residential	268	643
No Data	8	19
TOTAL	**325**	**780**

The overall load of wastewater generated by the population of 780 people was 20,670 bn MPN/day. Discharge was based on an estimate of the number of working and failed systems. Charles County instituted design requirements for separation from groundwater in 1990. Systems built prior to that have a higher chance of failure. The parcel analysis indicated that 170 of the systems in the watershed (52%) were built prior to 1990. For the purposes of the analysis, an assumption was used that 7.5% had failed, consistent with MDE's estimate of failures statewide.

Discharge from working systems was calculated assuming that all were conventional systems, with a reduction rate of log 3.5, or 99.968 percent. Failed systems were assumed to discharge the entire wastewater load. Loads from working systems were 7 bn MPN/day and from failed systems, 1,550 bn MPN/day.

Domestic

Pets, Rural Areas. Based on the parcel analysis, there were only a minimal number of dwelling units in rural areas of the watershed, essentially the 13 agricultural parcels. Loads from these sources were not modeled.

Pets, Urban Areas. The parcel analysis showed there were 268 residential parcels in the watershed. Contributions from dogs were the only bacteria sources considered in the TMDL. Using the calculations provided, pet waste contributed 125 bn MPN/day to the watershed load, as follows:

Table 25: Bacteria Loads from Domestic Pets

Parameter	Units	Factor	Calculation
Households	number		268
Dogs/household	percent	41%	110
% walkers	percent	56%	62
% that don't pick up	percent	41%	25
FC / dog	bn MPN/day	5.0	
TOTAL	**bn MPN/day**		**125**

Wildlife

Certain wildlife can be found in urban areas, including raccoons, resident geese, and deer, all of which were part of the TMDL assessment of wildlife loads. Wildlife loads were estimated using the data from the TMDL on species, density per type of habitat, GIS calculations of habitat area, whether the habitat was in urban or rural land use, and production per animal. Results are shown in Table 26 and Table 27.

Table 26: Wildlife Population

Wildlife	Density	Density Units	Habitat	Habitat (ac)		Population	
				Urban	Rural	Urban	Rural
Beaver	4.8	animals/ mile of stream	Tidal and non-tidal regions	1.3	9.1	6	43
Deer	0.047	animals/acre	Entire watershed	1,509.0	2,411.4	71	113
Goose	0.087	animals/acre	Entire watershed	1,509.0	2,411.4	131	210
Duck	0.039	animals/acre	Entire watershed	1,509.0	2,411.4	59	94
Muskrat	2.75	animals/acre	Within 66 feet of streams and ponds	8.4	54.5	23	150

Wildlife	Density	Density Units	Habitat	Habitat (ac)		Population	
				Urban	Rural	Urban	Rural
Raccoon	0.07	animals/acre	Within 600 feet of streams and ponds	76.6	495.8	5	35
Wild Turkey	0.01	animals/acre	Entire watershed	1,509.01	2,411.43	15	24

Table 27: Bacteria Loads from Wildlife

Wildlife	Bacteria per Animal (bn MPN/day)	Urban Load (bn MPN/day	Rural Load (bn MPN/day
Beaver	0.25	1.50	10.75
Deer	0.50	35.50	56.50
Goose	2.43	318.33	510.30
Duck	0.034	143.37	228.42
Muskrat	1.00	0.78	5.10
Raccoon	0.093	5.00	35.00
Wild Turkey	0.25	1.40	2.23
	TOTAL	**505.9**	**848.3**

Livestock

The TMDL estimated livestock population based on pro-rating Countywide data to the land use area within Indian Creek. The data were reviewed and visually compared with aerial photography of the watershed. The results of the assessment were that there were no large pastured areas with significant numbers of livestock. An estimate of 20 horses on small hobby farms was used for the livestock loading analysis. This resulted in a small load of less than two bn MPN/day.

Table 28: Bacteria Loads from Livestock

Livestock	Bacteria per Animal (bn MPN/Day)	Percent Confined	% Manure For Washoff	Net Loading Rate	Urban Load (bn MPN/Day	Rural Load (bn MPN/Day
Cows	0.25	20%	40%	3.84	0.0	0.0
Chicken	0.50	85%	10%	2.04E-03	0.0	0.0
Pig	2.43	100%	40%	0.00E+00	0.0	0.0
Sheep	0.034	50%	40%	2.40	0.0	0.0
Horse	1.00	50%	40%	0.08	1.68	0.0
	TOTAL				**1.7**	**0.0**

2.2.4 Reduction Target Derivation

The Indian Creek fecal coliform bacteria SW-WLA is listed on MDE's TMDL data center as an aggregate; however; the SW-WLA is implicitly disaggregated. The SW-WLA for stormwater was estimated in the TMDL by considering the urban land area in the watershed to be the regulated stormwater, and calculating the SW-WLA by pro-rating the allowable load to the urban land. Since the only permitted jurisdiction in the watershed is Charles County, the County's urban land was used for the calculation. This resulted in a pro-rated percentage of 10.6% of the TMDL and a total of 15.6 bn MPN/day for the SW-WLA, shown in the tables below. It should be noted that this method of estimating the SW-WLA includes loads from all sources, including human, domestic pets, wildlife, and livestock as part of the regulated urban load.

Table 29: Indian Creek Land Use Distribution

Land Use	Total Area (ac)	Charles County (ac)	Charles County (%)	St. Mary's County (ac)	St. Mary's County (%)
Non-Urban	5,710.1	3,090.2	39.4%	2,619.8	33.4%
Regulated Urban	829.1	829.1	10.6%		0.0%
Non-regulated Urban	1,309.8		0.0%	1,309.8	16.7%
Total	7,849.0	3,919.4	49.9%	3,929.6	50.1%

Source: TMDL Tables C-2 and C-3

Table 30: Stormwater Waste Load Allocation (WLA) and Load Allocation (LA) (bn MPN/day)

	SW-WLA	LA	TMDL
Charles County	15.6	57.7	73.3
St. Mary's County	0.0	73.4	73.4
Published Total	15.6	131.1	146.7

Source: TMDL Section 4.8

Review of the TMDL modeling shows that the allowable load was derived from the water quality criteria and the current load from monthly monitoring data. As a result, the TMDL computation is based on instream loads calculated from measurements of concentration in the receiving water. Watershed loads, calculated from sources which are not transported and which have not undergone transformation such as die-off are required for restoration analysis.

Watershed loads have been modeled with a spreadsheet analysis. As a result, the load analysis performed for implementation modeling calculates watershed loads and reductions only. These loads cannot be compared to the baseline, WLA, and LA loads in the TMDL.

This approach allows the County to use its best land use and treatment data to develop baseline loads and reduction targets consistent with the baseline TMDL date of 2001. The information used in the TMDL to determine source contributions was sufficient to develop a load analysis for Charles County's urbanized area representing the WLA and the rural area representing the LA.

The modeled load reduction for the bacteria SW-WLA is the target for the Indian Creek bacteria local TMDL. This value is presented in bold in Table 31. The modeling method used for the bacteria TMDL for reductions and planning scenarios is described further in section 2.2.

Table 31. Lower Patuxent River- Indian Creek (021311010887) Disaggregated and Calibrated Local TMDL SW-WLAs and Load Reductions

Baseline Year	WLA Type	Baseline Model[1]	Pollutant	Unit	MDE Published SW-WLA	MDE Published Reduction %[2]	Baseline Loads[3]	Load Reductions[4]	WLA[5]
2001	Individual	Steady state tidal prism	Fecal Coliform Bacteria	billion MPN/day	15.6	43.94%	3,038	**1,335**	1,703

Target load reductions used in the Restoration Plan shown in bold text.

1) Baseline model used to create the TMDL.
2) Published WLA and Reduction % from the MDE TMDL Data Center SW WLAs for County Storm Sewer Systems in Charles County and from TMDL documentation.
3) Disaggregated baseline loads calculated by development of independent model.
4) Disaggregated load reductions were calculated from the disaggregate baseline loads and reduction %.
5) WLA calculated by subtracting the load reduction from the baseline load.

2.2.5 2015 Progress

Between the baseline year of the TMDL and 2015, two septic systems were upgraded with Best Available Technology (BAT) for nitrogen removal in the Indian Creek watershed, with data showing that one was a replacement system and one was repaired. Assuming these systems were failed at the time of upgrade, bacteria loadings would have been reduced by 64 bn MPN/day.

2.2.6 Restoration Plan

The implementation approach for the restoration plan is to address all sources described in Table 22, regardless of whether they are attributable to MS4 discharges or non-point sources. In particular, the County plans to work with the alternate approach described in MDE's bacteria TMDL guidance (MDE 2014) which states that the priority is to address human sources due to the greater health risk. Even though the TMDL does not describe any human sources that discharge through the MS4, reducing loads from non-MS4 sources such as septic systems will be an acceptable method of meeting the TMDL requirement.

Human - Septic Systems Bacteria loads from working systems were not affected by any restoration programs. The projects planned for failed systems are septic system denitrification upgrades, which will bring the systems back to working status, and add additional treatment to reduce nitrogen loads significantly. Upgrades will repair failures to the septic tank structure and the drainfield, allowing the system to reduce bacteria loads as originally designed. It is currently estimated that 24 septic upgrades will provide the level of treatment needed to meet the SW-WLA goals.

As part of an adaptive management strategy, the County will work to better characterize the number of failed systems and the impact and loading from them. It is anticipated that this analysis will improve the ability to target restoration to areas where it can be most effective.

Domestic - Pets The planned reduction in pet waste will be accomplished through expanding existing programs to encourage dog owners to clean up after their pets. The goal is to increase awareness through a number of outreach activities targeted to residents in the Indian Creek watershed with the goal of changing the fraction of dog walkers who pick up waste from 60% to 70%.

Wildlife - Urban No programs are planned to address this source. While goose management can be a successful method of reducing bacterial loads, the watershed does not have open water locations such as ponds where the birds congregate and where management practices can be applied easily. Other wildlife species are similarly dispersed and it is not feasible to reduce the population.

Wildlife - Rural No programs are planned to address this source.

Livestock No programs are planned to address this source. There are no areas of pasture where livestock have access to streams for water so off-stream watering or fencing would not reduce livestock pollution. The minimal loads from this source did not justify additional effort for pollutant load reductions.

2.2.7 Load Reductions Expected

The required reduction could not be met with the sources discharging to the storm drain system, however, by including septic system upgrades as a restoration strategy, the target percentage reduction from the TMDL can be met. Two upgrades before 2015 provided a small reduction in loading. Upgrades for the estimated remaining failed systems will meet more than the required WLA reduction, along with reducing the priority source from human contributions.

	TMDL Bacteria (bn MPN/day)	Modeled Bacteria (bn MPN/day)
Baseline and Targets		
2001 Baseline Loads with BMPs	261.5	3,038
Target Percent Reduction	43.94%	43.94%
Reduction Required	114.9	1,335
WLA	146.6	1,703
2015 Progress Reductions		
Restoration Reduction (from baseline to 2015)	-	64
Restoration Reduction Percent	-	2.11%
Reduction Remaining for Treatment	-	1,271
Planned Reduction Programs		
Pet Waste Outreach	-	30
Septic System Replacement	-	1,549
Summary		
Reduction (Progress + Planned)	-	1,643
Reduction Percent (Progress + Planned)	-	54.08%
Reduction Remaining for Treatment	-	0

2.2.8 Cost and End Date of Indian Creek TMDL Restoration

The costs to implement projects and programs to meet the Indian Creek TMDL have been estimated based on the implementation described above. Septic system upgrades for 24 systems, at an average of $13,000 per upgrade would total $312,000. A targeted pet waste outreach program using door hangers, a returnable pledge to pick up pet waste, and potentially a give-away of dog waste bags has been preliminarily estimated at $5,000.

The end date for implementation based on the above is expected to occur by 2025.

2.3 Potomac River PCB TMDL

The Potomac River Lower Tidal, Middle Tidal, and Upper Tidal watersheds each have polychlorinated biphenyl (PCB) TMDLs (Haywood and Buchanan, 2007). The TMDL was developed in 2007 and approved by USEPA on October 31, 2007. Figure 10 shows the location of the Potomac River Tidal watershed within Charles County.

2.3.1 Potomac River PCB Disaggregation

The Potomac PCB TMDL presents SW-WLAs for each jurisdiction, therefore no additional disaggregation was required to determine Charles County's allocation.

The EPA requires stormwater discharges to be included in the WLA of a TMDL. The WLA percent reduction for the Lower, Middle, and Upper Potomac River Tidal in Charles County is 5%. This 5% reduction is due to the Margin of Safety (MOS) built into the TMDL calculation. According to the TMDL, "it is expected that the proposed 93% reduction in atmospheric deposition of PCBs will yield the 5% reduction in stormwater loads represented by the MOS" (Haywood and Buchanan, 2007). Consequently, reduction strategies from the stormwater sector in Charles County are not necessary to meet the overall TMDL.

2.3.2 Sources

PCBs are a group of man-made organic chemicals. They were widely used as coolants and lubricants in electrical equipment. New production of PCBs has been banned since 1979 since they have been classified as a probable human carcinogen. While new production has been banned, the compounds are still used in existing equipment and are transported into the environment through inadequate disposal, leaks, fires, and spills. PCBs do not break down easily and bioaccumulate in aquatic environments.

Sources of PCB to the Potomac are grouped into six categories: the non-tidal Potomac River at Chain Bridge, lower basin tributaries, direct drainage, wastewater treatment plants (WWTPs), combined sewer overflows (CSOs), atmospheric deposition to the water surface, and contaminated sites. The WLA portion of the TMDL includes WWTPs, regulated stormwater, and CSOs. As stated previously, 5% MOS reduction is expected to be achieved through the proposed 93% reduction in atmospheric deposition, therefore strategies for PCB reduction will not be addressed in this report.

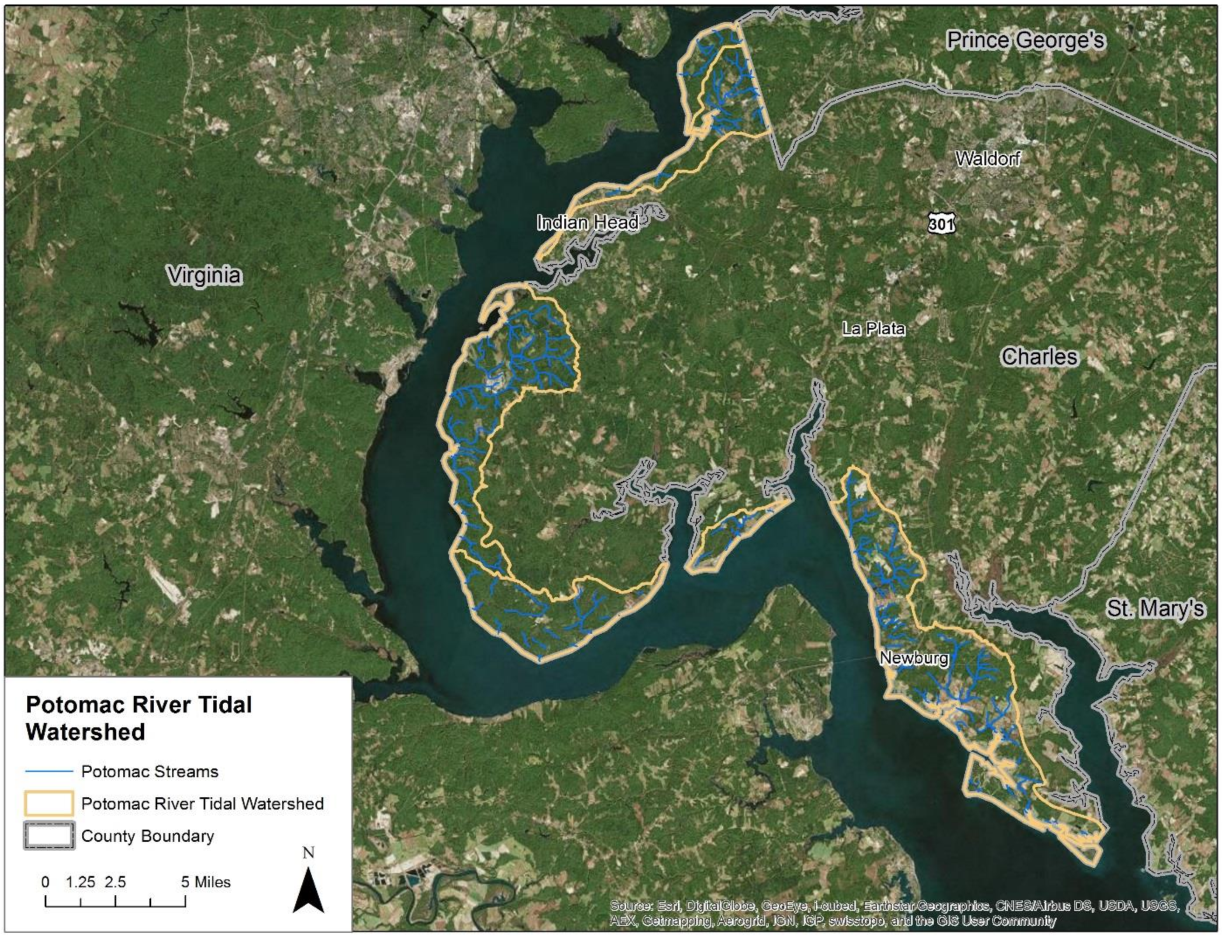


Figure 10. Potomac River Tidal Watershed

Table 32. Tidal Potomac River Upper (02140201), Middle (02140102, and Lower (02140101) Disaggregated and Calibrated Local TMDL SW-WLAs and Load Reductions

Baseline Year	WLA Type	Baseline Model[1]	Pollutant	Unit	MDE Published SW-WLA	MDE Published Reduction %[2]	Baseline Loads[3]	Load Reductions[4]	WLA[5]
2005	Individual	POTPCB	PCBs	grams/yr	12.6	5%	13.2	**0.6**	12.6

Target load reductions used in the Restoration Plan shown in bold text.

1) Baseline model used to create the TMDL. Potomac PCB Model (POTPCB).
2) Published WLA and Reduction % from the MDE TMDL Data Center SW WLAs for County Storm Sewer Systems in Charles County and from TMDL documentation.
3) Baseline load from Table 12 in PCB TMDL (Haywood and Buchanan, 2007).
4) Load reduction from Table 12 in PCB TMDL (Haywood and Buchanan, 2007).
5) WLA from Table 12 in PCB TMDL (Haywood and Buchanan, 2007).

3 Chesapeake Bay TMDL and Impervious Surface Reduction

Charles County's stormwater sector is required by its MS4 NPDES permit to meet the Bay TMDL requirements by completion of the 20% impervious surface restoration; therefore these two programs and goals are described together in this section. The impervious surface restoration is required to be met by the end of the County's permit term in December of 2019, and the Bay TMDL is required to be met by 2025.

3.1 Impervious Restoration

3.1.1 Impervious Surface Analysis

Impervious surfaces concentrate stormwater runoff, accelerating flow rates and directing stormwater to the receiving stream. This accelerated, concentrated runoff can cause stream erosion and habitat degradation. Runoff from impervious surfaces picks up and washes off pollutants and is usually more polluted than runoff generated from pervious areas. In general, undeveloped watersheds with small amounts of impervious cover are more likely to have better water quality in local streams than urbanized watersheds with greater amounts of impervious cover. Impervious cover is a primary factor when determining pollutant characteristics and loadings in stormwater runoff.

The degree of imperviousness in a watershed also affects aquatic life. There is a strong relationship between watershed impervious cover and the decline of a suite of stream indicators. As imperviousness increases the potential stream quality decreases with most research suggesting that stream quality begins to decline at or around 10 percent imperviousness (Schueler, 1994; CWP, 2003). However, there is considerable variability in the response of stream indicators to impervious cover observed from 5 to 20 percent imperviousness due to historical effects, watershed management, riparian width and vegetative protection, co-occurrence of stressors, and natural biological variation. Because of this variability, one cannot conclude that streams draining low impervious cover will automatically have good habitat conditions and a high quality aquatic life.

Figure 11 shows the distribution of impervious cover within the County using the County's 2011 planimetric impervious surface spatial data. Table 8 presents a summary of the countywide impervious cover totals by watershed and Table 33 presents a summary of impervious cover totals by each NPDES source sector by watershed, both using analysis with the County's 2011 planimetric impervious GIS data.

The total impervious surface acreage for Charles County using 2011 planimetric data is 14,883.9 acres, or 5.0% of the county. Mattawoman Creek is the watershed with the most impervious acres and largest percentage of imperviousness, at 4,323.5, or 9.7% of total watershed area, respectively (Table 8). It is noted too that most of the impervious cover in the Mattawoman is focused in the upper portion of the watershed in the Waldorf area and along the US Route 301 corridor. The watershed with the lowest impervious percentage is Nanjemoy Creek at 1.9%. Table 33 presents percent impervious cover by watershed and NPDES source sector. The majority of the County's impervious cover is within the County MS4 Phase I source sector (87.6%) with some impervious cover owned by Maryland State Highway Administration (SHA) (8%), within the Federal Phase II MS4 (2.8%), other State-owned property (1.2%), and some regulated industrial facilities (0.4%).

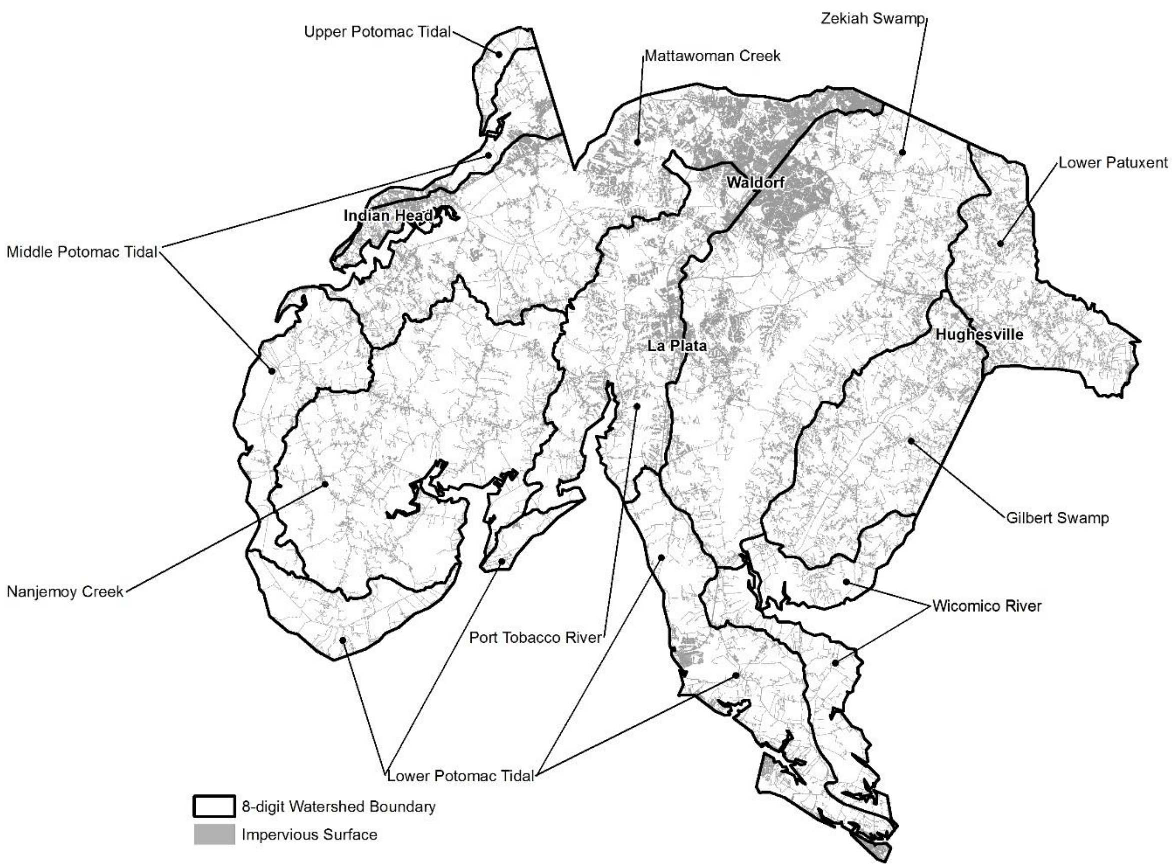


Figure 11. Distribution of impervious cover within Charles County (as of 2011)

Table 33. Percent Impervious Cover by Watershed and NDPES Source Sector

Watershed Name	Total Impervious Acres	County Phase I MS4	Federal Property	Municipal Phase II MS4	Regulated Industrial Facility	SHA Phase I MS4	State Property
Gilbert Swamp	1,010.7	92.9%	0.0%	0%	0.5%	6.4%	0.2%
Mattawoman Creek	4,323.5	83.6%	5.7%	0%	0.6%	8.8%	1.4%
Nanjemoy Creek	903.3	90.4%	0.5%	0%	0.0%	8.4%	0.7%
Patuxent River Lower	839.8	89.9%	0.0%	0%	0.0%	7.2%	2.8%
Port Tobacco River	1,961.5	66.2%	0.4%	22.4%	0.6%	9.5%	0.8%
Potomac River L Tidal	945.2	87.6%	2.9%	0%	0.7%	8.6%	0.2%
Potomac River M Tidal	621.5	64.6%	19.3%	0%	0.0%	11.2%	4.9%
Potomac River U Tidal	48.1	67.3%	32.7%	0%	0.0%	0.0%	0.0%
Wicomico River	388.7	85.0%	0.0%	0%	0.0%	13.3%	1.7%
Zekiah Swamp	3,841.5	85.3%	0.0%	7.9%	0.1%	5.9%	0.8%
Countywide Total	**14,883.9**	**82.6%**	**2.8%**	**5.0%**	**0.4%**	**8.0%**	**1.2%**

3.1.2 20% Impervious Restoration Goal

As a requirement of section PART IV.E.2.a of the NPDES MS4 Discharge Permit issued by MDE to Charles County, the County must conduct an impervious area assessment to define the restoration efforts required under the permit to restore 20% of remaining Countywide baseline impervious acres not already restored to the MEP. The restoration is required to be complete by 2019, the end of the current permit term.

Vista Design, Inc. was contracted by Charles County in May 2013 to complete an impervious surface area assessment, which resulted in the *Stormwater Management by Era and Impervious Surface Area Assessment Report* (Vista, 2015a). Data presented in this section was provided in Vista, 2015a and related GIS files from the impervious surface assessment.

The first step in this process is to determine the County's MS4 area of jurisdiction and the baseline impervious surface area that is treated, untreated, and partially treated. The County's GIS planimetric impervious layer was used as the basis for the analysis. Using this layer in combination with treatment from existing BMPs, the amount of untreated impervious surfaces was obtained and the 20% then applied. Existing BMPs include structural stormwater BMPs and other treatment including rooftop and non-rooftop disconnects.

Impervious accounting methodology is provided here with results at the watershed and County scale presented in Table 34. The impervious analysis was developed at the parcel scale. Each parcel was analyzed independently of others such that more than 65,000 parcels were evaluated individually to create a more accurate assessment. The following stormwater eras and analyses were used to derive the baseline values and 20% treatment target:

- **ERA 0** – Areas undeveloped or outside County jurisdiction – Impervious areas under public ownership other than County ownership and impervious areas regulated under other NPDES stormwater permits, such as Phase II or Industrial, were removed as they are not under County MS4 jurisdiction. Parcels considered "non-county" included the municipal limits of La Plata and Indian Head; however county-owned properties within these municipal limits were included. Other parcels not included are agricultural land, undeveloped forests, and properties assessed but with an improvement value of less than $10,000, owned by the State of Maryland, owned by the Federal Government, or within a preserved area. There were also 45 identified industrial permitted facilities with NPDES permits that were not included.
- **ERA 1** – Prior to 1985 stormwater management was not required at the state level. Some development may have included stormwater design techniques; however development occurring before 1985 is generally considered to not have stormwater adequate management in place, particularly in regards to water quality treatment. Era 1 locations make up a large portion of the County's untreated impervious area baseline.
- **ERA 2** – Between 1985 and 2002 developments were required to implement stormwater BMPs according to the 1982 stormwater management law which required all new development to treat the first 0.5-inches of runoff from impervious surfaces. It has since been determined that the 0.5-inch treatment is not adequate for full water quality treatment therefore these areas are considered partially treated. Therefore these areas make up a portion of the baseline untreated value.
- **ERA 3** – Areas developed after 2002 under Maryland's 2000 Storm-water Design Manual were required to treat the first 1.0-inch of stormwater runoff from impervious surfaces. Areas of rural

development had the same requirement after 2004. Because treatment at the 1.0-inch level is consider to be providing full water quality treatment (treating 100% of the water quality volume or WQv), those areas developed after 2002 are considered fully treated and are part of the baseline treated portion of the County's overall impervious surfaces total.

- **ERA 4** – Areas developed under this era include more recent Environmental Site Design regulations. These areas, like those in era 3, provide treatment for the full water quality volume at the 1.0-inch runoff level and are therefore considered to be fully treated.
- **ERA 6** - Rooftop and Non-Rooftop Impervious Surface Disconnects– An analysis was conducted to determine those impervious areas (rooftops and non-rooftops i.e. roads, driveways parking lots) which drain to vegetative systems and may meet ESD requirements for impervious surface disconnection. These areas, with varying levels of treatment depending on the site conditions, were subtracted from the impervious untreated baseline and added to the treated portion.
- The result of the calculations Countywide yields the impervious acres that are fully treated, partially treated, and not treated.
- Untreated Impervious Area – Following from the impervious treatment analysis, the total acres of treatment were subtracted from the County's total MS4 impervious area and the result is the acres of untreated or partially untreated impervious area.
- 20% Target – A 20% factor was applied to the County's total untreated impervious acres to determine the restoration target.

Charles County's impervious baseline accounting is presented in Table 34 and Table 35. Countywide, the total County MS4 Impervious Area, or the area under Charles County jurisdiction, is 9,941.7 acres. The difference between this value and the total impervious area of 14,883.9 acres is impervious area under other ownership (state lands), areas regulated by other NPDES permits (MSHA and industrial sites), and undeveloped land which totals 4,942.2 acres.

The impervious baseline treated area is 2,893.9 acres and the untreated area is 7,047.8 acres. Applying the 20% factor to the untreated area yields a 20% restoration target of 1,409.6 acres. The levels of treated and untreated impervious area are shown per watershed, however the 20% restoration goal is implemented at the County scale and is therefore not shown at the watershed level.

3.1.3 Impervious Restoration Progress

Charles County has implemented several projects and programs in recent years that can be counted as progress towards the restoration goal. Progress as of 2015 is shown in Table 35.

Table 34. Impervious Accounting Results per Watershed

	Gilbert Swamp	Mattawoman Creek	Nanjemoy Creek	Patuxent River Lower	Port Tobacco River	Potomac River L Tidal	Potomac River M Tidal	Potomac River U Tidal	Wicomico River	Zekiah Swamp	Total
	Impervious Baseline and Target (Impervious Credit Acres)										
Total Impervious Area	**1,010.7**	**4,323.5**	**903.3**	**839.8**	**1,961.5**	**945.2**	**621.5**	**48.1**	**388.7**	**3,841.5**	**14,883.9**
County MS4 Impervious Area[1]	**550.2**	**3,326.4**	**522.9**	**611.9**	**1,202.7**	**443.8**	**286.3**	**34.7**	**160.9**	**2,801.8**	**9,941.7**
Era 1: Pre-1985 Stormwater BMPs	403.3	1,575.3	399.1	397.2	648.2	350.6	198.2	26.4	125.0	1,761.7	5,885.0
Era 2: 1985 - 2002 Stormwater BMPs	58.0	1,123.2	12.7	102.3	300.6	21.3	41.4	3.8	4.1	450.5	2,118.0
Era 3: 2002 - 2013 Stormwater BMPs	27.0	420.9	30.2	65.9	139.2	33.9	13.0	1.2	15.9	428.8	1,175.9
Era 4: ESD Regulations	9.4	64.4	10.5	17.3	54.9	11.3	1.2	0.1	6.5	44.2	219.7
Era 6: Rooftop Disconnect	52.5	142.7	70.5	29.2	59.8	26.6	32.4	3.3	9.3	116.6	543.0
Impervious Baseline Treated	**108.8**	**1,157.3**	**109.2**	**158.8**	**389.2**	**78.5**	**63.9**	**5.6**	**32.4**	**790.1**	**2,893.9**
Impervious Baseline Untreated	**441.4**	**2,169.1**	**413.7**	**453.1**	**813.5**	**365.3**	**222.4**	**29.2**	**128.5**	**2,011.6**	**7,047.8**
20% Restoration Target											**1,409.6**

1) Excludes Era 0 impervious, which includes impervious area under other ownership (state lands), areas regulated by other NPDES permits (MSHA and industrial sites), and undeveloped land which totals 4,942.2 acres.

Table 35. Impervious Restoration 2015 Progress per Watershed

	Gilbert Swamp	Mattawoman Creek	Nanjemoy Creek	Patuxent River Lower	Port Tobacco River	Potomac River L Tidal	Potomac River M Tidal	Potomac River U Tidal	Wicomico River	Zekiah Swamp	Total
Impervious Baseline and Target (Impervious Credit Acres)											
County MS4 Impervious Area	**550.2**	**3,326.4**	**522.9**	**611.9**	**1,202.7**	**443.8**	**286.3**	**34.7**	**160.9**	**2,801.8**	**9,941.7**
Impervious Baseline Treated	**108.8**	**1,157.3**	**109.2**	**158.8**	**389.2**	**78.5**	**63.9**	**5.6**	**32.4**	**790.1**	**2,893.9**
Impervious Baseline Untreated	**441.4**	**2,169.1**	**413.7**	**453.1**	**813.5**	**365.3**	**222.4**	**29.2**	**128.5**	**2,011.6**	**7,047.8**
20% Restoration Target											**1,409.6**
2015 Progress Impervious Restoration (Impervious Credit Acres)											
2015 Restoration Progress	0.0	49.5	0.0	0.2	0.0	0.0	0.0	0.0	0.0	46.3	95.9
Septic Credits	5.2	16.7	6.5	7.0	16.0	11.6	2.7	1.6	4.5	12.5	84.3
Total 2015 Progress Restoration	**5.2**	**66.2**	**6.5**	**7.2**	**16.0**	**11.6**	**2.7**	**1.6**	**4.5**	**58.8**	**180.2**
Remaining Impervious Restoration											**1,229.4**

The table builds on the impervious accounting information included in Table 34 in the previous section, but adds the restoration progress completed between July 1, 2013 and November 2015. Results are provided at the watershed level for informational purposes only and to aid in planning and targeting future restoration efforts, the 20% requirement is to be met at the County scale, not at the watershed scale. The results indicate that the County has 180.2 impervious acres of restoration to apply to its 20% goal, leaving 1,229.4 acres of impervious restoration to be completed by the end of the permit term in December, 2019.

Projects implemented to date have been located in the Mattawoman (5 projects), Zekiah (4 projects) and Lower Patuxent (1 project) Watersheds. These projects were identified in earlier watershed assessments conducted by the County in 2004, 2007 and 2011. The sites are located in the neighborhoods of Benedict, Pinefield, Bryans Road, Fox Run, Ryon Woods and Carrington. The types of projects include stormwater retrofits to shallow marsh wetland facilities, SPSC, rain gardens, pond retrofits and dry swales.

A full list of completed projects is included in Appendix A.

3.1.4 Planned Impervious Restoration (Scenario 1)

The following describes the level of project implementation and cost that would be required to meet the 20% goal by 2019 fully by completing projects wholly within the stormwater sector (Scenario 1). Subsequent sections will describe the potential for the County to use cross-sector trading with the wastewater sector to ensure compliance by 2019 and still meet the restoration goals.

The County has identified a suite of stormwater projects that if completed can meet the 20% restoration goals. These projects are included in Levels 2-7 of the County's project planning list and represent a total of 65 additional projects to implement before December 2019. The projects are summarized in Table 36 with the levels of planned impervious treatment and the numbers of projects shown. Also shown are the reductions expected from the operational programs.

The planned projects and programs collectively are expected to treat an additional 1,582.6 impervious acres, which would exceed the 20% goal and result in treatment of 22.5%. When added to the 2015 progress results (180.2 acres) the total impervious treatment planned is 1,762.8 acres or 25.0%.

It is likely that many projects currently identified may not succeed in producing the anticipated level of treatment once the project has done through full design and construction. Additionally, some projects will likely not move forward from concept stages to full design based on additional feasibility analyses. The addition treatment currently identified represents a planning buffer and some level of assurance that the level of required projects may be feasible.

Additional projects and programs are identified in Levels 8 and 9 that can be used if feasibility for those in Levels 2-7 deems those projects less desirable or beneficial. Level 8 are projects identified by Vista, BayLand and GMB that were not as cost effective (cost per impervious acre treated) than those selected for further development. Level 9 projects are those identified by KCI in the watershed assessments in Port Tobacco, Mattawoman and Lower Patuxent watersheds. These projects will also need to be incorporated into the full prioritization and planning process to ultimately select the best projects to move forward with.

Table 36. Scenario 1 - Levels of Planned Stormwater Sector Restoration Required per Watershed to meet 20% Goal

	Gilbert Swamp	Mattawoman Creek	Nanjemoy Creek	Patuxent River Lower	Port Tobacco River	Potomac River L Tidal	Potomac River M Tidal	Potomac River U Tidal	Wicomico River	Zekiah Swamp	Total
Planned Impervious Restoration (2016-2019) (Impervious Credit Acres)											
Level 2 In Construction	0.0 (0)	55.5 (3)	2.9 (1)	0.0 (0)	0.0 (0)	0.0 (0)	21.4 (1)	0.0 (0)	0.0 (0)	5.3 (1)	85.0 (6)
Level 3 In Design	0.0 (0)	351.3 (15)	0.0 (0)	18.0 (1)	6.0 (1)	66.2 (2)	0.0 (0)	0.0 (0)	0.0 (0)	233.5 (5)	675.0 (24)
Level 5 ISA Baseline Reductions	0.0 (0)	0.7 (2)	0.0 (0)	0.0 (0)	26.1 (5)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	102.6 (9)	129.3 (16)
Level 6 Concept Design High Priority	0.0 (0)	66.5 (6)	0.0 (0)	0.0 (0)	18.4 (2)	82.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	166.9 (9)
Level 7 Concept Design Medium Priority	0.0 (0)	15.3 (4)	0.0 (0)	0.0 (0)	21.4 (5)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	36.6 (9)
Levels 2-7 Total	**0.0 (0)**	**489.3 (30)**	**2.9 (1)**	**18.0 (1)**	**71.9 (13)**	**148.2 (3)**	**21.4 (1)**	**0.0 (0)**	**0.0 (0)**	**341.4 (15)**	**1,093.1 (64)**
Operational Reductions	0.1	157.1	0.0	0.0	3.4	0.0	4.4	0.2	0.0	119.1	284.3
Septic Reductions	4.5	12.8	4.2	11.3	10.5	6.1	1.6	0.9	2.3	10.4	64.7
Homeowner Reductions	0.0	39.2	0.0	19.9	81.4	0.0	0.0	0.0	0.0	0.0	140.5
Total Reductions	**4.6**	**698.4**	**7.1**	**49.2**	**167.2**	**154.3**	**27.4**	**1.1**	**2.3**	**470.9**	**1,582.6**

Notes: Total may not match sum of values in the table due to rounding. Implementation for structural projects in Levels 2-7 are listed as Impervious Acres Treated and (Number of Projects). Operational Reductions include street sweeping and storm drain cleaning. Septic reductions include upgrades, pump-outs and connections.

3.1.5 Planned Impervious Restoration (Scenario 2)

The County is currently investigating the potential for cross-sector trading-in-time with the wastewater sector to assist in meeting the 20% restoration goal by 2019. The proposed trading-in-time is a temporary balancing of permitted discharges, by an owner of multiple discharge permits, for the purpose of maintaining permit compliance, in the interim of implementing additional stormwater sector projects to achieve target restoration goals. MDE in January 2016 published draft guidance on water quality trading across sectors that for the first time allowed the MS4 sector to participate with the agricultural and wastewater sectors (MDE, 2016). Charles County is interested in, and is exploring the feasibility of trading with credits from its municipal waste water treatment plants that have demonstrated additional capacity under their loading caps.

Currently the draft guidance is under review and comment by many interested parties including municipalities, and there are many details to be sorted out and finalized; however the following trading elements are understood to currently be a part of the process that would impact the County's intra-jurisdictional trading.

- Point sources (MS4) may participate
- Waste water sector (WWTP) may participate
- Trading could be used for up to half of the County's 20% impervious surface restoration goal
- Trading is preferred to occur with three geographic boundaries (Potomac River Basin, Patuxent River Basin, and Easter Shore/Western Shore Tributary Basins including the Susquehanna
- Delivery factors may apply if trading occurs across the geographic boundaries
- Trading should occur within a priority order
    - Within a local watershed under a TMDL
    - Within the regulated MS4 jurisdiction
    - Within any 8-digit watershed that extends beyond the MS4 boundary
    - Within Maryland Trading Regions (only after the first three priorities have been exhausted)

Currently the guidance calls for a 20 year duration of credits to include two full five year permit terms and a plan to demonstrate how the credits will be maintained for an additional 10 years. The County, and many other MS4 are advocating for "trading-in-time" or a temporary credit framework allocated on an annual basis. In this manner Charles County could use cross-sector trading to meet its 20% goal in 2019, but continue to implement stormwater sector projects and "pay back" the credit over time such that ultimately the full 20% goal would still be met through the stormwater sector.

Scenario 2 includes using currently unused load capacity at the County's Mattawoman WWTP to meet half (10%) of the restoration goal. It is anticipated that trading within a County, among County owned and operated NPDES permits will simplify the transaction. The following describes the preliminary analysis completed to demonstrate the feasibility of this trade.

The County's baseline untreated impervious area is 7,047.8 acres, which results in a 20% goal of 1,409.6 acres, and a 10% goal of 704.8 acres. Using MDE's impervious to loading equivalents (Table 37) we have calculated the loads (TN and TP) required to obtain a range of credits from 1% impervious baseline treatment to 10% impervious baseline treatment (Table 38).

Table 37. Impervious to Pollutant Load Conversion Rates

Parameter	Impervious (lbs/ac/yr)	Forest (lbs/ac/yr)	Delta (lbs/ac/yr)
TN	15.34	3.08	12.26
TP	1.7	0.08	1.62
TSS	0.56	0.03	0.53

The table below also provides a generic cost evaluation associated with each level of crediting between 1 and 10% using an average cost per impervious acre treated in the stormwater sector.

Table 38. Loading Equivalents and Associated Stormwater Sector Costs

Potential Trade Percent	Equivalent Impervious Acres	Cost of Impervious Treatment (Stormwater)	Equivalent TN Credits (lbs/yr)	Equivalent TP Credits (lbs/yr)	Equivalent TSS Credits (lbs/yr)
base numbers	1.00	$50,000	12.26	1.62	0.53
1%	70.48	$3,523,900	864.06	114.17	37.35
2%	140.96	$7,047,800	1728.12	228.35	74.71
3%	211.43	$10,571,700	2592.18	342.52	112.06
4%	281.91	$14,095,600	3456.24	456.70	149.41
5%	352.39	$17,619,500	4320.30	570.87	186.77
6%	422.87	$21,143,400	5184.36	685.05	224.12
7%	493.35	$24,667,300	6048.42	799.22	261.47
8%	563.82	$28,191,200	6912.48	913.39	298.83
9%	634.30	$31,715,100	7776.54	1027.57	336.18
10%	704.78	$35,239,000	8640.60	1141.74	373.53

From this analysis it is determined that to trade a full 10%, the waste water sector would need to have available loading capacity of 8,640.60 lbs/yr of TN, and 1,141.74 lbs/yr of TP. Table 39 presents the annual TN and TP loading and a five year average from 2010-2015. The 'Loading Capacity' indicates the additional capacity that would have been available each year to trade.

Table 39. Mattawoman WWTP Annual Loading Summary

Year	Total Effluent Flow (MGY)	Avg Daily Flow (MGD)	TN Conc. (mg/l) Annual Average	TN Loading (lbs/yr)	TN Loading Capacity (lb/yr)	TP Conc. (mg/l) Annual Average	TP Loading (lbs/yr)	TP Loading Capacity (lb/yr)
Cap				243,645			10,964	
2016*	1,034	11.36	7.29	63,690	179,955	0.06	532	10,432
2015	3,667	10.05	6.68	224,457	19,188	0.08	2,286	8,678
2014	3,979	10.90	4.06	147,286	96,359	0.09	2,969	7,995
2013	3,829	10.49	2.77	91,337	152,308	0.08	2,435	8,529
2012	3,519	9.64	1.88	55,554	188,091	0.08	2,354	8,610
2011	4,115	11.27	1.88	65,403	178,242	0.07	2,440	8,524
2010	3,952	10.83	3.58	133,609	110,036	0.07	2,131	8,833
Average**	3,844	10.53	3.48	119,608	124,037	0.08	2,436	8,528

* data available through March of 2016

** Average of annual values 2010-2015

Finally, the annual loading capacity is converted back to impervious area using the same impervious to load equivalents in Table 37. The results in Table 40 indicate that, on average, there is 14 times the TN capacity to meet the 10% trading limit, and 7.5 times the TP capacity to meet the 10% trading limit.

Table 40. Mattawoman WWTP Annual Impervious Equivalents

Year	TN Loading Capacity (lb/yr)	Impervious Area Equivalent (using TN)	Impervious Acre % Treated (using TN)	TP Loading Capacity (lb/yr)	Impervious Area Equivalent (using TP)	Impervious Acre % Treated (using TP)
2015	19,188	1,565.09	22%	8,678	5,356.79	76%
2014	96,359	7,859.62	112%	7,995	4,935.19	70%
2013	152,308	12,423.18	176%	8,529	5,265.01	75%
2012	188,091	15,341.86	218%	8,610	5,314.82	75%
2011	178,242	14,538.50	206%	8,524	5,261.57	75%
2010	110,036	8,975.20	127%	8,833	5,452.43	77%
Average	124,037	10,117.24	144%	8,528	5,264.30	75%

Additional information is required to determine the level of service and average daily flows to the plant estimated in future years to ensure that even a short-term trade would be feasible. The County's 2016 proposed comprehensive plan indicates an existing treatment capacity of 20 MGD (million gallons per day) and 80,000 EDU (equivalent dwelling units). Projections in the plan indicate a total demand in 2040 of 18.869 MGD and 75,477 EDU. A basic estimation using the remaining capacity of 1.131 MGD and the five-year average TN concentration of 3.48 mg/L yields an annual load of just over 200,000 lbs/yr, which is still well under the 243,645 TN loading cap. Likewise for TP the annual load in 2040 at the expected demand would be 4,598 lbs/yr, still under the loading cap by 6,366 lbs/yr.

Table 41. Estimated Mattawoman WWTP Future Capacity

	5 Year Average	2040
Average Daily Flow	10.530	18.869
Treatment Capacity	20.000	20.000
Available Capacity	9.470	1.131
Total Nitrogen		
TN Concentration (mg/L)	3.48	3.48
TN Load (lbs/yr)	119,608	200,018
2025 Permit Cap on TN Load (lbs/yr)	243,645	243,645
Available TN Load (lbs/yr)	124,037	43,627
Total Phosphorus		
TP Concentration (mg/L)	0.08	0.08
TP Load (lbs/yr)	2,436	4,598
2025 Permit Cap on TP Load (lbs/yr)	10,964	10,964
Available TP Load (lbs/yr)	8,528	6,366

If trading is used under Scenario 2, the County would need to only meet half of the goal by 2019. To reach 10% by the end of 2019, the 2015 progress (181.9 impervious acres) is subtracted from the 10% goal (704.8 impervious acres) to result in a goal of 522.9 impervious acres. This can be accomplished through implementation of the planned operational and programmatic practices which is planned to account for 334.3 impervious acres treated, and by the projects currently under levels 2 and 3, those in construction and full design, respectively. Level 2 is estimated to produce 63.7 acres of impervious treatment, and Level 3 668.4 acres. This would result in a total treatment of 1,066.3 impervious acres which is well over the 522.9 impervious acres goal under this scenario and therefore provides a conservative estimate.

3.1.6 Cost of Impervious Restoration

Costs of impervious restoration are presented here for the two restoration scenarios described in the previous section.

Scenario 1

Costs for Scenario 1 are included below in Table 42. Several of the projects have already been funded under previous fiscal year budgets. This includes all of Level 2 (in construction) projects, some Level 3 (in design) projects and one Level 6 concept project. While these projects add to the total cost of meeting the goals, they have been separated so that the additional funding from FY17 forward is understood.

Under this scenario, $32,384,000 in structural project Capital Improvement Plan (CIP) funds are needed to meet the 20% goal with an additional $7,052,000 in costs for the operational and programmatic practices. This CIP cost equates to an annual requirement of $10,795,000 to implement the projects over the next 3 years.

The County's FY17 budget has $10,783,000 allocated in FY17 and $10,950,000 per year allocated in FY18 through FY21.

Based on this analysis, current funding levels for structural CIP projects, termed 'NPDES Retrofit Projects' in the County's FY17 budget should be adequate.

Scenario 2

Under this scenario the County would complete at least 10% of the impervious restoration by December 2019, and continue to develop stormwater projects to pay back the traded credits over a period of time yet to be determined. By trading, the County can spread out the costs of meeting the 20% goal over a longer period of time, while still meeting the overall TMDL goal.

If trading is used under Scenario 2 for half of the required 20% restoration, the County would need to implement the projects currently in construction and design (Levels 2 and 3) by the end of 2019. There are currently six projects in construction, and 24 projects in design for a total of 30 projects to implement. As mentioned previously, all Level 2 projects and some Level 3 projects have already been funded so their cost is reported separately. This scenario would incur a cost of $28,458,000 moving forward including structural and operational programs. The cost per year of the NPDES Retrofit Projects alone would be $7,135,670 per year ($21,407,000 total). Costs for Scenario 2 are included below in Table 43.

Table 42. Scenario 1 Cost to meet 20% Goal within the Stormwater Sector ($ in thousands)

	Gilbert Swamp	Mattawoman Creek	Nanjemoy Creek	Patuxent River Lower	Port Tobacco River	Potomac River L Tidal	Potomac River M Tidal	Potomac River U Tidal	Wicomico River	Zekiah Swamp	Total
2015 Progress Impervious Restoration (Completed Projects)											
Level 1 Completed Projects	$0	$4,341	$0	$42	$0	$0	$0	$0	$0	$1,989	$6,372
Planned Impervious Restoration (Projects Funded in Prior FY Budgets)											
Level 2, 3 and 6 Already Funded	$0	$16,340	$108	$0	$1,097	$2,194	$928	$0	$0	$3,685	$24,352
Planned Impervious Restoration (2016-2019) (Funding FY19 to Dec FY20)											
Levels 3-7	$0	$14,224	$0	$370	$3,137	$1,427	$0	$0	$0	$13,225	$32,384
Operational Reductions	$2	$394	$0	$0	$21	$0	$11	$6	$0	$163	$596
Septic Reductions	$89	$172	$129	$443	$314	$246	$56	$34	$98	$213	$1,795
Homeowner Reductions	$0	$1,676	$0	$856	$2,129	$0	$0	$0	$0	$0	$4,661
Total Cost	**$0**	**$16,466**	**$129**	**$1,669**	**$5,601**	**$1,673**	**$67**	**$40**	**$98**	**$13,601**	**$39,436**

Table 43. Scenario 2 Cost to meet 20% Goal with 10% Credit from Cross-sector Trading ($ in thousands)

	Gilbert Swamp	Mattawoman Creek	Nanjemoy Creek	Patuxent River Lower	Port Tobacco River	Potomac River L Tidal	Potomac River M Tidal	Potomac River U Tidal	Wicomico River	Zekiah Swamp	Total
2015 Progress Impervious Restoration (Completed Projects)											
Level 1 Completed Projects	$0	$4,341	$0	$42	$0	$0	$0	$0	$0	$1,989	$6,372
Planned Impervious Restoration (Projects Funded in Prior FY Budgets)											
Level 2, 3 and 6 Already Funded	$0	$16,340	$108		$1,097	$2,194	$928	$0	$0	$3,685	$24,352
Planned Impervious Restoration (2016-2019) (Funding FY19 to Dec FY20)											
Level 3	$0	$8,901	$0	$370	$0	$0	$0	$0	$0	$12,136	$21,406
Operational Reductions	$2	$394	$0	$0	$21	$0	$11	$6	$0	$163	$596
Septic Reductions	$89	$172	$129	$443	$314	$246	$56	$34	$98	$213	$1,795
Homeowner Reductions	$0	$1,676	$0	$856	$2,129	$0	$0	$0	$0	$0	$4,661
Total Cost	**$91**	**$11,143**	**$129**	**$1,669**	**$2,464**	**$246**	**$67**	**$40**	**$98**	**$12,512**	**$28,458**

If the remaining 10% is to be paid back through implementation of stormwater projects over a three year period starting in 2020, it is anticipated that the cost differential between the two Scenarios ($10,978,000) would be spread across the 3 year period adding an additional $3,659,333 to FY budgets from FY20-FY22.

It is expected that the County may receive an additional 10-20% treatment requirement in the next MS4 permit cycle set to begin in January 2020. Using current cost estimates and assuming that half of the $39,436,000 would be needed for the additional 10% then an additional $19,718,000 would be needed from FY20 to FY24. Under Scenario 1 these costs would be incurred after the initial 20% restoration is met; however in Scenario 2 they would overlap in FY20 to FY22. Overall however the annual costs in Scenario 2 are more evenly distributed. The analysis does not include an accounting for inflation, nor does it account for the idea that as the easier and most cost effective projects are completed, that the relative cost of restoration in the future, on a dollar per impervious acre basis, may go up. A cost comparison of the two scenarios per FY is presented in Table 44.

Table 44. Impervious Restoration Cost Summary

		Scenario 1 – Stormwater Sector Only			Scenario 2 – Credit Trading for 10%			
		NPDES Retrofit	Operational	Total	NPDES Retrofit	Operational	Credit Pay-back	Total
20% Goal	FY17	$ 10,794,670	$2,350,667	$13,145,337	$7,135,667	$2,350,667		$9,486,000
	FY18	$ 10,794,670	$2,350,667	$13,145,337	$7,135,667	$2,350,667		$9,486,000
	FY19	$ 10,794,670	$2,350,667	$13,145,337	$7,135,667	$2,350,667		$9,486,000
New 10% Goal	FY20	$ 3,238,400	$705,200	$3,943,600	$3,238,400	$705,200	$3,659,333	$7,602,933
	FY21	$ 3,238,400	$705,200	$3,943,600	$3,238,400	$705,200	$3,659,333	$7,602,933
	FY22	$ 3,238,400	$705,200	$3,943,600	$3,238,400	$705,200	$3,659,333	$7,602,933
	FY23	$ 3,238,400	$705,200	$3,943,600	$3,238,400	$705,200		$3,943,600
	FY24	$ 3,238,400	$705,200	$3,943,600	$3,238,400	$705,200		$3,943,600
			Total	$59,154,010			Total	$58,315,490

3.2 Chesapeake Bay TMDL for Nitrogen and Phosphorus

The Chesapeake Bay TMDL, established by the EPA (EPA, 2010), sets pollution limits for nitrogen, phosphorus, and sediment in the Chesapeake Bay Watershed. Total limits set in the Bay TMDL for the states of Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia, and the District of Columbia are "185.9 million pounds of nitrogen, 12.5 million pounds of phosphorus and 6.45 billion pounds of sediment per year—a 25 percent reduction in nitrogen, 24 percent reduction in phosphorus and 20 percent reduction in sediment" (EPA, 2010). The TMDL also sets "rigorous accountability measures" for state compliance.

3.2.1 Sources

Nutrients are a pollutant of concern as an overabundance can cause algal blooms. Nitrogen is the limiting nutrient in the Chesapeake Bay, with high levels of nitrogen leading to algal blooms which cause decreased water clarity and light attenuation in the bay, as well as rob the bay of dissolved oxygen as algal blooms die and decompose at the bottom of the water column. Phosphorus is the limiting nutrient in freshwater systems and can lead to algal blooms in lakes and reservoirs with the same impacts as algal blooms in the Chesapeake Bay but also can have an impact on drinking water if the bloom occurs in a reservoir that is used as a water source for municipal drinking water. Sources of nutrients include agricultural runoff, urban stormwater, municipal wastewater treatment plants, phosphorus bound to sediments supplied to the system, and discharge from upstream impoundments.

3.2.2 Modeling Approach

A combination of models were used for baseline, progress, and planned pollutant load modeling for Bay and local TMDLs. They are described below. Each BMP provides impervious surface restoration as well as a reduction for nitrogen, phosphorus, and sediment, along with other pollutants.

Section 1.8 presents the suite of practices the County uses for current implementation and/or plans to use to address local TMDL and impervious restoration permit requirements. Sections 4 presents information on how progress toward load reductions will be evaluated and how management plans will be adapted on an on-going basis.

MAST

The pollutant loads (i.e., nitrogen, phosphorus, and sediment) for the Bay TMDL baseline were determined using MAST, which calculates pollutant loads and reductions calibrated to the Chesapeake Bay Program Partnership Watershed Model. MAST, created by Devereux Environmental Consulting for MDE, is a web-based pollutant load estimating tool that streamlines environmental planning. Users specify a geographic area (e.g., County, watershed) and then select BMPs to apply on that area. MAST builds the scenario and provides estimates of pollutant load reductions and allows users to understand which BMPs provide the greatest load reduction benefit and the extent to which these BMPs can be implemented. Based on the scenario outputs, users can refine their BMP choices in their planning. MAST facilitates an iterative process to determine if TMDL allocations are met. Scenarios may be compared to each other, to TMDL allocations, or to the amount of pollutants reduced by current BMP implementation.

MAST estimates of load reductions for point and nonpoint sources include: agriculture, urban, forest, and septic loading. Load reductions are not tied to any single BMP, but rather to a suite of BMPs working in concert to treat the loads. Both MAST and the Watershed Model calculate reductions from all BMPs as a group, much like a treatment train. Reductions are processed in order, with land use change BMPs first, load reduction BMPs next, and BMPs with individual effectiveness values at the end. The overall load reduction can vary depending on which BMPs are implemented.

Both the Watershed Model and MAST provide loads at two different scales: Edge-of-Stream (EOS) and Delivered (DEL). Delivered loads show reductions based on in-stream processes, such as nutrient uptake by algae or other aquatic life. Local TMDL plans focus on reducing load on the land, so EOS estimates are more appropriate and were used for nutrient and sediment modeling analysis.

Removal Rate Curve Equations

Pollutant load reductions for progress scenarios and planned projects were calculated using revised removal rate curve equations for runoff reduction (RR) and stormwater treatment (ST) practices prepared by Chesapeake Stormwater Network (MDE, 2014c). Reductions are calculated based on rainfall treatment, whether noted in project concepts or as an assumption of 1-inch treatment, and removal efficiencies per RR and ST practice (Table 45).

Table 45. Runoff Reduction and Stormwater Treatment Practices Removal Rate Reductions

Practice	Rainfall Treatment	Nitrogen Reduction	Phosphorus Reduction	Sediment Reduction
Runoff Reduction (RR)	1”	60%	70%	75%
Stormwater Treatment (ST)	1”	35%	55%	70%

3.2.3 Baseline and Target Loads

The County’s MS4 permit is requiring compliance with the Chesapeake Bay TMDL for the stormwater sector through the use of the 20% impervious surface treatment strategy, as described in greater detail in the following section. The strategies provided in this plan to meet local TMDL reduction targets have been modeled in order to calculate potential progress toward meeting the Bay TMDL nutrient and sediment reduction goals. It is anticipated that the County may receive another 10-20% requirement in the following permit term if the goals are not met.

Table 46 provides a concise summary of Charles County’s portions of target edge of stream (EOS) and delivered (DEL) reductions towards the Chesapeake Bay TMDL and 2010 baseline and 2025 allocated loads. These terms and dates are presented here to assist the reader in understanding the definitions of each, how they were derived, and to provide an overall summary demonstrating the percent reduction required through full implementation of this plan.

- **TN, TP, TSS:** Total Nitrogen, Total Phosphorus, Total Suspended Sediment. As specified in the Bay TMDL, if the phosphorus target is met, the sediment target will be met.
- **EOS lbs/yr and DEL lbs/yr:** An EOS load is the amount of a pollutant load that is transported from a source to the nearest stream annually while a DEL load is the amount of a pollutant load that is transported to the tidal waters of the Chesapeake Bay annually. DEL loads are generally less than EOS loads due to losses during transport from streams to the Bay.

- **Calibrated 2010 Baseline Load**: Baseline levels (i.e., land use loads with baseline BMPs) from 2010 conditions in the Charles County MS4 source sector using the Maryland Assessment Scenario Tool (MAST) Chesapeake Bay Program Phase 5.3.2 (CBP P5.3.2) model. Baseline loads were used to calibrate the Bay TMDL nitrogen and phosphorus SW-WLAs.
- **Target Percent Reduction**: Percent reductions assigned to Charles County Phase I MS4 stormwater sector (http://wlat.mde.state.md.us/ByMS4.aspx). If TP target is met, TSS target will be met.
- **Calibrated Target Reduction:** Target reduction calibrated to MAST CBP v.5.3.2 by multiplying the reduction percent published by the 2010 baseline load. If TP target is met, TSS target will be met.
- **Calibrated TMDL WLA**: Allocated loads are calculated from the 2010 baseline levels, calibrated to CBP P5.3.2 as noted above, using the following calculation: 2010 Baseline – (2010 Baseline x Target Percent Reduction); or, 2010 Baseline x (1 – Target Percent Reduction).

Table 46. Charles County Chesapeake Bay TMDL Baseline and Target Loads

Baseline and Target	TN-EOS lbs/yr	TN-DEL lbs/yr	TP-EOS lbs/yr	TP-DEL lbs/yr	TSS-EOS lbs/yr	TSS-DEL lbs/yr
Calibrated 2010 Baseline Load	235,070	178,693	20,037	17,690	5,739,174	6,477,189
Target Percent Reduction	18.19%	20.24%	37.70%	38.26%	-	-
Calibrated Target Reduction	42,759	36,167	7,554	6,768	-	-
Calibrated Bay TMDL WLA	192,311	142,526	12,483	10,922	-	-

3.2.4 Chesapeake Bay TMDL Progress

2015 Progress results are shown in Table 47. As mentioned in previous plan sections, Charles County is meeting its Bay TMDL responsibilities through the 20% impervious surface restoration; therefore the Bay TMDL targets and reductions shown here are for informational purposes only.

Projects implemented to date have been located in the Mattawoman (6 projects), Zekiah (4 projects) and Lower Patuxent (1 project) Watersheds. These projects were identified in earlier watershed assessments conducted by the County in 2004, 2007 and 2011. The sites are located in the neighborhoods of Pinefield, Bryans Road, Fox Run, Ryon Woods and Carrington. The types of projects include stormwater retrofits to shallow marsh wetland facilities, SPSC, pond retrofits and dry swales.

Table 47. Bay TMDL 2015 Progress Reductions Achieved

	TN-EOS lbs/yr	TN-DEL lbs/yr	TP-EOS lbs/yr	TP-DEL lbs/yr	TSS-EOS lbs/yr	TSS-DEL lbs/yr
Baseline Loads and Target Reductions						
Calibrated 2010 Baseline Load	235,070	178,693	20,037	17,690	5,739,174	6,477,189

Target Percent Reduction	18.19%	20.24%	37.70%	38.26%	-	-
Calibrated Target Reduction	42,759	36,167	7,554	6,768	-	-
Calibrated Bay TMDL WLA	192,311	142,526	12,483	10,922	-	-
2015 Progress Reductions						
Structural Reductions	471	296	78	62	30,757	33,058
Operational Reductions	2,488	1,558	995	801	298,523	322,627
Restoration Reductions (from baseline to 2015)	2,959	1,854	1,073	863	329,280	355,684
Restoration Reduction Percent	1.3%	1.0%	5.4%	4.9%		
Reduction Remaining for Treatment	39,800	34,313	6,481	5,905		

3.2.5 Bay TMDL Restoration

The structural projects listed in Appendix A in addition to operational practices (street sweeping, storm drain cleaning) and homeowner practices (rain barrels, rain gardens) make up the primary programs to be implemented for meeting the Bay TMDL goals by 2025. A detail of the projects, from Level 2 through 9 is included in Table 48. The projects are divided into Structural BMPs, ESD practices, and Alternate MS4 BMPs.

There are 243 projects currently identified including the 10 projects already completed, 91 projects in levels 2-7, 65 level 8 projects and 77 level 9 projects.

Table 48. Number of Projects Per Type Per Level and Planning Period

BMP Type	Unit	2015 Progress	Planned Restoration										Total
			2016-2019				2020-2025						
			Level 2	Level 3	Progra-mmatic	Total	Level 5	Level 6	Level 7	Level 8 and 9	Progra-mmatic	Total	
Structural BMPs													
Bioretention	DA (ac)			10.0		**10.0**		0.6	4.3	31.2		**36.0**	**46.0**
Bioswale	DA (ac)			6.5		**6.5**		2.0				**2.0**	**8.5**
Created Wetland	DA (ac)			496.2		**496.2**		731.4	39.3	60.8		**831.5**	**1,327.7**
Dry Pond Conversion to Bioretention	DA (ac)			8.9		**8.9**						**0.0**	**8.9**
Dry Pond Conversion to Constructed Wetland	DA (ac)			21.8		**21.8**						**0.0**	**21.8**
Dry Swale	DA (ac)	6.3				**0.0**	256.8		13.4	541.9		**812.1**	**818.4**
Micro-Bioretention	DA (ac)			1.3		**1.3**				1.5		**1.5**	**2.8**
Grass Swale	DA (ac)			16.2		**16.2**				0.7		**0.7**	**16.9**
Infiltration Basin	DA (ac)					**0.0**				54.1		**54.1**	**54.1**
Organic Filter	DA (ac)			2.1		**2.1**						**0.0**	**2.1**
ISA Baseline Reduction	DA (ac)					**0.0**	2,878.5					**2,878.5**	**2,878.5**
Pond Retrofit	DA (ac)			51.8		**51.8**	142.8			195.0		**337.8**	**389.6**
Shallow Marsh	DA (ac)	172.4				**0.0**						**0.0**	**172.4**
StormFilter	DA (ac)					**0.0**				31.3		**31.3**	**31.3**
Stormwater Wetland	DA (ac)					**0.0**				93.2		**93.2**	**93.2**
Stream Restoration	Linear Feet					**0**				43,525		**43,525**	**43,525**
Submerged Gravel Wetland	DA (ac)		237.9	333.4		**571.3**		262.9	22.9	183.2		**469.0**	**1,040.3**
Tree Planting	DA (ac)					**0.0**				114.6		**114.6**	**114.6**
Underground Infiltration	DA (ac)					**0.0**				18.4		**18.4**	**18.4**
Enhanced Filter	DA (ac)	9.1				**0.0**						**0.0**	**9.1**
Wet Pond	DA (ac)	83.5		92.2		**92.2**		75.1		54.1		**129.2**	**304.9**

BMP Type	Unit	2015 Progress	Planned Restoration										Total
			2016-2019				2020-2025						
			Level 2	Level 3	Progra-mmatic	Total	Level 5	Level 6	Level 7	Level 8 and 9	Progra-mmatic	Total	
Wet Swale	DA (ac)	33.7		9.9		**9.9**				42.8		**42.8**	**86.4**
Environmental Site Design Practices													
Rainwater Harvesting	DA (ac)			2.0		**2.0**						**0.0**	**2.0**
Sheetflow to Conservation Areas	DA (ac)					**0.0**		52.6	37.9	5.7		**96.2**	**96.2**
Downspout Disconnection	No. Disconnects				1,322	**1,322**						**0**	**1,322**
Rain Barrels	No. Barrels				9,065	**9,065**						**0**	**9,065**
Rain Garden	DA (ac)	0.2		1.0	3.6	**4.5**				2.8		**2.8**	**7.5**
Alternative MS4 BMPs													
Shoreline Management	Linear Feet					**0.0**				5,898		**5,898**	**5,898**
Shoreline Restoration	Linear Feet			1,488		**1,488**		2,050		7,159		**9,209**	**10,697**
Step Pool Storm Conveyance	DA (ac)	23.1	163.2	39.3		**202.5**				667.3		**667.3**	**892.9**
Septic Connections*	No. of Connections	23.0			16	**0.0**					24	**0.0**	**23.0**
Septic Pump-Outs*	No. of Pump-Outs/year	1,093			1,093	**1,093**					1,093	**0.0**	**2,186**
Septic Upgrades*	No. Upgrades	168			75	**75**					112	**0**	**243**
Storm Drain Vacuuming	No. Pipes/year	247			247	**247**					247	**0**	**494**
Street Sweeping	Miles Swept/year	193.2			193	**193.2**					193.2	**0.0**	**386.4**

Level: 1- Completed; 2- Construction; 3- Full Design; 5- Existing SWM Upgrades; 6- 7 Concept, 8 and 9 sites identified
*Septic practices are included in Impervious Restoration crediting calculations but not Load Reduction calculations

3.2.6 Load Reductions Expected

When all of the County's structural restoration projects (Levels 2-9) are included in addition to the operational practices and homeowner practices, the resulting loading reduction exceeds the required TP reductions (and TSS by default). Total nitrogen is projected to be at 58.6% of the goal reduction with 21,199 lbs/yr reduced (delivered).

Table 49. Bay TMDL Reductions Expected – Full Implementation

	TN-EOS lbs/yr	TN-DEL lbs/yr	TP-EOS lbs/yr	TP-DEL lbs/yr	TSS-EOS lbs/yr	TSS-DEL lbs/yr
Baseline and Targets						
Calibrated 2010 Baseline Load	235,070	178,693	20,037	17,690	5,739,174	6,477,189
Target Percent Reduction	18.19%	20.24%	37.70%	38.26%	-	-
Calibrated Target Reduction	42,759	36,167	7,554	6,768	-	-
Calibrated Bay TMDL WLA	192,311	142,526	12,483	10,922	-	-
2015 Progress Reduction Summary						
Restoration Reductions (from baseline to 2015)	2,957	1,853	1,072	863	329,071	355,500
Reduction Remaining for Treatment	39,802	34,314	6,482	5,905		
Planned Reductions (2016- 2019)						
Level 2-3	6,927	4,292	1,623	1,332	641,911	616,227
Level 4-7	7,942	6,725	1,276	1,145	665,503	728,057
Homeowner Reductions	199	143	42	37	-	-
Planned Reductions (2020 - 2025)						
Level 8	4,341	3,359	1,823	1,663	1,756,969	1,773,211
Level 9	5,436	4,826	2,853	2,692	941,084	918,958
Total Reductions						
Reduction (Progress + Planned)	27,802	21,198	8,689	7,732	4,334,537	4,391,953
Reduction Percent (Progress + Planned)	11.8%	11.9%	43.4%	43.7%		
Reduction Remaining for Treatment	14,957	14,969	(1,135)	(964)		
Reduction Percent Remaining	6.4%	8.4%	-5.7%	-5.4%		

3.2.7 Additional Reductions

Charles County will investigate additional projects and strategies to meet the remaining TN load reduction by 2025. This could include additional water quality trades, particularly with the waste water (septic) sector, which through connections, upgrades and pump-outs may have credits available to the MS4 sector before 2025.

3.2.8 Cost of Bay TMDL Restoration

The total cost of the Bay TMDL implementation proposed thus far is presented in Table 50. The cost for levels 8 and 9 are added to the projects and programs that were identified for the 2016-2025 period to estimate a total cost for the planned projects and programs of $107,377,000. Per year this breaks down to $11,930,778 per year for 9 years. Adding in the cost of projects completed thus far and those that have already been funded by the County in previous fiscal years, the total cost is $138,101,000.

The TMDL plan, as drafted does not currently meet the full TN Bay reduction required in the SW-WLA. If the County were to meet the remaining load reductions through stormwater projects similar to those described in this plan the estimated cost of the additional treatment would be $42,697,769. This is based on a cost per lb of TN removed with the Level 8 and 9 projects which is $2,852 per lb.

Factoring in this additional cost to meet the TN requirement with the cost to implement the projects in this plan, the total to be incurred is estimated at $138,101,000 or $15,344,556 per year over the 9 year period from 2017 to 2025. This level of funding far exceeds that required to meet the 20% impervious surface restoration.

Table 50. Bay TMDL Cost ($ in thousands)

	Gilbert Swamp	Mattawoman Creek	Nanjemoy Creek	Patuxent River Lower	Port Tobacco River	Potomac River L Tidal	Potomac River M Tidal	Potomac River U Tidal	Wicomico River	Zekiah Swamp	Total
2015 Progress Impervious Restoration (Completed Projects)											
Level 1 Completed Projects	$0	$4,341	$0	$42	$0	$0	$0	$0	$0	$1,989	$6,372
Planned Impervious Restoration (Projects Funded in Prior FY Budgets)											
Level 2, 3 and 6 Already Funded	$0	$16,340	$108	$0	$1,097	$2,194	$928	$0	$0	$3,685	$24,352
Planned Impervious Restoration (2016-2019) (Funding FY17 to Dec FY25)											
Levels 3-7	$0	$14,224	$0	$370	$3,137	$1,427	$0	$0	$0	$13,225	$32,384
Operational Reductions	$2	$394	$0	$0	$21	$0	$11	$6	$0	$163	$597
Homeowner Reductions	$0	$1,676	$0	$856	$2,129	$0	$0	$0	$0	$0	$4,661
Planned Impervious Restoration (2020-2025) (Funding FY20 to Dec FY25)											
Level 8	$0	$11,227	$4,747	$4,333	$1,989	$701	$3,489	$0	$179	$7,947	$34,612
Level 9	$0	$12,120	$0	$2,488	$18,119	$0	$0	$0	$0	$0	$32,727
Total Cost Planned (2016 to 2025)	**$108**	**$40,575**	**$4,997**	**$8,575**	**$26,025**	**$2,679**	**$3,639**	**$91**	**$401**	**$21,872**	**$108,963**
Full Cost of TMDL Restoration Complete and Planned											
Total Cost, Completed and Planned	**$49**	**$61,090**	**$4,957**	**$8,490**	**$26,769**	**$4,544**	**$4,495**	**$46**	**$268**	**$27,392**	**$138,101**

4 Implementation, Evaluation and Monitoring

Progress evaluation will be measured through three approaches: tracking implementation of management measures, estimating load reductions through modeling, and tracking overall program success through long term monitoring.

4.1 Implementation

4.1.1 Prioritization

Watershed Scale

To implement watershed restoration activities thoughtfully, priorities are set at two scales. First, resources are allocated at the watershed scale and then projects within each watershed are evaluated relative to each other and to operational and programmatic programs to determine the most effective methods to move forward with.

The County will prioritize activities in local TMDL watersheds in order to meet local TMDL requirements for restoration. These include the Mattawoman Creek and Indian Creek watersheds. Watersheds with higher amounts and percentages of impervious surface are also priorities. These include Mattawoman Creek at 9.7% impervious, Port Tobacco River at 7.0% impervious, and Zekiah Swamp at 5.9% impervious with most of the activity in Zekiah in the upper portions of the watershed in and around Waldorf.

As noted in previous sections, the Mattawoman Creek is a high priority watershed for the County due to several factors including the diverse, high quality ecosystem. The Mattawoman Creek has ranked 8th out of 137 watersheds in Maryland for freshwater stream biodiversity and is home to six stream animal RTE species (Interagency Mattawoman Ecosystem Management Task Force. 2012). The Mattawoman Creek local nutrient TMDL has very aggressive load reduction requirements, particularly for nitrogen, therefore the County will have to make restoration in the watershed a priority over other watersheds with no SW-WLA or TMDL defined, and over watersheds not currently listed on the state's impaired waters list.

Project Scale

To support the County's resource allocation and decision making process, a prioritization is developed for each subwatershed as part of the watershed assessment process for the projects identified. The results indicate which projects are the most beneficial and cost effective that should move forward to full implementation. Results can be found in each watershed assessment report. The method is described here briefly.

The prioritization involves 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 is 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 includes 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. 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 51 with a brief description of each.

Table 51: Prioritization Metrics

Metric	Description
Project Benefits	
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?
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	Does the project receive MS4 drainage?
Project Constraints	
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?
Existing Utility Conflicts	Are there existing underground or overhear utilities conflicting with the design? Are the private or public?
Project Cost	
Total Life Cycle 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

Projects identified under Capital Services program to meet the 20% impervious restoration goal use the cost per impervious acre treated metric to evaluate projects. As the County moves forward into additional implementation the full set of projects will be prioritized together to develop a more complete restoration prioritization method.

Structural projects will also be evaluated against the cost of operational programs. For example, the septic pump-out program in the first full year of implementation (FY2015) is credited with 24.93 impervious acres restored at 0.03 acres/pump-out. The cost per pump-out is $3,908 per impervious acre restored, far less than that achieved through traditional structural stormwater practices.

4.1.2 Project Implementation

Charles County has an implementation process in place through on-call design contracts. The County has three engineering firms on this on-call contract to complete the design and engineering, permitting, construction phase and monitoring elements of structural stormwater BMP and retrofit projects including all of the project types identified in the current round of watershed assessments.

The County seeks to partner with local watershed groups and watershed restoration and monitoring programs to implement its plan. Watershed groups, such as the Mattawoman Watershed Society, and the Port Tobacco River Conservancy will be instrumental in achieving the goal of healthy watersheds. The County has an agreement with the Maryland State Highway Administration for potential shared TMDL restoration projects.

The County looks for opportunities to work with technical assistance and financial providers such as the Chesapeake Bay Trust Forestry Grant. The County leverages capital projects being completed by other County agencies and departments to determine if the projects can provide restoration credit. Examples include sewer connection projects, Acton Lane and Stavor's Road improvements, Old Washington Road redevelopment. The County is working with the school system and has identified several restoration opportunities that are moving forward to full design at these sites.

4.2 Tracking Implementation of Management Measures

Implementation will be measured by determining whether the targets for implementation shown in previous sections are maintained according to schedule.

4.2.1 Plan Review and Adaptation

Feasibility studies of the planned strategies may reveal that some existing structures or sites identified for retrofitting or enhancement may not be feasible candidates for future projects and may be eliminated from consideration. Since many restoration projects will need to be done on private property, lack of approval by private property owners may also impact the number and types of projects that can be accomplished. 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. New technologies are continuously evaluated to determine if the new technologies allow more efficient or effective pollution control. The County will also continue to monitor changes in regulations and policy that could impact the program.

4.2.2 Two-Year Milestone Reporting

As a part of the federal Chesapeake Bay Accountability Framework and in support of Maryland's BayStat accountability system, the County reports to MDE two-year milestones representing near-term commitments and progress towards achieving load reduction goals for the Bay TMDL. These efforts will also support local TMDL planning and tracking at the County level.

Milestones are reported in two forms: Programmatic and BMP Implementation. Programmatic milestones identify the anticipated establishment or enhancement of the institutional means that support and enable implementation. Examples of Programmatic milestones include projected funding, enhancement of existing programs and resources, and the establishment of new programs and studies. The milestone period for Programmatic covers two calendar years – for example, the period for 2014 - 2015 was from January 1, 2014 through December 31, 2015. BMP Implementation milestones are a quantitative account of various types of restoration activities (e.g., structural BMPs, stream restoration, maintenance efforts), which have geo-located coordinates. The period for BMP implementation milestones differs from the Programmatic milestones period and covers two state fiscal years – for example, the period for 2014 – 2015 is from July 1, 2013 through June 30, 2015. Planned BMP Implementation milestones reported to MDE include the action (e.g., BMP type), proposed restoration over the 2-year milestone period (e.g., area treated, length restored), actual rate of implementation over 1 year, and percent progress.

The Programmatic and BMP Implementation milestone submittal and reporting process follows an iterative approach and includes three separate submittals to MDE. The first is an initial milestone submittal to MDE by January 31st of the first milestone calendar year (e.g., 2014), followed by an interim milestone progress report submittal by January 31st of the second milestone calendar year (e.g., 2015), and concluding with a final milestone progress submittal by January 31st of the start of the subsequent milestone period (e.g., 2016).

4.2.3 Annual NPDES Reporting

As a requirement of the NPDES permit, the County must submit annually a progress report demonstrating the implementation of the NPDES stormwater program based on the fiscal year. If the County's annual report does not demonstrate compliance with their permit and show progress toward meeting WLAs, the County must implement BMP and program modifications within 12 months.

The annual report includes the following – items in bold font directly relate to elements of the load reduction evaluation criteria:

- The status of implementing the components of the stormwater management program that are established as permit conditions including:
    i. Source Identification
    ii. Stormwater Management
    iii. Erosion and Sediment Control
    iv. Illicit Discharge Detection and Elimination
    v. Litter and Floatables
    vi. Property Management and Maintenance
    vii. Public Education
    viii. Watershed Assessment
    ix. Restoration Plans
    x. TMDL Compliance
    xi. Assessment of Controls; and,
    xii. Program Funding
- **A narrative summary describing the results and analyses of data, including monitoring data that is accumulated throughout the reporting year**
- Expenditures for the reporting period and the proposed budget for the upcoming year

- A summary describing the number and nature of enforcement actions, inspections, and public education programs
- **The identification of water quality improvements and documentation of attainment and/or progress toward attainment of benchmarks and applicable WLAs developed under EPA approved TMDLs; and,**
- **The identification of any proposed changes to the County's program when WLAs are not being met**
- Attachment A – The County is required to complete a database containing the following information:
    i. Storm drain system mapping
    ii. Urban BMP locations
    iii. Impervious surfaces
    iv. Water quality improvement project locations
    v. Monitoring site locations
    vi. Chemical monitoring results
    vii. Pollutant load reductions
    viii. Biological and habitat monitoring
    ix. Illicit discharge detection and elimination activities
    x. Erosion and sediment control, and **stormwater program information**
    xi. Grading permit information
    xii. Fiscal analyses – cost of NPDES related implementation
- Financial Assurance Plan (FAP) – Accompanies the Annual Report and demonstrates the County's budget for restoration activities from various funding sources. Includes five elements:
    i. Explanation of actions necessary to meet the MS4 permit (in the narrative of the permit conditions), and itemized impervious restoration projects
    ii. Projected annual and 5-year costs to meet the impervious surface restoration plan
    iii. Projected annual and 5-year revenues and other funds that will be used to meet the costs of the impervious surface restoration plan
    iv. Sources of funds that will be utilized by the county to meet the MS4 permit
    v. Specific actions and expenditures that the county implemented in previous fiscal years to meet its impervious surface restoration requirements

4.2.4 SMART Tool

The County anticipates using the SMART Tool (Stormwater Management and Restoration Tracker) to gather information from individual homeowners and watershed organizations completing small scale restoration projects. The SMART Tool, operated by the University of Maryland Extension, is an on-line resource for outreach and education for homeowner based practices, particularly rain barrels and rain gardens, two practices that the County is encouraging through financial incentives. The tool allows users report the installation of their stormwater practice and to become "SMART Certified". The tool will allow the County to track implementation progress of homeowner based programs.

4.3 Best Management Practices Inspection and Maintenance

Charles County conducts triennial inspections of stormwater BMPs as required by COMAR and its MS4 NPDES permit. These inspections and the subsequent maintenance ensure that the BMPs are in good condition and functioning as they were designed. Recent improvements to the County's program include an increase in the number of full time inspectors in FY2016. Anticipated improvements to the

County's program include the use of a digital mobile inspection and reporting platform, use of a rapid BMP inspection protocol, development of a residential BMP inspection program, and an alternative BMP inspection program for alternative practices such as shoreline stabilization and stream restoration. Results of the County's inspections will continue to be submitted annually to MDE with the MS4 NPDES annual report.

4.4 Estimating Load Reductions

Progress assessments are scheduled by the Chesapeake Bay Program for 2017 and 2021. Multiple lines of evidence including: several models, monitoring data, and the most recent science on BMP effectiveness and water quality response will be evaluated in the assessments. The milestones and progress assessments will contribute to regular reassessment of management plans, and adaptation of responses accordingly as technologies and efficiencies change, programs mature, credit trading is enacted, and regulations are put in place. The County will model load reductions in BayFAST / MAST at the interim (2016, 2018) and milestone (2017, 2019) years, which equates to about once a year at minimum.

Results of the modeling, coupled with a compilation of impervious surface treatment totals for the period will be used to evaluate load reduction and impervious surface credits towards reaching the restoration goals.

4.5 Monitoring

Official monitoring for impairment status is the responsibility of the State; however the County utilizes a variety of monitoring programs to monitor progress towards its NPDES responsibilities and TMDL goals.

The County conducts monitoring under its MS4 NPDES permit that includes several outcomes. The Acton/Hamilton long term monitoring site is monitoring for chemical, biological and physical parameters including chemical analysis of wet weather events. The site is downstream of watershed restoration projects that have been focused on the Acton/Hamilton watershed and the monitoring is established to detect changes over time as restoration progresses. Monitoring is also conducted in the Tributary to Piney Branch watershed to determine the effectiveness of the state's 2000 Stormwater Management Design Manual relative to the channel protection volume criteria. The physical and geomorphic monitoring is determining the effectiveness of the design criteria in maintaining stable receiving stream channels.

The United States Geological Survey (USGS) is operating a stream gage (#0165800) on the Mattawoman Creek located near Pomonkey, MD and downstream of Old Womans Run. The site monitors stream flow as well as temperature, pH, specific conductivity, dissolved oxygen, turbidity, suspended sediment, and various forms of nitrogen and phosphorus. Data from this site represent a long term record to compare over time as additional restoration activities come on line.

The USGS Chesapeake Bay Nontidal Network (NTN) currently includes the Mattawoman Creek. The NTN quantifies nutrient and sediment loads in the nontidal rivers of the Chesapeake Bay watershed. The loads are defined as the mass of nutrient or sediment passing a monitored location per unit time. The NTN estimates changes over time (trends) in sediment and nutrient loads, in a manner that compensates for any concurrent trend in stream discharge. Trends estimated in this manner can indicate changes in the watershed, such as the effects of best management practices that cannot be attributed primarily to climatic fluctuation. This program is currently funded by the Chesapeake Bay Program's Long-term Status and Trends Network and the USGS Priority Ecosystem Program.

The County will investigate the application of a bacteria monitoring program in the Indian Creek watershed. The TMDL is based on two sampling points located in the estuary, which is problematic since the estuary receives drainage from both Charles and St. Mary's Counties and from multiple land use types, making is difficult to determine the specific source of the pollutant. The County will investigate regular monitoring at the three main tributaries draining Charles County's portion of the watershed. Monitoring sites at the downstream ends of these drainages before confluences with Indian Creek itself may help to determine the full extent of the bacteria loading from the watershed, will assist in targeting restoration actions spatially, and can be used to monitor progress over time. The County will also investigate use of Bacteria Source Tracking (BST) methods to determine more specifically the source of the load – human, wildlife, or livestock.

4.6 Public Participation/Education

Charles County's MS4 permit requires a significant increase in effective public outreach and community stewardship. The awareness and participation of all County citizens is the cornerstone of a united effort to reaching restoration goals. Public involvement through education programs, environmental stewardship, restoration projects, and best management practice (BMP) maintenance and implementation, will ensure the protection and restoration of Charles County's waterways and watersheds, and the Chesapeake Bay. The following describes public involvement strategies being used to gather input for this report and a summary of education and outreach programs.

4.6.1 Restoration Report and Watershed Assessment Public Participation

Development of the recent watershed assessments (Port Tobacco, Mattawoman Creek, and Lower Patuxent watersheds) and preparation of this Restoration Plan are done with public input gathered through a combination of public review and comment periods and through a public meeting. The draft watershed assessment reports for the Port Tobacco, Mattawoman, and Lower Patuxent watersheds and this draft Restoration Plan were posted on the County's Planning and Growth Management website in May and June 2016 for a 30-day public review and comment period. Comments received have been taken into consideration and modifications to the assessments and Restoration Plan have been made where appropriate.

A public meetings was held on May 9, 2016 to disseminate information on the County's watershed planning and restoration program and to specifically introduce the goals, methods and results of the assessments and Restoration Plan. The meeting included presentations of the planning documents and opportunities for questions. Maps and copies of the planning documents were present for participants to review in person. Individuals who completed the field assessments were present to answer questions and to describe assessment results from any specific location that a property owner or interested individual might be concerned about.

Public comments from both the May 9, 2016 public meeting, and from the 30-day comment period are included as Appendix C of this plan.

4.6.2 Watershed Protection and Restoration Program Web Page

In fiscal year 2016, Charles County revamped their Watershed Protection and Restoration Program (WPRP) website content. The new web page provides information about the County's WPRP program whose major functions are capital improvements and restoration, stormwater management (SWM) planning, and public education and outreach. The program aims to protect the water quality of the County's local waterways, restore stream and wetland ecosystems, and ensure Charles County complies with Federal and State environmental regulations. The web page provides information about streams and watersheds, stormwater, watershed assessments and restoration. The web page also provides information about the Illicit Discharge Detection and Elimination (IDDE) Program, wastewater and septic systems as they relate to watershed protection, and local regulations that address watershed protection and restoration. The site includes valuable information about opportunities for citizens to receive reimbursements and fee reductions for various programs, including septic pump-outs and the stormwater remediation fee.

The website can be found here: http://www.charlescountymd.gov/watershed

4.6.1 BMP Maintenance Guidance Documents Development

Charles County is required to perform routine maintenance inspections at least every three years of all Environmental Site Design (ESD) and stormwater BMP facilities. Landowners are responsible for structural and non-structural maintenance of facilities on privately owned lots, including residential and commercial properties. The County is developing BMP maintenance guidance documents for various SWM facilities to inform and educate landowners on how and when to perform maintenance and repairs. A brochure entitled Guidance for Maintaining Stormwater Management Ponds has been developed and is being distributed to homeowner's association (HOA) leaders and landowners. These guidance documents will be posted on the Planning and Growth Management web page and provided to BMP owners as they become available. The documents will be used as a tool for SWM inspectors to increase awareness, maintenance compliance, and increased functionality of stormwater BMPs.

4.6.2 School Group Education

Charles County's WPRP program began outreach education within Charles County Public Schools in spring 2016. Staff attended six career days at elementary schools throughout the County and educated over 400 students about the mission of the WPRP program, watershed concepts, the role of staff, and what students can do to help protect watersheds and water quality. School group outreach is planned to continue in fall 2017 and continue to be ongoing. Future strategies for school group outreach include developing additional watershed education program through partnerships with teachers and schools, and participation at school based special events with environmental focus.

4.6.3 Septic Pump-out Reimbursement Program

The Septic Pump-Out Reimbursement Program began in in 2014 (FY 2015). The program funds the partial reimbursement of the cost of pumping a septic system. Properties within the Chesapeake Bay Critical Area (CBCA) are eligible for a 75% reimbursement and properties outside the CBCA can receive a

50% reimbursement. Each property or system is eligible to participate every three years. Septic pump-outs are tracked and are counted toward meeting impervious acre restoration goals. The WPRP web page provides educational information about the program and the value of maintaining septic systems. Educational information was added to the program application form in winter 2016. Awareness of the program is increasing, thereby giving the WPRP program the opportunity to increase restoration goals through this financial incentivized program.

4.6.4 Radio/TV/Social Media/Signage

Development of radio Public Service Announcements (PSAs) about watershed and water quality protection, stormwater, and the storm drain system are planned for Fall 2016. WPRP staff plans to implement an ongoing radio PSA campaign to increase awareness of water quality issues and increase stewardship among Charles County citizens. Staff also plans to partner with media staff for Charles County Government Television (CCGTV) to feature topics that will foster increased awareness of WPRP programs and stewardship of citizens. Outreach efforts and educational material will be posted to the Charles County Government Facebook (FB) page to increase awareness and availability of outreach information. The aforementioned SWM Pond Maintenance guidance document was posted on FB, as well as photos from school group outreach for a career days in 2016. Outreach via radio, TV, and social media regarding water quality and stormwater issues is planned to continue and increase in order to grow awareness and stewardship among citizens.

Signage at road crossings throughout the County can raise awareness of watersheds and stream systems. A program adopted approximately 10 years ago by the Wicomico Scenic River Commission placed watershed boundary signs in prominent locations for the Wicomico boundary. A similar Maryland State Highway Program utilizes signs at stream and river crossings such as the Mattawoman and Zekiah Creeks. The programs will be evaluated and potentially expanded to include additional signage on perhaps smaller stream crossings or at additional watershed boundaries.

4.6.5 Illicit Discharge Detection and Elimination (IDDE) Program

Outreach material for good housekeeping practices including dumpster maintenance, outside storage of materials, and car washes is planned to be developed. Such outreach material will increase awareness of the implications of illicit discharges and what citizens can do to prevent them from occurring. Increased compliance with regulations prohibiting illicit discharges can improve water quality and help achieve TMDL restoration goals. A brochure about IDDE is already available on the WPRP webpage, and the brochure is also available in hard copy to citizens and business owners. Some good housekeeping practice information is currently on the web page, with more planned to be developed.

4.6.6 Chesapeake Bay Trust (CBT) Partnership

The WPRP partners with the Chesapeake Bay Trust (CBT) in public outreach efforts. The WPRP annually allocates funding to CBT to vet and administer restoration and education grant projects in Charles County. In FY 2016, a restoration project was awarded a grant to develop a rain garden on a faith-based organization property. An outreach grant was awarded, which provides rain barrels to program participant for home use. The continuation of this partnership will serve to meet impervious surface restoration goals as more restoration projects are completed, and foster stewardship by citizens through outreach grant programs.

A variety of grant programs have been proposed, and will be evaluated annually through the CBT grant program. A proposal to increase watershed geographical awareness by posting watershed signs on public roads. This project would increase the public's awareness of the County's ten sub-watersheds and the value of stewardship practices and projects in each one. Another suggested proposal is increased IDDE outreach through an educational program grant. A tree planting restoration and educational effort is another proposal that has been suggested, which could be implemented using grant funding.

5 Conclusion

This Stormwater Restoration Plan presents the projects and programs to be implemented by Charles County to meet the NPDES MS4 requirements for local TMDL SW-WLAs in the Mattawoman Creek and Lower Patuxent River watersheds, and restoration goals for the Chesapeake Bay TMDL and impervious surface treatment.

The plan is based on the County's current understanding of the TMDL requirements and the County's existing MS4 permit. In addition, the plan is based on current guidance from MDE, with allowances for some flexibility in implementation, as programs, regulations, and guidance continue to evolve at both the Federal and State levels. These changing conditions include elements such as new and updated expert panel work and Bay Program guidance, which define and refine restoration credits and allowances, new MS4 permitting and reporting requirements, potential future approval of additional local TMDLs, and new programs such as the Draft Maryland Trading and Offset Policy, which could expand water quality trading to the urban stormwater sector.

The County will need to adapt to these evolving conditions, while also managing project and program implementation challenges. The implementation of capital improvement restoration projects faces various obstacles and challenges. When considering all the obstacles, the timely completion of projects is the most concerning when striving to meet restoration goals within the allotted timeframes. Challenges include community outreach (1-3 months), construction permitting (12-18 months), acquiring right-of-way permissions, which starts when the design is at 60%-90% completion to avoid errors and false understanding in the community (6-12 months), bidding construction (3-6 months), time-of-year construction restrictions due to aquatic species reproduction cycles, and other unforeseen circumstances. Examples of unforeseen circumstances include: utilities not previously identified per available sources, historical artifacts being unearthed, and neighborhoods or individual property owners who are unwilling or reluctant to cooperate in project implementation.

For these reasons, the County is exploring alternative compliance options to allow permit compliance in 2019 in regards to impervious surface restoration goals. Trading-in-time with the wastewater sector is one of the alternative options currently under review by MDE and various local jurisdictions.

Charles County will continue to work with technical, outreach, and funding partners to ensure that the County's waterways are protected and restored, stormwater impacts are reduced, and that the County is doing its part for the restoration of the Chesapeake Bay.

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APPENDIX A – WATERSHED RESTORATION PROJECT MASTER LIST

Planning Level	Watershed	Project ID	Name	Water Quality Facility Type	Drainage Area (ac)/ Length (ft)	Imperv-ious Acreage	Pervious Acreage	Current Impervious Acres Treated	Imperv-ious Credit Acres	Runoff Dept Treated (inches)	Load Removal TN EOS lbs/yr	TN DEL lbs/yr	TP EOS lbs/yr	TP DEL lbs/yr	TSS EOS lbs/yr	TSS DEL lbs/yr	Total Cost
1- Completed	Lower Patuxent	VCI 140021	Historic Benedict Village	Rain Garden	0.20	0.15	0.05	0.00	0.15	1.00	0.8	0.8	0.1	0.1	33.3	33.3	$42,000
1- Completed	Mattawoman	40021	Acton Lane Roadway	Wet Pond	32.51	17.39	15.12	9.39	8.00	1.00	51.5	28.5	8.7	6.9	3,694.7	3,252.0	$318,300
1- Completed	Mattawoman	09-0078	Bryans Road	Dry Swale	1.61	0.73	0.88	0.00	0.73	1.00	6.3	3.5	0.9	0.7	332.8	292.9	
1- Completed	Mattawoman	09-0078	Bryans Road	Enhanced Filter	9.10	8.92	0.18	0.00	8.92	1.00						0.0	$1,711,629
1- Completed	Mattawoman	11-0102	Fox Run	Step Pool Storm Conveyance	23.14	9.51	13.63	0.00	9.51	1.00	52.6	29.1	9.6	7.6	4,160.5	3,662.0	$1,091,710
1- Completed	Mattawoman	09-0111	Pinefield Pond	Wet Pond	51.00	22.30	28.70	0.00	22.34	1.00	116.9	64.6	22.0	17.5	9,601.3	8,450.9	$1,219,630
1- Completed	Zekiah	AMT-06-0034	NPDES: Carrington - Brown Elementary School	Shallow Marsh	75.53	30.88	44.65	0.00	25.33	0.82	147.2	102.7	25.4	20.4	9,342.6	12,615.2	$1,464,000
1- Completed	Zekiah	AMT-06-0036	NPDES: Carrington - Homeowner's Association	Wet Swale	33.67	18.60	15.07	0.00	3.00	0.04	2.8	2.0	0.3	0.2	82.8	111.8	$201,610
1- Completed	Zekiah	AMT-06-0035	NPDES: Carrington - Middleton Elementary School	Wet Swale	96.91	31.10	65.81	0.00	17.00	0.28	77.7	54.2	9.0	7.2	2,878.9	3,887.3	$201,610
1- Completed	Zekiah	VIS-11-0099	NPDES: Ryon Woods	Dry Swale	4.66	1.38	3.28	0.00	0.95	0.69	13.7	9.6	1.4	1.1	420.6	567.9	$121,862
2- In Construction	Mattawoman	VIS-P-8	Holly Tree	Step Pool Storm Conveyance	106.63	49.22	57.41	20.92	28.30	1.00	229.9	127.1	43.7	34.8	17,727.1	15,603.1	$1,746,700
2- In Construction	Mattawoman	VIS-P-7	Tanglewood	Step Pool Storm Conveyance	56.55	21.46	35.09	9.49	11.97	1.00	120.6	66.7	21.7	17.3	8,699.2	7,656.9	$1,310,410
2- In Construction	Mattawoman	WTB-1	Temi Drive	Submerged Gravel Wetland	40.01	15.20	24.81	0.00	15.20	1.00	90.1	49.8	15.9	12.7	6,811.1	5,995.0	$1,114,300
2- In Construction	Nanjemoy	14-0006	10th District VFD	Submerged Gravel Wetland	5.43	2.87	2.56	0.00	2.87	1.00	12.8	12.3	2.6	2.5	1,057.9	1,023.1	$107,830
2- In Construction	Potomac- Middle	12-0095	Potomac Height HOA	Dry Swales	51.97	23.82	28.15	0.00	1.08	342.6	208.8	30.0	30.0	15,657.9	15,657.9	18.14	$927,759
2- In Construction	Potomac- Middle	12-0095	Potomac Height HOA	Wet Pond	5.29	1.21	4.08	0.00	2.70	32.5	13.0	1.9	1.9	1,064.2	1,064.2	3.27	
2- In Construction	Zekiah	VIS-12-0067	White Plains	Submerged Gravel Wetland	192.50	45.42	147.08	0.00	5.25	0.12	73.5	51.3	7.0	5.6	2,014.1	2,719.6	$737,530
3- Full Design	Lower Patuxent	SH-9	Benedict Ave	Shoreline Restoration	450.00				18.00		34.0	34.0	31.0	31.0	62,000.0	62,000.0	$369,563
3- Full Design	Mattawoman	VIS-P-1	Acton-Hamilton Regional	Submerged Gravel Wetland/Created Wetland	286.56	101.62	184.95	44.19	13.70	0.57	1,394.2	770.5	213.2	169.7	77,645.1	68,342.2	$2,976,960
3- Full Design	Mattawoman	VIS-P-1A	Acton-Hamilton Regional	Created Wetland	443.44	157.24	286.19	68.39	21.20	0.57	807.2	446.1	168.0	133.7	73,208.2	64,436.9	
3- Full Design	Mattawoman	VIS-P-3	Brookside Pl	Micro-bio/SPSC Facility	1.27	0.83	0.44	0.00	0.83	1.00	4.6	2.5	1.2	1.0	565.1	497.4	$160,304
3- Full Design	Mattawoman	VIS-P-6	Charles County Plaza	Submerged Gravel Wetland	23.06	19.90	3.16	1.26	18.64	1.00	56.0	30.9	14.8	11.8	6,899.1	6,072.5	$790,096
3- Full Design	Mattawoman	GMB-Henson-SWM-01	JC Parks Elementary/ Matthew Henson Middle Schools	Constructed Wetland	28.95	9.81	19.14	0.00	9.81	1.00	27.9	15.4	3.4	2.7	1,098.8	967.1	$1,097,280
3- Full Design	Mattawoman	GMB-Lackey-SWM-01	Lackey High School	Grass Swale	7.30	0.56	6.74	0.00	0.56	1.00	0.9	0.5	0.1	0.1	22.5	19.8	$1,238,560
3- Full Design	Mattawoman	GMB-Lackey-SWM-02	Lackey High School	Grass Swale	8.88	0.59	8.29	0.00	0.59	1.00	0.9	0.5	0.1	0.1	21.5	18.9	
3- Full Design	Mattawoman	GMB-Lackey-SWM-03	Lackey High School	Bioswale	1.31	0.88	0.43	0.00	0.88	1.00	4.6	2.6	0.6	0.4	183.0	161.1	
3- Full Design	Mattawoman	GMB-Lackey-SWM-04	Lackey High School	Submerged Gravel Wetland	4.88	3.96	0.92	0.00	3.96	1.00	24.8	13.7	3.0	2.4	976.5	859.5	
3- Full Design	Mattawoman	GMB-Lackey-SWM-05	Lackey High School	Bioswale	0.95	0.46	0.49	0.00	0.46	1.00	1.8	1.0	0.2	0.2	71.2	62.7	
3- Full Design	Mattawoman	GMB-Lackey-SWM-06	Lackey High School	Existing Pond	8.44	7.09	1.35	0.00	7.09	1.52	22.9	12.6	2.8	2.2	901.9	793.9	
3- Full Design	Mattawoman	GMB-Lackey-SWM-07	Lackey High School	Submerged Gravel Wetland	2.65	0.82	1.83	0.00	0.82	1.00	2.2	1.2	0.3	0.2	85.9	75.6	
3- Full Design	Mattawoman	GMB-Lackey-SWM-08	Lackey High School	Submerged Gravel Wetland	2.85	1.05	1.80	0.00	1.05	1.00	3.2	1.8	0.4	0.3	125.6	110.5	
3- Full Design	Mattawoman	VIS-C-9	Laurel Branch- Apple Creek	SPSC/Stream Restoration	39.29	6.40	32.89	0.01	6.39	1.00	79.1	43.7	10.5	8.4	4,060.6	3,574.1	$967,566
3- Full Design	Mattawoman	VIS-C-22	Laurel Branch- Poplar Court	Wet Pond	92.21	12.22	79.99	0.00	12.22	1.00	192.3	106.3	23.0	18.3	8,676.3	7,636.8	$1,231,051
3- Full Design	Mattawoman	GMB-Mattawoman/ Berry WS 1A	Mattawoman Middle/Berry Elementary Schools	Dry Pond Conversion to Constructed Wetland	21.80	6.75	15.05	0.00	6.75	1.00	48.1	26.6	7.7	6.1	3,239.6	2,851.5	$0
3- Full Design	Mattawoman	GMB-Mattawoman/ Berry WS 1B	Mattawoman Middle/Berry Elementary Schools	Wet Swale/Bioswale	3.45	0.26	3.19	0.00	0.26	1.00	7.1	3.9	0.8	0.6	263.3	231.8	$0
3- Full Design	Mattawoman	GMB-Mattawoman/ Berry WS 2	Mattawoman Middle/Berry Elementary Schools	Dry Pond Conversion to Bioretention	8.90	5.45	3.45	0.00	5.45	1.00	36.6	20.2	6.1	4.9	2,306.0	2,029.7	$1,123,680
3- Full Design	Mattawoman	VIS-P-2	Meadow Ln	Pond Retrofit	5.41	2.45	2.96	0.75	1.70	1.00	6.8	3.8	1.7	1.4	796.3	700.9	$555,460
3- Full Design	Mattawoman	VIS-13-0013	Pinefield Drainage Improvements	Storm Drain Vacuuming					94.00		822.5	454.6	329.0	261.8	98,700.0	86,874.4	$1,359,220
3- Full Design	Mattawoman	NGO-1	Stavors Road Design Improvements	Submerged Gravel Wetland	11.56	3.96	7.60	1.00	2.64	1.25	27.1	15.0	4.6	3.7	1,934.9	1,703.1	$294,925

											Load Removal						
Planning Level	Watershed	Project ID	Name	Water Quality Facility Type	Drainage Area (ac)/ Length (ft)	Imperv-ious Acreage	Pervious Acreage	Current Impervious Acres Treated	Imperv-ious Credit Acres	Runoff Dept Treated (inches)	TN EOS lbs/yr	TN DEL lbs/yr	TP EOS lbs/yr	TP DEL lbs/yr	TSS EOS lbs/yr	TSS DEL lbs/yr	Total Cost
3- Full Design	Mattawoman	WURC-Matt	Waldorf Urban Development Corridor	Various	126.11				140.98		779.8	431.0	184.6	146.9	46.6	41.0	$7,775,618
3- Full Design	Mattawoman	VIS-P-4	Westdale Ct 1	Bioretention	2.21	1.22	0.99	0.61	0.61	1.00	4.9	2.7	1.1	0.9	444.6	391.3	$300,152
3- Full Design	Mattawoman	VIS-P-5	Westdale Ct 2	Organic Filter	1.01	0.67	0.34	0.33	0.34	1.00	2.3	1.3	0.5	0.4	225.8	198.7	$54,770
3- Full Design	Mattawoman	VIS-P-5A	Westdale Ct 3	Organic Filter	1.11	0.69	0.42	0.34	0.35	1.00	2.5	1.4	0.6	0.5	244.5	215.2	$54,770
3- Full Design	Port Tobacco	GMB-SWM-02	McDonough High School	Bioswale	0.82	0.32	0.50	0.00	0.32	1.56	1.8	1.8	0.2	0.2	42.9	42.9	$1,097,280
3- Full Design	Port Tobacco	GMB-SWM-03	McDonough High School	Submerged Gravel Wetland	1.80	0.69	1.11	0.00	0.69	1.61	2.2	2.2	0.3	0.3	85.9	85.9	$0
3- Full Design	Port Tobacco	GMB-SWM-04	McDonough High School	Bioretention- Expand	1.74	1.58	0.16	0.00	1.58	0.10	11.0	11.0	1.3	1.3	432.0	432.0	$0
3- Full Design	Port Tobacco	GMB-SWM-05	McDonough High School	Rainwater Harvesting	1.97	1.60	0.37	0.00	1.60	0.23	30.3	30.3	2.3	2.3	596.8	596.8	$0
3- Full Design	Port Tobacco	GMB-SWM-06	McDonough High School	Bioretention	2.97	1.81	1.16	0.00	1.81	0.64	8.7	8.7	1.1	1.1	341.5	341.5	$0
3- Full Design	Potomac- Lower	PRLT	Piccowaxen Middle / Thomas Higdon Elementary Schools	Pond Retrofit	8.68	2.92	5.76	0.00	2.92	1.00	19.3	19.3	3.2	3.2	1,930.4	1,930.4	$1,047,540
3- Full Design	Potomac- Lower	PRLT	Piccowaxen Middle / Thomas Higdon Elementary Schools	Pond Retrofit	29.27	3.78	25.49	0.00	3.78	1.00	61.0	61.0	7.2	7.2	3,865.4	3,865.4	$0
3- Full Design	Potomac- Lower	SH-5	Swan Point	Shoreline Restoration	1,488.00				59.50		112.0	112.0	101.0	101.0	204,000.0	204,000.0	$1,146,500
3- Full Design	Zekiah		John Hanson Middle School	Created Wetland	6.47	1.52	4.95	0.00	1.52	1.00	13.9	9.7	2.0	1.6	701.6	947.4	$95,636
3- Full Design	Zekiah		John Hanson Middle School	Created Wetland	5.21	2.78	2.43	0.00	2.78	1.00	12.3	8.6	2.5	2.0	977.3	1,319.6	$150,045
3- Full Design	Zekiah		John Hanson Middle School	Rain Garden	0.95	0.95	0.00	0.00	0.95	1.00	2.5	1.7	0.7	0.6	295.6	399.1	$143,797
3- Full Design	Zekiah		John Hanson Middle School	Wet Swale	6.47	1.32	5.15	0.00	1.32	1.00	13.8	9.6	1.9	1.5	648.5	875.7	$82,792
3- Full Design	Zekiah		JP Ryon	Created Wetland	8.72	4.09	4.63	0.00	4.09	1.00	20.2	14.1	4.0	3.2	1,486.5	2,007.2	$848,580
3- Full Design	Zekiah		NPDES: Public Works Campus	Rain Garden			0.00		0.00			0.0		0.0		0.0	
3- Full Design	Zekiah		NPDES: Public Works Campus	Step Pool Storm Conveyance			0.00		29.50		278.2	194.2	82.6	66.4	27,400.0	36,997.8	$1,200,768
3- Full Design	Zekiah		TC Martin Elementary School	Created Wetland	3.41	0.41	3.00	0.00	0.41	1.00	7.1	5.0	0.8	0.6	266.1	359.3	
3- Full Design	Zekiah		TC Martin Elementary School	Bioretention	0.57	0.57	0.00	0.00	0.57	1.00	2.6	1.8	0.6	0.5	190.1	256.7	$898,320
3- Full Design	Zekiah		TC Martin Elementary School	Bioswale	3.40	0.64	2.76	0.00	0.64	1.00	7.2	5.0	1.0	0.8	326.6	441.0	
3- Full Design	Zekiah		TC Martin Elementary School	Bioretention	2.46	1.26	1.20	0.00	1.26	1.00	9.9	6.9	1.5	1.2	479.6	647.6	
3- Full Design	Zekiah	WURC-Zek	Waldorf Urban Development Corridor	Various	188.12				190.46		1,169.7	816.4	277.0	222.6	69.9	94.4	$11,663,427
5- Existing SWM Upgrades	Mattawoman	VIS-B	Hess Court	Pond Retrofit	7.29	2.68	4.61	1.34	0.27	1.00	12.8	7.1	1.8	1.4	729.6	642.2	$94,440
5- Existing SWM Upgrades	Mattawoman	VIS-A	Wimbrell Court	Pond Retrofit	11.83	3.63	8.20	1.71	0.38	1.00	21.5	11.9	2.9	2.3	1,130.4	995.0	$135,317
5- Existing SWM Upgrades	Port Tobacco	VIS-PTR-C-1A	Dorchester Lower	Dry Swale	256.78	74.25	182.53	37.16	7.42	1.00	39.9	39.9	4.5	4.5	1,061.0	1,061.0	$454,458
5- Existing SWM Upgrades	Port Tobacco	VIS-PTR-C-1B	Dorchester Lower	ISA Baseline Reduction							529.6	529.6	84.4	84.4	27,734.7	27,734.7	$0
5- Existing SWM Upgrades	Port Tobacco	VIS-PTR-C-10	Preference Pond	ISA Baseline Reduction	251.79	28.89	222.90	3.21	2.76	1.00	491.7	491.7	58.1	58.1	16,906.0	16,906.0	$45,675
5- Existing SWM Upgrades	Port Tobacco	VIS-PTR-C-14	Upper Dorcester	ISA Baseline Reduction	99.89	28.61	71.28	15.52	2.62	1.00	417.9	417.9	30.2	30.2	5,524.9	5,524.9	$72,150
5- Existing SWM Upgrades	Port Tobacco	VIS-PTR-C-3	White Plains Lake	ISA Baseline Reduction	721.38	136.44	584.94	70.16	13.26	1.00	1,442.5	1,442.5	196.7	196.7	61,010.7	61,010.7	$79,175
5- Existing SWM Upgrades	Zekiah	SWM-04	Henry Ford Circle Pond	ISA Baseline Reduction	294.90	123.00	171.90	38.60	11.42	1.00	258.9	180.7	29.8	23.9	17,600.0	23,765.0	$265,500
5- Existing SWM Upgrades	Zekiah	RC-6*	Huntington Lake	ISA Baseline Reduction	120.42	30.76	89.66	0.29	6.09	1.00	260.3	181.7	38.7	31.1	13,621.8	18,393.3	$42,000
5- Existing SWM Upgrades	Zekiah	SWM-05	Industrial Park Pond	ISA Baseline Reduction	114.30	57.39	56.91	22.99	5.44	1.00	103.6	72.3	13.0	10.4	7,800.0	10,532.2	$184,375
5- Existing SWM Upgrades	Zekiah	RC-5*	Lambeth Hill Lake	ISA Baseline Reduction	133.36	38.53	94.83	2.90	7.13	1.00	284.4	198.5	43.6	35.0	15,466.1	20,883.6	$42,000
5- Existing SWM Upgrades	Zekiah	RC-1*	Post Office Lake	ISA Baseline Reduction	477.28	182.38	294.90	0.00	36.48	1.00	1,075.2	750.4	190.4	153.0	70,370.3	95,019.9	$42,000
5- Existing SWM Upgrades	Zekiah	RC-8*	Sheffield/St. Martin's Drive	ISA Baseline Reduction	172.35	60.15	112.20	46.90	2.65	1.00	259.4	181.0	29.3	23.5	9,304.0	12,563.0	$42,000
5- Existing SWM Upgrades	Zekiah	SWM-09	St. Paul Drive	ISA Baseline Reduction	95.90	28.88	67.02	6.22	2.78	1.00	75.5	52.7	7.6	6.1	4,400.0	5,941.3	$184,375

Planning Level	Watershed	Project ID	Name	Water Quality Facility Type	Drainage Area (ac)/ Length (ft)	Imperv-ious Acreage	Pervious Acreage	Current Impervious Acres Treated	Imperv-ious Credit Acres	Runoff Dept Treated (inches)	Load Removal TN EOS lbs/yr	TN DEL lbs/yr	TP EOS lbs/yr	TP DEL lbs/yr	TSS EOS lbs/yr	TSS DEL lbs/yr	Total Cost
5- Existing SWM Upgrades	Zekiah	RC-2*	Wakefield Lake	ISA Baseline Reduction	349.57	137.93	211.64	0.00	27.59	1.00	790.4	551.6	142.0	114.1	52,693.8	71,151.6	$42,000
5- Existing SWM Upgrades	Zekiah	SWM-01	White Oak Village Pond	Pond Retrofit	123.70	30.97	92.73	8.41	3.02	1.00	95.7	66.8	9.1	7.3	5,200.0	7,021.5	$245,500
6- Concept	Mattawoman	VIS-C-5	AMF Waldorf Lanes	Submerged Gravel Wetland	3.47	2.88	0.59	0.11	2.77	1.00	8.2	4.5	2.2	1.8	951.8	837.8	$180,333
6- Concept	Mattawoman	VIS-C-16	Constitution Hills- Hale Court	Sheetflow to Conservation Areas	37.94	12.19	25.75	0.52	11.67	1.00	79.7	44.0	13.3	10.6	5,194.9	4,572.5	$120,141
6- Concept	Mattawoman	GMB-Smallwood-SWM-01	General Smallwood Middle School	Submerged Gravel Wetland	2.17	0.97	1.20	0.00	0.97	1.00	3.5	1.9	0.4	0.3	138.6	122.0	$1,089,240
6- Concept	Mattawoman	GMB-Smallwood-SWM-02	General Smallwood Middle School	Bioswale	1.97	0.96	1.01	0.00	0.96	1.00	3.8	2.1	0.5	0.4	147.7	130.0	
6- Concept	Mattawoman	GMB-Smallwood-SWM-03	General Smallwood Middle School	Bioretention	0.56	0.40	0.16	0.00	0.40	1.00	2.2	1.2	0.3	0.2	88.2	77.7	
6- Concept	Mattawoman	GMB-Smallwood-SWM-04	General Smallwood Middle School	Submerged Gravel Wetland	2.48	1.23	1.25	0.00	1.23	1.00	4.8	2.7	0.6	0.5	191.0	168.1	
6- Concept	Mattawoman	GMB-Smallwood-SWM-05	General Smallwood Middle School	Submerged Gravel Wetland	2.77	1.84	0.93	0.00	1.84	1.00	9.5	5.3	1.2	0.9	375.5	330.5	
6- Concept	Mattawoman	VIS-C-6	Grinder/Old Washington Rd	Wet Pond/Impervious Removal	75.05	40.06	34.99	12.53	21.75	1.00	154.8	85.6	31.8	25.3	12,881.3	11,337.9	$378,840
6- Concept	Mattawoman	VIS-C-29	Ruth B Swann Park	Created Wetland/SPSC/SGW/SR	731.38	144.63	586.75	53.65	20.51	0.51	150.9	83.4	80.5	64.1	20,256.4	17,829.4	$3,019,830
6- Concept	Mattawoman	VIS-C-8	Verizon Pond	Submerged Gravel Wetland	3.22	2.42	0.80	0.31	2.09	0.99	7.1	3.9	1.7	1.4	735.3	647.2	$223,688
6- Concept	Mattawoman	VIS-C-2	Wexford Village- Murre Court	Sheetflow to Conservation Areas	14.63	4.51	10.12	2.26	2.26	1.00	23.1	12.8	3.0	2.4	950.2	836.4	$113,095
6- Concept	Port Tobacco	VIS-PTR-C-11	Talbot Street	Submerged Gravel Wetland	8.12	5.70	2.42	0.00	5.70	1.00	32.6	32.6	5.8	5.8	1,763.2	1,763.2	$592,518
6- Concept	Port Tobacco	VIS-PTR-C-8	Warren Drive	Submerged Gravel Wetland	240.66	15.18	225.48	2.52	12.66	1.00	798.3	798.3	61.6	61.6	14,048.4	14,048.4	$922,965
6- Concept	Potomac- Lower	SH-4	NPDES: Clifton	Shoreline Restoration	2,050.00				82.00		154.0	154.0	139.0	139.0	280,000.0	280,000.0	$1,427,313
7- Concept	Mattawoman	VIS-C-23	Pinefield Center	Submerged Gravel Wetland	7.21	5.46	1.75	0.45	5.01	1.00	16.7	9.2	4.2	3.3	1,823.6	1,605.1	$365,434
7- Concept	Mattawoman	VIS-C-25	Shoppers Ditch	Submerged Gravel Wetland	7.03	5.98	1.05	2.89	3.09	1.00	16.7	9.2	4.5	3.6	1,976.6	1,739.8	$175,718
7- Concept	Mattawoman	VIS-C-24	Shoppers Parking	Bioretention Islands	4.29	3.98	0.31	1.99	1.99	1.00	10.4	5.7	3.0	2.4	1,305.3	1,148.9	$137,703
7- Concept	Mattawoman	VIS-C-7	Walmart Pond	Dry Swale/Bioretention Islands	13.40	9.89	3.51	4.72	5.17	1.00	31.0	17.1	7.8	6.2	3,379.8	2,974.9	$378,840
7- Concept	Port Tobacco	VIS-PTR-C-4	Espirit Place	Sheetflow to Conservation Areas	24.82	12.18	12.64	6.09	6.09	1.00	42.0	42.0	5.0	5.0	1,188.1	1,188.1	$100,250
7- Concept	Port Tobacco	VIS-PTR-C-9	Pheasant Farms Entrance	Created Wetland	39.25	5.58	33.67	0.10	5.48	1.00	77.3	77.3	9.7	9.7	2,887.6	2,887.6	$330,870
7- Concept	Port Tobacco	VIS-PTR-C-4A	Southwinds Drive	Sheetflow to Conservation Areas							27.4	27.4	3.2	3.2	773.4	773.4	$100,250
7- Concept	Port Tobacco	VIS-PTR-C-5	Theodore Green Blvd	Submerged Gravel Wetland	8.64	6.65	1.99	1.72	4.93	1.00	35.3	35.3	6.6	6.6	2,021.5	2,021.5	$329,665
7- Concept	Port Tobacco	VIS-PTR-C-12	Wilton Court	Sheetflow to Conservation Areas	13.10	9.89	3.21	5.04	4.85	1.00	93.0	93.0	8.5	8.5	1,870.3	1,870.3	$108,878
8- Concept	Lower Patuxent	BAY_LP_SEC_1	Benedict Shoreline	Shoreline Management	450.00				18.00		33.8	33.8	30.6	30.6	61,650.0	61,650.0	$40,125
8- Concept	Lower Patuxent	BAY_LP_SEC_2	Benedict Shoreline	Shoreline Management	3,016.00				120.64		226.2	226.2	205.1	205.1	413,192.0	413,192.0	$2,045,894
8- Concept	Lower Patuxent	Benedict-1	Benedict Rain Garden	Rain Garden	0.50	0.50	0.00	0.00	0.50	1.00	5.5	5.5	0.6	0.6	0.2	0.2	$2,045,894
8- Concept	Lower Patuxent		Benedict Reforestation	Tree Planting	1.48				1.48		19.8	19.8	2.0	2.0	0.5	0.5	$200,625
8- Concept	Mattawoman	VIS-C-10	Athens Place	StormFilter	5.56	2.30	3.26	1.15	1.15	1.00	5.1	2.8	1.0	0.8	403.5	355.2	$124,133
8- Concept	Mattawoman	VIS-C-11	Berry Hill Manor	SPSC/Stream Restoration	300.19	41.98	258.21	29.33	12.65	1.00	502.3	277.6	52.7	41.9	16,038.8	14,117.1	$2,691,340
8- Concept	Mattawoman	VIS-C-12	Bonnie Lane	Step Pool Storm Conveyance	60.39	11.45	48.94	0.20	11.25	1.00	122.8	67.9	16.7	13.3	6,096.6	5,366.1	$1,091,125
8- Concept	Mattawoman	VIS-C-28	Bridle Path	Step Pool Storm Conveyance	93.33	11.26	82.07	0.00	11.26	1.00	185.7	102.6	21.3	17.0	7,217.9	6,353.1	$895,475
8- Concept	Mattawoman	VIS-C-13	Butte Place	StormFilter	12.24	4.76	7.48	2.37	2.39	1.00	11.1	6.1	2.1	1.7	829.5	730.1	$144,003
8- Concept	Mattawoman	VIS-C-14	Community Drive	Submerged Gravel Wetland	16.27	4.79	11.48	2.39	2.40	1.00	25.9	14.3	2.8	2.2	913.3	803.9	$175,115
8- Concept	Mattawoman	VIS-C-15	Holiday Inn Express	Submerged Gravel Wetland	1.50	1.14	0.36	0.57	0.57	1.00	3.5	1.9	0.9	0.7	390.1	343.4	$149,425
8- Concept	Mattawoman	VIS-C-18	Lacrosse Pond	StormFilter	13.48	5.77	7.71	2.88	2.89	1.00	12.4	6.9	2.6	2.1	1,005.4	884.9	$195,588
8- Concept	Mattawoman	VIS-C-19	Lombard Pond	Submerged Gravel Wetland	22.52	8.79	13.73	4.40	4.39	1.00	36.2	20.0	4.4	3.5	1,472.2	1,295.8	$313,808
8- Concept	Mattawoman	VIS-C-20	Marbella Stream	SPSC/Stream Restoration	136.62	66.63	69.99	18.37	48.26	1.00	294.3	162.7	58.3	46.4	23,781.1	20,931.8	$2,731,575
8- Concept	Mattawoman	VIS-C-1	Merganser Court	Sheetflow to Conservation Areas	5.72	2.10	3.62	1.05	1.05	1.00	7.5	4.1	1.2	1.0	386.5	340.2	$101,853
8- Concept	Mattawoman	VIS-C-21	Pembrooke Square	Submerged Gravel Wetland	75.57	39.45	36.12	14.25	23.08	1.00	146.4	80.9	27.2	21.6	10,398.7	9,152.8	$673,335
8- Concept	Mattawoman	GMB-Potomac-BMP-1	Potomac Library	Submerged Gravel Wetland	3.65	1.29	2.36	0.00	1.29	1.00	6.6	3.6	0.6	0.5	158.8	139.8	$87,714
8- Concept	Mattawoman	GMB-Potomac-BMP-2	Potomac Library	Submerged Gravel Wetland	0.52	0.47	0.05	0.00	0.47	1.00	5.6	3.1	0.5	0.4	135.7	119.4	$41,992
8- Concept	Mattawoman	GMB-Potomac-BMP-3	Potomac Library	Submerged Gravel Wetland	0.47	0.42	0.05	0.00	0.42	1.00	5.0	2.8	0.4	0.3	120.0	105.6	$41,141

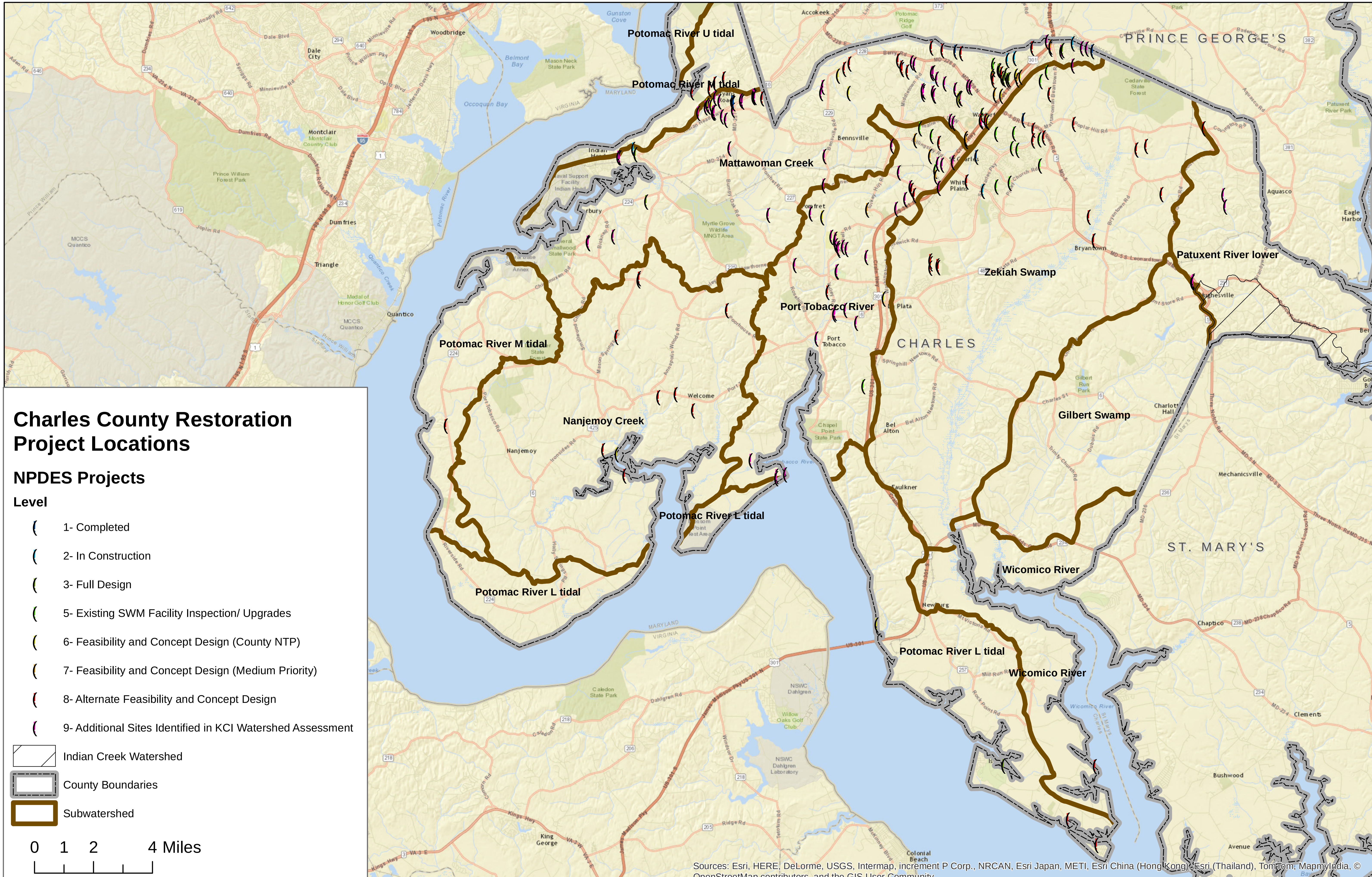
Planning Level	Watershed	Project ID	Name	Water Quality Facility Type	Drainage Area (ac)/ Length (ft)	Imperv-ious Acreage	Pervious Acreage	Current Impervious Acres Treated	Imperv-ious Credit Acres	Runoff Dept Treated (inches)	Load Removal TN EOS lbs/yr	TN DEL lbs/yr	TP EOS lbs/yr	TP DEL lbs/yr	TSS EOS lbs/yr	TSS DEL lbs/yr	Total Cost
8- Concept	Mattawoman	GMB-Potomac-BMP-4	Potomac Library	Grass Swale	0.72	0.36	0.36	0.00	0.36	1.00	2.5	1.4	0.2	0.2	60.2	53.0	$17,050
8- Concept	Mattawoman	GMB-RuthSwann-AltB	Ruth B Swann Park	Submerged Gravel Wetland	10.80	10.80	0.00	0.00	10.80	1.00	28.8	15.9	8.3	6.6	3,899.8	3,432.6	$651,114
8- Concept	Mattawoman	VIS-C-26	Silverleaf Street	Dry Swale	9.00	1.81	7.19	0.00	1.81	1.00	18.4	10.2	2.5	2.0	938.5	826.1	$132,965
8- Concept	Mattawoman	VIS-C-17	St. Patricks Drive	Submerged Gravel Wetland	3.81	2.71	1.10	0.00	2.71	1.00	8.8	4.9	2.2	1.8	935.7	823.6	$175,718
8- Concept	Mattawoman	VIS-C-27	Thomas Road	Step Pool Storm Conveyance	12.51	3.48	9.03	0.00	3.48	1.00	25.9	14.3	4.1	3.3	1,560.2	1,373.3	$400,120
8- Concept	Mattawoman	VIS-C-4	Westdale Dr	SPSC/Stream Restoration	19.20	5.22	13.98	0.85	4.37	1.00	29.4	16.2	4.6	3.7	1,831.9	1,612.4	$392,890
8- Concept	Nanjemoy	SWM-03	Friendship Park	Bioretention	2.31	1.28	1.03	0.00	1.30	1.02	10.2	9.8	1.4	1.4	800.0	773.7	$97,605
8- Concept	Nanjemoy	SWM-09	Glasgow Lane	Step Pool Storm Conveyance	13.61	1.90	11.71	0.95	1.50	1.29	80.9	77.8	5.0	4.9	2,200.0	2,127.6	$305,938
8- Concept	Nanjemoy	SR-10	Gordon Place	Stream Restoration	400.00				4.00		30.0	28.8	27.2	26.5	6,000.0	5,802.4	$361,000
8- Concept	Nanjemoy	SR-09	Gunston Road	Stream Restoration	375.00				3.80		28.1	27.0	25.5	24.8	5,800.0	5,609.0	$325,938
8- Concept	Nanjemoy	SR-08	Mason Springs Road	Stream Restoration	400.00				4.00		30.0	28.8	27.2	26.5	6,000.0	5,802.4	$361,000
8- Concept	Nanjemoy	SH-2	NPDES: Friendship Farm Park	Shoreline Restoration	1,987.00				79.50		149.0	143.2	135.0	131.4	272,000.0	263,043.0	$1,106,759
8- Concept	Nanjemoy	SH-2	NPDES: Friendship Farm Park	Shoreline Restoration	2,518.00				100.70		189.0	181.7	171.0	166.5	344,000.0	332,672.1	$1,577,842
8- Concept	Nanjemoy	SWM-08	Pisgah United Methodist	Bioretention	3.70	0.70	3.00	0.00	0.80	1.14	16.7	16.1	1.5	1.5	0.4	0.4	$74,710
8- Concept	Nanjemoy	SWM-01	Port Tobacco Road 1	Step Pool Storm Conveyance	8.46	2.42	6.04	0.00	2.10	0.87	61.1	58.7	4.3	4.2	2,000.0	1,934.1	$453,605
8- Concept	Nanjemoy	SH-3	Walters Landing Road	Shoreline Restoration	120.00				4.80		9.0	8.7	8.0	7.8	16,000.0	15,473.1	$82,840
8- Concept	Port Tobacco	VIS-PTR-C-7A	Coastal Blvd	Submerged Gravel Wetland	22.95	3.00	19.95	0.00	3.00	1.00	57.8	57.8	4.5	4.5	952.5	952.5	$219,073
8- Concept	Port Tobacco	VIS-PTR-C-7B	Coastal Blvd	Wet Swale							31.4	31.4	3.7	3.7	1,084.6	1,084.6	$0
8- Concept	Port Tobacco	VIS-PTR-C-13A	Eller Street	Wet Swale	42.76	3.41	39.35	0.03	3.38	1.00	67.6	67.6	7.6	7.6	2,100.4	2,100.4	$268,248
8- Concept	Port Tobacco	VIS-PTR-C-13B	Eller Street	Submerged Gravel Wetland							142.6	142.6	11.5	11.5	2,673.2	2,673.2	$377,033
8- Concept	Port Tobacco	VIS-PTR-C-2	Red Horse Court	Underground Infiltration	18.36	7.51	10.85	3.76	3.75	1.00	60.2	60.2	14.6	14.6	5,343.3	5,343.3	$741,713
8- Concept	Port Tobacco	VIS-PTR-C-6A	Tate Street	Submerged Gravel Wetland	19.45	4.55	14.90	0.04	4.51	1.00	60.3	60.3	6.2	6.2	1,553.3	1,553.3	$382,853
8- Concept	Port Tobacco	VIS-PTR-C-6B	Tate Street	Wet Swale							15.5	15.5	2.0	2.0	644.4	644.4	
8- Concept	Potomac- Lower	SH-6	Porter Road	Shoreline Restoration	1,007.00				40.30		76.0	76.0	68.0	68.0	138,000.0	138,000.0	$701,124
8- Concept	Potomac- Middle	SR-04	Amherst Road	Stream Restoration	300.00				3.00		22.5	22.5	20.4	20.4	4,600.0	4,600.0	$255,750
8- Concept	Potomac- Middle	SR-07	Bryans Crossing	Stream Restoration	2,100.00				21.00		157.5	157.5	142.8	142.8	32,000.0	32,000.0	$1,338,725
8- Concept	Potomac- Middle	SR-01	Riverside Road	Stream Restoration	400.00				4.30		35.2	35.2	27.6	27.6	6,200.0	6,200.0	$385,100
8- Concept	Potomac- Middle	SH-1	Ruth B. Swann	Shoreline Restoration	1,208.00				48.30		91.0	91.0	82.0	82.0	166,000.0	166,000.0	$793,656
8- Concept	Potomac- Middle	SWM-07	South Hampton Ponds	Pond Retrofit	48.17	14.15			7.20		148.7	148.7	15.5	15.5	8,800.0	8,800.0	$715,770
8- Concept	Wicomico	SH-8	Charleston Estates	Shoreline Restoration	319.00				12.80		24.0	24.0	22.0	22.0	44,000.0	44,000.0	$178,758
8- Concept	Zekiah	SR-06	Bryan Meadows Lane	Stream Restoration	700.00				7.00		52.5	36.6	47.6	38.3	10,600.0	14,313.0	$583,925
8- Concept	Zekiah	SR-07	Bryantown Road	Stream Restoration	1,700.00				17.00		127.5	89.0	115.6	92.9	25,800.0	34,837.3	$1,194,250
8- Concept	Zekiah	SWM-15	CC Public School Admin	Stormwater Wetland	7.90	4.30	3.60	0.00	4.30	1.00	34.0	23.7	4.5	3.6	2,800.0	3,780.8	$411,000
8- Concept	Zekiah	SWM-16	CCPublic School Annex	Stormwater Wetland	3.10	1.74	1.36	0.00	1.70	0.98	13.7	9.6	1.8	1.4	1,200.0	1,620.3	$245,500
8- Concept	Zekiah	SR-01	Idlewood Trailer Park	Stream Restoration	260.00				2.70		20.3	14.2	18.4	14.8	4,200.0	5,671.2	$222,010
8- Concept	Zekiah	SWM-13	La Plata High School	Stormwater Wetland	46.10	16.06	30.04	0.68	13.40	0.88	184.2	128.6	19.1	15.3	10,800.0	14,583.1	$514,250
8- Concept	Zekiah	SWM-03	Lakewood Estates Pond	Pond Retrofit	47.30	8.82	38.48	4.58	4.30	1.01	35.8	25.0	3.1	2.5	1,600.0	2,160.5	$293,750
8- Concept	Zekiah	SWM-12	Malcolm Elementary	Rain Garden	2.30	2.00	0.30	0.00	2.00	1.00	19.4	13.5	2.3	1.8	1,200.0	1,620.3	$137,300
8- Concept	Zekiah	SR-02	Meadow Creek Lane 1	Stream Restoration	1,950.00				19.50		146.3	102.1	132.6	106.6	29,600.0	39,968.4	$1,374,875
8- Concept	Zekiah	SR-03	Meadow Creek Lane 2	Stream Restoration	500.00				5.00		37.5	26.2	34.0	27.3	7,600.0	10,262.2	$401,250
8- Concept	Zekiah	SR-04	Poplar Hill Road	Stream Restoration	320.00				3.20		24.0	16.8	21.8	17.5	4,800.0	6,481.4	$272,800
8- Concept	Zekiah	SWM-14	Radio Station Road	Submerged Gravel Wetland	5.70	3.97	1.73	0.00	4.00	1.01	44.2	30.8	4.8	3.9	2,600.0	3,510.7	$274,600
8- Concept	Zekiah	SR-05	St. Charles Community	Stream Restoration	1,000.00				10.00		75.0	52.3	68.0	54.6	15,200.0	20,524.3	$752,500
8- Concept	Zekiah	SR-08	St. Charles Parkway	Stream Restoration	475.00				4.80		35.6	24.8	32.3	26.0	7,200.0	9,722.0	$436,790
8- Concept	Zekiah	SWM-11	Thomas Stone High School	Stormwater Wetland	36.10	15.56	20.54	8.53	7.20	1.01	31.8	22.2	3.7	3.0	2,200.0	2,970.6	$391,000
8- Concept	Zekiah	SWM-08	Vest Lane	Pond Retrofit	99.50	11.30	88.20	5.57	8.60	0.99	95.6	66.7	26.1	21.0	7,400.0	9,992.1	$441,000
9- Planning	Lower Patuxent	KCI-LP_SR_1	Celestial Ln	Stream Restoration	3,442.53				34.43		258.2	258.2	234.1	234.1	51,638.0	51,638.0	$2,375,863
9- Planning	Lower Patuxent	KCI-LP_SWM_1	Harley Davidson	Micro-bioretention	1.50	0.72	0.78	0.00	0.05	0.05	0.4	0.4	0.1	0.1	34.4	34.4	$12,394
9- Planning	Lower Patuxent	KCI-LP_SWM_2	Harley Davidson	Bioretention	0.08	0.06	0.02	0.00	1.19	1.75	0.4	0.4	0.1	0.1	25.6	25.6	$21,851
9- Planning	Lower Patuxent	KCI-LP_SWM_3	Harley Davidson	Bioretention	0.67	0.46	0.21	0.00	1.04	1.15	2.9	2.9	0.5	0.5	196.7	196.7	$156,839
9- Planning	Mattawoman	KCI-MW_TP_7	Bensville Park	Reforestation	1.55	0.00	1.55	0.00	0.59		5.8	3.2	0.4	0.3	67.3	59.2	$18,641
9- Planning	Mattawoman	KCI-MW_BMP_9	Bryans Rd Vol Fire Department	Wet Pond	1.43	1.14	0.29	0.00	1.01	1.05	3.7	2.0	0.9	0.7	432.5	380.7	$81,313
9- Planning	Mattawoman	KCI-MW_TP_4	Cheryl Turn Pond Planting	Reforestation	0.28	0.00	0.28	0.00	0.11		1.1	0.6	0.1	0.1	12.3	10.8	$3,399

											Load Removal						
Planning Level	Watershed	Project ID	Name	Water Quality Facility Type	Drainage Area (ac)/ Length (ft)	Imperv-ious Acreage	Pervious Acreage	Current Impervious Acres Treated	Imperv-ious Credit Acres	Runoff Dept Treated (inches)	TN EOS lbs/yr	TN DEL lbs/yr	TP EOS lbs/yr	TP DEL lbs/yr	TSS EOS lbs/yr	TSS DEL lbs/yr	Total Cost
9- Planning	Mattawoman	KCI-MW_BMP_17	County Ln Pond	Infiltration Basin	13.19	4.31	8.88	0.00	1.13	1.51	54.4	30.1	6.7	5.3	2,368.8	2,085.0	$344,161
9- Planning	Mattawoman	KCI-MW_BMP_10	Crake Ct Pond	Created Wetland	32.96	6.79	26.17	0.00	0.81	0.81	65.7	36.3	9.0	7.2	3,590.5	3,160.3	$385,450
9- Planning	Mattawoman	KCI-MW_BMP_3	Dale's Smokehouse	Bioretention	0.05	0.04	0.01	0.00	0.94	0.94	0.2	0.1	0.1	0.1	16.7	14.7	$8,082
9- Planning	Mattawoman	KCI-MW_TP_20	Daniel of St. Thomas Jenifer Elementary School	Reforestation	1.39	0.00	1.39	0.00	0.53		5.3	2.9	0.3	0.2	60.6	53.3	$16,809
9- Planning	Mattawoman	KCI-MW_BMP_8	Dash-in Pond	Wet Pond	1.83	1.22	0.61	0.00	1.16	1.64	4.9	2.7	1.1	0.9	520.4	458.0	$99,664
9- Planning	Mattawoman	KCI-MW_TP_16	First Baptist Church of Waldorf	Reforestation	3.28	0.00	3.28	0.00	1.25		12.3	6.8	0.8	0.6	142.5	125.4	$39,499
9- Planning	Mattawoman	KCI-MW_BMP_11	Fleet Ct Pond	Created Wetland	10.58	4.11	6.47	0.00	1.09	1.35	25.5	14.1	4.6	3.7	1,954.5	1,720.3	$314,682
9- Planning	Mattawoman	KCI-MW_BMP_4	Fox Chase Apartment	Bioretention	6.71	3.26	3.45	0.00	1.04	1.18	27.7	15.3	4.1	3.3	1,519.1	1,337.1	$683,087
9- Planning	Mattawoman	KCI-MW_TP_9	Gale Bailey Elementary School	Reforestation	2.16	0.00	2.16	0.00	0.82		8.2	4.5	0.5	0.4	94.1	82.8	$26,078
9- Planning	Mattawoman	KCI-MW_TP_17	Grace Baptist Church of Waldorf	Reforestation	0.40	0.00	0.40	0.00	0.15		1.5	0.8	0.1	0.1	17.4	15.3	$4,835
9- Planning	Mattawoman	KCI-MW_BMP_2	Grinders Seafood	Bioretention	0.26	0.20	0.06	0.00	1.03	1.12	1.2	0.7	0.2	0.2	81.9	72.1	$40,526
9- Planning	Mattawoman	KCI-MW_BMP_15	Hallmark Ln Pond	Infiltration Basin	3.92	1.36	2.56	0.00	1.40	2.60	17.1	9.5	2.1	1.7	767.6	675.6	$134,887
9- Planning	Mattawoman	KCI-MW_TP_8	Horizon Center	Reforestation	1.41	0.00	1.41	0.00	0.54		5.3	2.9	0.3	0.2	61.5	54.1	$17,048
9- Planning	Mattawoman	KCI-MW_TP_10	Indian Head Hwy	Reforestation	0.93	0.00	0.93	0.00	0.35		3.5	1.9	0.2	0.2	40.3	35.5	$11,164
9- Planning	Mattawoman	KCI-MW_TP_21	Jenifer School Ln	Reforestation	6.46	0.00	6.46	0.00	2.45		24.4	13.5	1.5	1.2	280.6	247.0	$77,799
9- Planning	Mattawoman	KCI-MW_SR_2	Kincaid Dr	Stream Restoration	946.00				9.46		71.0	39.2	64.3	51.2	14,190.0	12,489.8	$653,108
9- Planning	Mattawoman	KCI-MW_TP_5	Little Valley Pl	Reforestation	1.76	0.00	1.76	0.00	0.67		6.6	3.6	0.4	0.3	76.3	67.2	$21,164
9- Planning	Mattawoman	KCI-MW_BMP_16	Long House Ct Pond	Wet Pond	2.51	1.02	1.49	0.00	1.30	2.20	6.4	3.5	1.2	1.0	502.0	441.9	$93,390
9- Planning	Mattawoman	KCI-MW_BMP_13	Lutheran Church of Our Savor Pond	Created Wetland	0.21	0.16	0.06	0.00	1.40	2.60	0.6	0.3	0.1	0.1	66.8	58.8	$15,294
9- Planning	Mattawoman	KCI-MW_TP_3	Madison Pl	Reforestation	0.70	0.00	0.70	0.00	0.27		2.6	1.4	0.2	0.2	30.6	26.9	$8,484
9- Planning	Mattawoman	KCI-MW_BMP_14	Mattawoman Middle School	Infiltration Basin	36.94	14.45	22.49	0.00	0.77	0.77	130.8	72.3	17.4	13.8	6,298.2	5,543.6	$784,202
9- Planning	Mattawoman	KCI-MW_TP_6	Melwood Horticultural Training Center	Reforestation	3.05	0.00	3.05	0.00	1.16		11.5	6.4	0.7	0.6	132.6	116.7	$36,751
9- Planning	Mattawoman	KCI-MW_TP_11	Middletown Rd	Reforestation	0.55	0.00	0.55	0.00	0.21		2.1	1.2	0.2	0.2	24.0	21.1	$6,649
9- Planning	Mattawoman	KCI-MW_BMP_12	Montrose Rd Pond	Wet Pond	24.83	7.35	17.48	0.00	1.06	1.24	57.4	31.7	9.1	7.2	3,772.8	3,320.8	$548,985
9- Planning	Mattawoman	KCI-MW_TP_12	Pinefield Rd	Reforestation	0.25	0.00	0.25	0.00	0.10		1.0	0.6	0.1	0.1	11.1	9.8	$3,065
9- Planning	Mattawoman	KCI-MW_SR_1	Piney Branch at McDaniel Rd	Stream Restoration	1,731.62				17.32		129.9	71.8	117.7	93.7	25,974.2	22,862.2	$1,195,074
9- Planning	Mattawoman	KCI-MW_TP_19	Pleasant Grove Missionary Baptist Church	Reforestation	0.76	0.00	0.76	0.00	0.29		2.8	1.5	0.2	0.2	33.1	29.1	$9,158
9- Planning	Mattawoman	KCI-MW_BMP_5	Portobello Ct Pond	Wet Pond	5.92	2.56	3.36	0.00	0.82	0.82	12.7	7.0	2.4	1.9	1,034.8	910.8	$147,198
9- Planning	Mattawoman	KCI-MW_TP_14	Potomac Branch Library	Reforestation	0.23	0.00	0.23	0.00	0.09		0.9	0.5	0.1	0.1	9.9	8.7	$2,744
9- Planning	Mattawoman	KCI-MW_TP_2	Rite Aid	Reforestation	0.86	0.00	0.86	0.00	0.33		3.2	1.8	0.2	0.2	37.6	33.1	$10,418
9- Planning	Mattawoman	KCI-MW_TP_13	Ruth B. Swann Park	Reforestation	1.94	0.00	1.94	0.00	0.74		7.3	4.0	0.5	0.4	84.1	74.0	$23,320
9- Planning	Mattawoman	KCI-MW_BMP_6	Scenic Meadow St Pond	Created Wetland	17.09	5.31	11.78	0.00	1.04	1.16	39.1	21.6	6.3	5.0	2,643.1	2,326.4	$389,611
9- Planning	Mattawoman	KCI-MW_SR_3	South Hampton Dr	Stream Restoration	5,564.19				55.64		417.3	230.6	378.4	301.1	83,462.9	73,462.9	$3,840,126
9- Planning	Mattawoman	KCI-MW_BMP_7	Storage Ln Pond	Bioretention	1.99	1.79	0.20	0.00	1.00	1.00	8.8	4.9	1.8	1.4	704.3	619.9	$359,036
9- Planning	Mattawoman	KCI-MW_TP_18	The Lutheran Church of our Savoir	Reforestation	0.66	0.00	0.66	0.00	0.25		2.5	1.4	0.2	0.2	28.7	25.3	$7,962
9- Planning	Mattawoman	KCI-MW_SR_4	Tributary to Piney Branch at Ashford Ln	Stream Restoration	1,984.19				19.84		148.8	82.2	134.9	107.4	29,762.9	26,196.9	$1,369,392
9- Planning	Mattawoman	KCI-MW_SR_5	Tributary to Piney Branch at Ashford Ln	Stream Restoration	208.00				2.08		15.6	8.6	14.1	11.3	3,120.0	2,746.2	$143,551
9- Planning	Mattawoman	KCI-MW_BMP_1	US Fuel	Bioretention	0.14	0.12	0.02	0.00	1.14	1.55	0.7	0.4	0.2	0.2	52.0	45.8	$27,357
9- Planning	Mattawoman	KCI-MW_TP_1	Waldorf Business Square Park	Reforestation	1.87	0.00	1.87	0.00	0.71		7.1	3.9	0.5	0.4	81.4	71.6	$22,562
9- Planning	Mattawoman	KCI-MW_TP_15	White Plains Baptist Church	Reforestation	0.43	0.00	0.43	0.00	0.16		1.7	0.9	0.1	0.1	18.8	16.5	$5,202
9- Planning	Mattawoman	KCI-MW_BMP_18	Wooster Rd Outfall	Step Pool Storm Conveyance	5.91	1.83	4.08	0.00	0.83	0.31	7.2	4.0	1.2	1.0	487.0	428.7	$68,063
9- Planning	Port Tobacco	KCI-PT_SWM_12	Atlantic Cycle	Bioretention	0.29	0.27	0.02	0.00	0.06	0.23	0.6	0.6	0.1	0.1	37.3	37.3	$12,628

Planning Level	Watershed	Project ID	Name	Water Quality Facility Type	Drainage Area (ac)/ Length (ft)	Imperv-ious Acreage	Pervious Acreage	Current Impervious Acres Treated	Imperv-ious Credit Acres	Runoff Dept Treated (inches)	Load Removal						Total Cost
											TN EOS lbs/yr	TN DEL lbs/yr	TP EOS lbs/yr	TP DEL lbs/yr	TSS EOS lbs/yr	TSS DEL lbs/yr	
9- Planning	Port Tobacco	KCI-PT_TP_5	Blossom Point	Reforestation	57.84	0.00	57.84	0.00	21.98	0.00	218.1	218.1	13.9	13.9	2,013.2	2,013.2	$696,973
9- Planning	Port Tobacco	KCI-PT_SWM_5	Channing St	Dry Swale	71.64	5.19	66.45	0.00	5.19	1.00	250.5	250.5	19.5	19.5	4,649.1	4,649.1	$244,823
9- Planning	Port Tobacco	KCI-PT_TP_2	Charles County Community College	Reforestation	0.93	0.00	0.93	0.00	0.35	0.00	3.5	3.5	0.2	0.2	32.2	32.2	$11,150
9- Planning	Port Tobacco	KCI-PT_SR_1	College of Southern MD North	Stream Restoration	2,828.00				28.28		212.1	212.1	192.3	192.3	42,420.0	42,420.0	$1,951,744
9- Planning	Port Tobacco	KCI-PT_SR_2	College of Southern MD South	Stream Restoration	3,843.00				38.43		288.2	288.2	261.3	261.3	57,645.0	57,645.0	$2,652,246
9- Planning	Port Tobacco	KCI-PT_SR_5	Hawthorne Country Club	Stream Restoration	3,190.00				31.90		239.3	239.3	216.9	216.9	47,850.0	47,850.0	$2,201,579
9- Planning	Port Tobacco	KCI-PT_TP_3	Hawthorne Country Club	Reforestation	10.95	0.00	10.95	0.00	4.16	0.00	41.3	41.3	2.6	2.6	381.2	381.2	$131,961
9- Planning	Port Tobacco	KCI-PT_SWM_11	Jacksonhole Pl	Bioretention	0.28	0.16	0.12	0.00	0.08	0.49	0.8	0.8	0.2	0.2	40.8	40.8	$15,776
9- Planning	Port Tobacco	KCI-PT_SWM_2	Kennedy Chiropractic	Bioretention	1.06	0.40	0.66	0.00	0.36	0.89	2.3	2.3	0.4	0.4	139.1	139.1	$71,642
9- Planning	Port Tobacco	KCI-PT_SWM_4	Lakeview Dr	Dry Swale	127.85	8.85	118.99	0.00	6.77	0.77	409.3	409.3	31.6	31.6	7,495.7	7,495.7	$319,405
9- Planning	Port Tobacco	KCI-PT_SWM_6	Marshall Corner Rd	Dry Swale	137.32	17.70	119.62	0.00	17.70	1.00	489.1	489.1	43.3	43.3	10,959.3	10,959.3	$834,693
9- Planning	Port Tobacco	KCI-PT_SWM_9	Mt Carmel Rd	Dry Swale	141.29	14.79	126.50	0.00	14.79	1.00	499.3	499.3	41.9	41.9	10,372.1	10,372.1	$697,519
9- Planning	Port Tobacco	KCI-PT_SR_8	Mudd Farm Ln	Stream Restoration	744.00				7.44		55.8	55.8	50.6	50.6	11,160.0	11,160.0	$513,472
9- Planning	Port Tobacco	KCI-PT_TP_1	New Life Wesleyan Church	Reforestation	1.96	0.00	1.96	0.00	0.75	0.00	7.4	7.4	0.5	0.5	68.3	68.3	$23,668
9- Planning	Port Tobacco	KCI-PT_SWM_10	North Campus Bioretention	Bioretention	0.94	0.46	0.48	0.00	0.44	0.97	3.7	3.7	0.6	0.6	162.9	162.9	$89,024
9- Planning	Port Tobacco	KCI-PT_SWM_13	North Campus SPSC	Step Pool Storm Conveyance	6.23	4.00	2.23	0.00	3.32	0.83	14.3	14.3	3.3	3.3	1,181.9	1,181.9	$254,642
9- Planning	Port Tobacco	KCI-PT_SWM_7	Park Ave	Dry Swale	54.82	4.84	49.99	0.00	4.84	1.00	192.7	192.7	15.6	15.6	3,786.5	3,786.5	$228,146
9- Planning	Port Tobacco	KCI-PT_SR_9	Port Tobacco Creek- County Project In Design	Stream Restoration	2,800.00				28.00		210.0	210.0	190.4	190.4	42,000.0	42,000.0	$1,932,420
9- Planning	Port Tobacco	KCI-PT_SR_3	Race Car Pl	Stream Restoration	800.00				8.00		60.0	60.0	261.3	261.3	57,645.0	57,645.0	$552,120
9- Planning	Port Tobacco	KCI-PT_SWM_8	South Campus Pond	Wet Pond	17.60	2.25	15.35	0.00	0.72	0.32	20.5	20.5	2.4	2.4	729.2	729.2	$50,406
9- Planning	Port Tobacco	KCI-PT_SWM_1	South Campus SPSC	SPSC Priority; Bioretention secondary	10.80	5.23	5.57	0.00	3.71	0.71	22.2	22.2	4.4	4.4	1,554.2	1,554.2	$233,850
9- Planning	Port Tobacco	KCI-PT_TP_6	South Potomac Church	Reforestation	9.80	0.00	9.80	0.00	3.72	0.00	37.0	37.0	2.3	2.3	341.0	341.0	$118,038
9- Planning	Port Tobacco	KCI-PT_SWM_3	Stanton Pl	Bioretention	12.69	1.84	10.85	0.00	0.17	0.09	5.0	5.0	0.6	0.6	187.0	187.0	$33,150
9- Planning	Port Tobacco	KCI-PT_SR_6	Valley Rd	Stream Restoration	3,976.00				39.76		298.2	298.2	270.4	270.4	59,640.0	59,640.0	$2,744,036
9- Planning	Port Tobacco	KCI-PT_TP_4	Valley Rd	Reforestation	0.75	0.00	0.75	0.00	0.28	0.00	2.8	2.8	0.2	0.2	26.0	26.0	$9,024
9- Planning	Port Tobacco	KCI-PT_SR_7	Valley Rd Tributary	Stream Restoration	418.00				4.18		31.4	31.4	28.4	28.4	6,270.0	6,270.0	$288,483
9- Planning	Port Tobacco	KCI-PT_SR_4	Walmart Stream	Stream Restoration	170.00				1.70		12.8	12.8	11.6	11.6	2,550.0	2,550.0	$117,326
9- Planning	Port Tobacco	KCI-PT_SEC_1	Windmill Point	Shoreline Management	2,432.00				97.28		182.4	182.4	165.4	165.4	333,184.0	333,184.0	$910,714

Projects with multiple BMP types have total project cost only listed in one line item- costs for projects with no cost listed are included in separate line.

APPENDIX B – RESTORATION PROJECT LOCATION MAPS

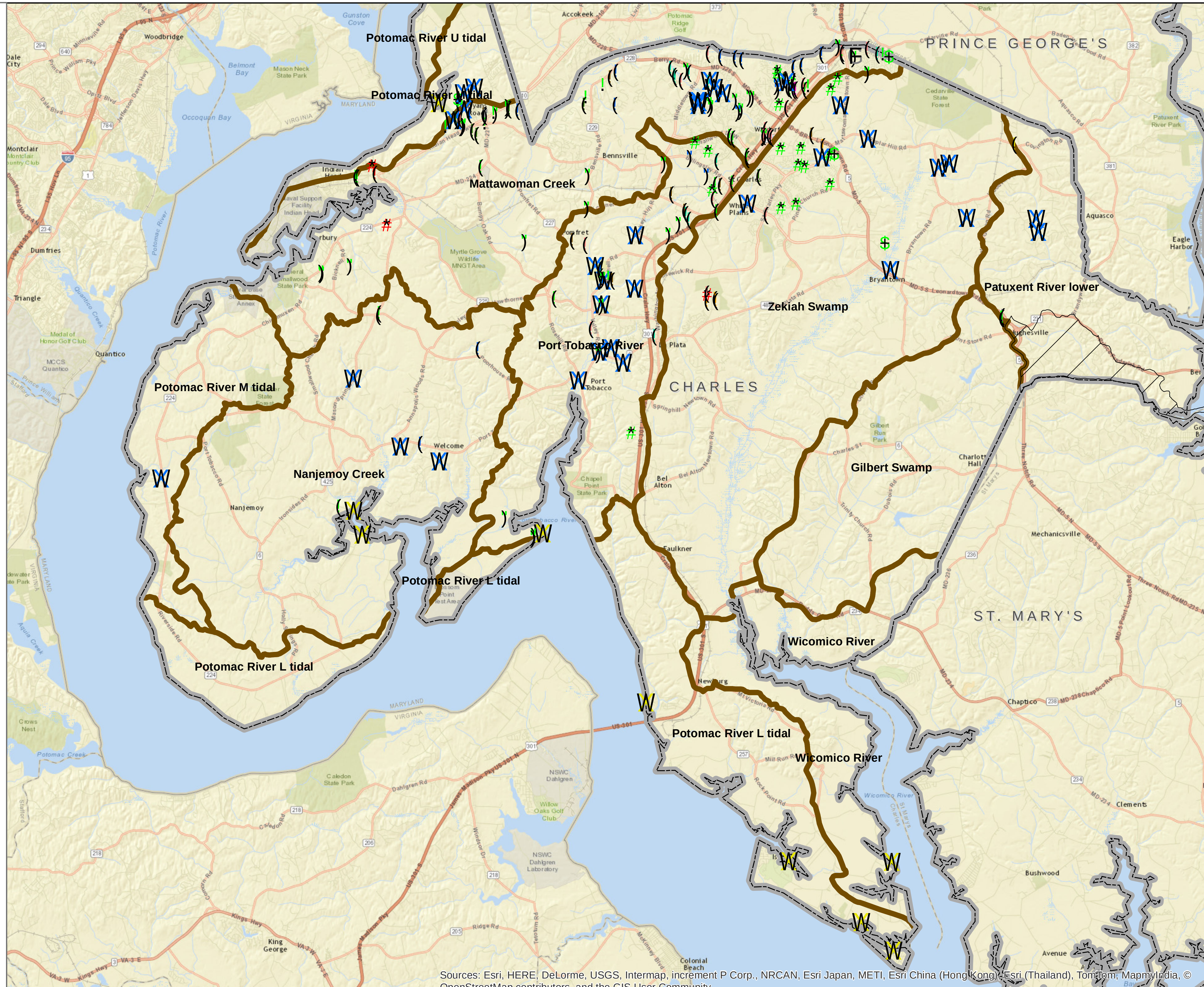

Charles County Restoration Project Locations
NPDES Projects
Level
1- Completed
2- In Construction
3- Full Design
5- Existing SWM Facility Inspection/ Upgrades
6- Feasibility and Concept Design (County NTP)
7- Feasibility and Concept Design (Medium Priority)
8- Alternate Feasibility and Concept Design
9- Additional Sites Identified in KCI Watershed Assessment
Indian Creek Watershed
County Boundaries
Subwatershed
0 1 2 4 Miles
Potomac River U tidal
Potomac River M tidal
Mattawoman Creek
Port Tobacco River
Zekiah Swamp
Patuxent River lower
Nanjemoy Creek
Potomac River L tidal
Gilbert Swamp
Wicomico River
CHARLES
PRINCE GEORGE'S
ST. MARY'S
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Charles County Restoration Project Locations

Facility Type

- Bioretention
- Created Wetlands
- Dry Swale
- ESD
- Filtering Practice
- Filterra
- Organic Filter
- Pond Reclassification
- Pond Retrofit
- Rain Garden
- SPSC
- Sheetflow to Conservation
- Shoreline Restoration
- Storm Drain Cleaning
- Stormwater Wetland
- Stream Restoration
- Submerged Gravel Wetlands
- Underground Storage Chamber
- Various
- Wet Pond
- Wet Pond/Impervious Removal
- Tree Planting
- Indian Creek Watershed
- County Boundaries
- Subwatershed

0 1 2 4 Miles



APPENDIX C – PUBLIC COMMENTS

Charles County solicited public review and comment of the draft Restoration Plan through a public meeting and review period. A public meeting was held at the Charles County government location in La Plata Maryland on May 9, 2016. The meeting included presentations of the County's completed watershed assessments and a presentation on the draft Restoration Plan. Questions and answer sessions followed each of the presentations. A 30-day public review period followed the meeting with questions and comments due to the County on June 9, 2016. The documents for review were available on the County's website.

A summary of the questions and comments received regarding the Restoration Plan, and the County's response to the comment, are included in this appendix. Comments on the Watershed Assessment are included as an Appendix to the Mattawoman Creek Watershed Assessment report.

<u>Public Meeting Comment Summary: Stormwater Restoration Plan 5/9/2016</u>

Questions related to the presentation on the Restoration Plan:

1) Q: How are PCBs a stormwater issue?
   A: PCB were banned in the 70's but are ubiquitous still in the environment today. PCBs attach to sediment and are hydrophobic. PCBs are very stable compounds, which is one of the reasons they were used widely. They migrate back and forth through environmental media: air, soil, water. When conditions are right, they volatize into a gas from soil and water to the air, or dust and small particulates move into the air. Subsequently, they end up back in the water or soil through either wetfall (precipitation) or dryfall (particulates). Although they were banned in 1979, they were allowed to continue to be used in existing equipment, mostly electrical; however they were also used in caulk and other building materials. The ultimate source then, is improper disposal, or leaks from poorly maintained equipment. Once PCBs are in the environment they eventually go everywhere.

2) Q: How does the County get the homeowners to maintain/upgrade septic systems?
   A: The Bay Restoration Fund is the primary source of funding for homeowner assistance with septic system maintenance and upgrades. Septic connections to an existing Waste Water Treatment Plan would implemented and paid for by the County. Upgrade would be the paid for by the Bay Restoration Fund

3) Q: If there are 3,000 septic systems in the Mattawoman watershed, how long would it take to connect these to sewer?
   A: Each individual project would have its own timeline. At the County scale 2035 is the TMDL goal.

4) Q: There is a separate septic sector requiring its own pollutant reductions, so how can septic projects be counted towards stormwater sector reductions?
   A: If the septic sector meets and exceeds its allocation goals then the leftover credits may be accessible to trade back to the stormwater sector. The primary programs in the septic sector are upgrades to denitrification systems, connection to municipal waste water, and regular septic system pump outs.

5) Q: What is the cost for upgrading septic systems?
A: The average upgrade cost to upgrade septic systems with nitrogen removal technology, is $13,000 however it varies based on the site. The average cost per septic connection to public sewer is $43,000.

6) Q: Who addresses septic system upgrades/connections not covered in the watersheds discussed tonight?
A: Other watershed plans have septic system upgrade and connection components included, and are addressed by the County in the countywide Chesapeake Bay Nutrient TMDL.

7) Q: Do you have a map of possible connections/distribution?
A: A map of possible areas and neighborhoods in addition to a list were included in the County's Phase II Watershed Implementation Plan (WIP), which can be accessed through the County's web page.
http://www.charlescountymd.gov/sites/default/files/pgm/planning/wipphase2strategy2-28-13.pdf
The area mapping is also included the Restoration Plan.

8) Q: Is there a restriction on additional growth until we meet our current long term load reduction goals, because it is putting us in a deeper hole?
A: New development loads do not need to be accounted for in the TMDL process. The reductions required are from the TMDL baseline year. It is noted however that future allocations are sometimes accounted for directly in the TMDL as in the case of the Mattawoman Creek TMDL.

9) Q: Why is it that we don't have a moratorium on development since it's already so bad, and can we put this in the plan?
A: The rate of new development is an issue addressed and regulated by the County's Comprehensive Plan, and Water Resources Element, and is out of the scope of TMDL planning which focuses on the baseline load. Maryland's Stormwater Management code and draft accounting for growth policy are to address additional loads from new growth since the TMDL baseline year.

10) Q: There is a 2001 baseline year for the Mattawoman TMDL, but is seems peculiar that MDE does not require new loads in the meantime to be addressed. I would encourage the County to look beyond MDE's requirements.
A: MDE's guidance is to take the reduction from the baseline. The Mattawoman TMDL is one of the rare TMDLs that has a future allocation of 5% of loads for non-point source and stormwater, so MDE did build in a small cushion for new growth.

11) Q: When and where is the Restoration Plan located for review?
A: The plan is currently posted on the county's website for review. This meeting is intended to give background understanding prior to reading the documents in depth.

12) Q: When do public comments need to be submitted?
A: June 9th 2016.

13) Q: Are there more opportunities for public input?
A: Today's public meeting and the public review period are the only currently planned and scheduled official avenues for commenting on the watershed assessments and restoration plans.

14) Q: Do the County Commissioners take action on the restoration plan?
A: The County Commissioners do not take action on the plan, but do take action on the budget to support the plan. This occurs during the budget adoption process, and this year will also include a Financial Assurance Plan. There is an adaptive element to the plan, so that it can be evaluated annually and evolve as needed to address the multiple moving parts, therefore it needs to be flexible.

15) Q: Is the proposed trading with the Mattawoman Wastewater Treatment Plant (WWTP) applied only to the countywide Bay TMDL, because it can't be applied to the local Mattawoman TMDL since the WWTP discharges outside the Mattawoman watershed?
A: Correct, the trading-in-time with the WWTP would be a surrogate for impervious surface restoration at a countywide level. It would only be used as a temporary solution to gain more time to complete the stormwater restoration projects.

16) Q: How are the restoration plan elements funded?
A: Primarily through the Watershed Protection and Restoration Fee (stormwater remediation fee). The County also applies for grants through various programs to offset and supplement County funds.

17) Q: The stormwater remediation fee is proposed to increase by 2020 to over $100 per household, and presently quarter acre lot owners are paying the same fee as the mall. Therefore, households are subsidizing big box and parking lots for commercial properties. There should be an effort by county staff to change this.
A: The staff will be reviewing the fee structure with the County Commissioners in the near future.

18) Q: When street sweeping picks up excess road salts, how is it disposed of so as not to add chloride back to streams?
A: Street sweeping waste is disposed of properly at the landfill which is lined and capped to ensure pollutants to not re-enter surface and groundwater.

19) Q: What are rain barrels and how are mosquitos controlled?
A: Typically a 55 gallon drum to collect water from downspouts that can be used to water plants that have a lid and screen to keep mosquitos from using them to lay eggs. The practice (like downspout disconnects) reduces the overall volume of water flowing to the stormwater system.

20) Q: If livestock is 64.7% of the bacteria source in Indian Creek, how do we get back to the farmers to address their large impact?
A: The agricultural sector, headed up by the Maryland Department of Agriculture, is addressing their loads similar to how the stormwater sector is addressing theirs, however they use a different suite of practices to accomplish it. Those practices include livestock exclusion fencing to keep animals out of streams, confined animal feeding operations, and stabilized livestock

crossings. However, the agriculture sector is not required to meet local TMDLs by a certain date, as the wastewater and stormwater sectors are by their discharge permits.

21) Q: As the Farm Bureau representative, we had the same sort of things to do in the agriculture sector and the same timeline as the other sectors, which was 2025, then reduced to 2020 by Governor O'Malley, and the ag sector was ahead of its completion date, but not sure of the exact percent.
A: Correct, the Agriculture sector has made significant progress with the Chesapeake Bay Nutrient and Sediment TMDL, for which many of the same practices will also decrease bacteria. However, the agriculture sector does not have plans or dates to meet local TMDLs.

22) Q: From knowing the Charles County side of Indian Creek, the numbers show livestock and humans tied up, however no current livestock operations, and on the other side of Indian Creek is Golden Beach where there are regular advisories not to go in the water. When you take a sample in the Creek you can't tell the source. The numbers are suspect.
A: The numbers are pre-bacteria source tracking, and are from over 15 years ago, so land use has changed in the watershed, and the sources have likely changed.

<u>Public Comment Period Summary: Stormwater Restoration Plan 5/9/2016-6/6/2016</u>

Chesapeake Bay Foundation Letter dated 6/9/2016

1) **<u>Comment:</u>** Thank you for the opportunity to submit these comments on behalf of the Chesapeake Bay Foundation (CBF) and our approximately 4,300 members in Charles County. Achieving and maintaining clean, healthy waters in the Chesapeake Bay and its rivers and streams is of the utmost importance to CBF and our members. Charles County is home to some of the most treasured natural places in the state. Mattawoman Creek, a 30-mile tributary to the Potomac River supports a diverse, high quality aquatic ecosystem and is a well-known area prized for its largemouth bass fishery. Other natural treasures in Charles County include Nanjemoy Creek and Zekiah Swamp, which has been called one of the "most important ecological areas on the East Coast" by the Smithsonian Institute. Unfortunately, these waters are all threatened by the development on surrounding lands, which leads to increased loads polluted runoff. According to the Maryland Department of Natural Resources, Mattawoman Creek lies at the precarious threshold of degradation beyond which there is no return.

   Stormwater, or polluted runoff, is the only major source of pollution on the rise in Maryland, and a major contributor to these local impairments in Charles County. The County's Municipal Separate Storm Sewer System ("MS4") Permit is an important step towards reducing and remediating polluted runoff sources in the County, but is only effective to the extent it is faithfully implemented with effective and verified pollution reduction measures.

   CBF appreciates the time and technical expertise that went into preparing the Charles County Municipal Stormwater Plan ("MS4 Plan"), and as a general matter, believe it demonstrates an achievable path towards compliance with the County's MS4 Permit. CBF has a number of comments and observations as detailed below, but the major concern arising from the MS4 Plan is the County's proposal to meet half of the MS4 Permit's 20% impervious surface restoration requirement by “trading” with the County’s wastewater treatment plants (“WWTP”). As explained in detail below, that proposal is not legally sufficient, would not result in any pollution reductions, and is not supported by the MS4 Permit program at this time. This comment letter will first address CBF’s overarching concern about the WWTP trading proposal, and then address the other portions of the MS4 Plan in the order in which they are found in the MS4 Plan itself.

Response: Introduction to following comments. No response necessary.

2) **Comment: “Scenario 2” Proposal to Trade for Wastewater Treatment Plant Loading Capacity** CBF is highly concerned that the proposal (described as “Scenario 2”) found in the MS4 Plan to trade for a wastewater treatment plant’s unused loading capacity instead of completing half of the MS4 Permit’s 20% restoration requirement, is not legal, is not supported by the MS4 Permit, and most importantly, will not result in improved water quality in Charles County. The United States Environmental Protection Agency (“EPA”) has already informed MDE that this type of trading proposal is not supported by the current MS4 Permits and will not be allowed to be used as credit towards obtaining MS4 Permit compliance without a number of conditions being satisfied first, including a major permit modification to the MS4 Permits. It is not acceptable to rely on this alternative Scenario 2 or proceed with the proposal before the legal and practical framework is in place.

CBF has been an active participant in the Maryland Trading and Offsets Working Group, which is empaneled by the Maryland Department of the Environment (“MDE”) to provide stakeholder input on a proposed trading and offsets guidance document and advise MDE on policies which may need further clarification and authorization through a regulation. The working group’s discussion on the topic of trading wastewater treatment plant capacity has been controversial and uncertain as to its legality. Primarily, the concern of trading wastewater capacity is that it essentially reallocates the federally approved Watershed Implementation Plan (“WIP”) goal requirements from one sector to another, rather than being a true nutrient trade that both lowers cost of load reductions and retires credits, resulting in an acceleration of total load reduction. Trading load capacity also fails the additionality test, as the load reductions from wastewater have already occurred, so just reallocating them to a different sector results in no additional load reduction.

Response: The Stormwater Restoration Plan proposes trading-in-time, and not a permanent shifting of load reductions from one sector to another. The proposed trading-in-time is a temporary balancing of permitted discharges, by an owner of multiple discharge permits, for the purpose of maintaining permit compliance, in the interim of implementing additional stormwater sector projects to achieve target restoration goals.

3) **Comment:** Under the WIP, each sector is responsible for meeting milestones for load reduction, including the MS4 Permit jurisdictions as part of meeting the urban/suburban load sector. In the case of Charles County, the MS4 Permit requirement of 20% impervious surface treatment comes out to only 1,409.6 acres. CBF believes this target is well within the reach of the county’s capabilities without resorting to this uncertain trading scheme. The County’s ability to accomplish the MS4 Permit’s goals is detailed in the MS4 Plan itself, as the County has identified and allocated the resources to do the approximately 90 projects required between now and the end of the MS4 Permit term in 2019.

Response: There are number of impediments and time constraints to implementing stormwater restoration, which available funding cannot resolve. These include: community outreach, which takes about 1-3 months, construction permitting, which takes 12-18 months, acquiring right-of-way permissions, which starts when the design is at 60%-90% completion to avoid errors and false understanding in the community, and which can take 6-12 months, bidding construction, which takes 3-6 months, time-of-year construction restrictions due to aquatic species reproduction cycles, and unforeseen circumstances that may arise. Examples of unforeseen circumstances include: utilities not previously identified per available sources, historical artifacts being unearthed, unwilling neighborhoods or individual property owners, etc.

4) **Comment:** Second of all, the MS4 Plan proposes on p. 72 to use credits generated by unused flow capacity of the wastewater treatment plants rather than any real load reductions that occurred from that sector as a result of exceeding their baseline by performing well beyond their permit limits. To the extent that any "trading" with WWTPs is being discussed, the mechanism would not be to allow a county to borrow unused capacity but rather, allow a county to borrow the difference between a WWTP permit terms and the WWTP's actual performance. In most cases, the state's Bay Restoration Fund was used to bring wastewater treatment plants up to Enhanced Nutrient Removal standards of 3 mg/l total Nitrogen. While the upgraded WWTPs' permit allow a discharge concentration up to 4 mg/l to prevent compliance issues, it would be inappropriate to "credit" any load reductions reached through over-performance unless they are documented significantly below 3 mg/l. MDE is considering the allowance of "trading" between the wastewater and stormwater sectors of the same MS4 jurisdiction ONLY for over-performance, not for capacity. Besides, trading for capacity hastens the loss of that capacity to accommodate additional growth. The proposal to connect septic systems on p. 47 seems in direct conflict with this proposal as each is using up theoretical capacity that just doesn't exist.

   Response: The Stormwater Restoration Plan includes Tables 37 through 39 on pp. 74 and 75 showing that the Mattawoman WWTP five year operating average is approximately 3.48 mg/l annual TN concentration, which is sufficient over-performance to meet the impervious acre equivalent needed. Additionally, for the period of time, trading is proposed, there will also be sufficient TN capacity, based on the Mattawoman WWTP permit cap for the TN load.

5) **Comment: Future Loads and "Accounting for Growth"**
   CBF appreciates the County's efforts in identifying potential pollution loads from future growth, as identifying the potential for future pollution can go a long way in helping avoid that pollution and the negative impact it would have on Charles County's water quality. In the absence of the overdue state regulated "Accounting for Growth" program that Maryland committed to in its WIP, it is critical that local jurisdiction plan future development carefully to avoid counteracting ongoing restoration efforts and to avoid further water degradation. As suggested in the MS4 Plan itself, the County will eventually have to deal with the increased loads over baseline. That planning process should begin now by avoiding new imperviousness that will cost more to mitigate in the future.

   Charles County is currently undergoing a comprehensive planning process that can help alleviate pollution loads from future development by limiting the density of impervious surfaces allowed in certain sensitive watershed areas. CBF has been participating in that planning process and urges the County to consider these efforts in tandem. As noted on page 20 of the MS4 Plan, "stream degradation still occurs in these [rural] areas as a likely result of large lot development…." Charles County can also avoid added pollutant loads and associated expenses by implementing a protective septic tier map that avoids major subdivisions on septic systems in sensitive environmental areas, such as the Mattawoman Creek watershed, the Nanjemoy Creek watershed, and other sensitive watersheds and stream valleys. Additionally, the County should direct development towards areas with existing water and sewer services. As noted in the MS4 Plan, meeting nitrogen reductions for several local TMDLs will require the connections of existing septic systems. With the existing need to reduce septic system pollution, the County must strive to avoid future development on septic systems.

Response: As noted in the comment, the County's long term planning process is underway, and the elected officials are considering these issues.

6) **Comment: 2.1 Mattawoman Creek TMDL for Nitrogen and Phosphorus**
The MS4 Plan identified a strategy to meet the Mattawoman Creek TMDL's wasteload allocation (WLA) using projects that go beyond the stormwater sector by incorporating the wastewater sector by way of septic system projects. CBF understands the County's concerns that accomplishing enough stormwater projects to meet the Mattawoman TMDL may be infeasible due to cost considerations and land availability. If this is the case, CBF believes the priority should be to reduce nitrogen to the level identified by the local TMDL. When using more cost-efficient reductions from other sectors is the only way to achieve that goal, it should be permitted. To the extent that septic systems are a nitrogen pollution source to the Mattawoman watershed, it may be appropriate to use pollution reductions from septic systems. However, these alternative plans must be well-vetted and appropriate verification on actual pollution reductions must be done to avoid a paper-only calculating exercise that fails to accomplish any real nitrogen reductions. Such verification must include the actual conditions and locations of septic systems that would be connected, such as the current treatment technology on the systems and whether they are failing, and consideration of the treatment capacity and performance at the wastewater treatment plant they would connect to. In addition, connection of septic systems cannot lead to the creation of more stormwater pollution from new development that may seek to take advantage of a new sewer line. Currently, the Charles County restoration plan does not provide the data or evidence to support the statement that 1,103 septic connections would achieve an additional 21,113 lbs/yr that would be needed to reach the Mattawoman TMDL after all planned stormwater projects are complete.

Response: Additional information has been included in the Stormwater Restoration Plan to explain how the load reductions from septics are calculated. It should be noted, traditional septic systems, whether failing or not, contribute nitrogen to nearby water bodies. The Chesapeake Bay Model accounts for this loading at edge of stream, or EOS. Connecting existing septics to sewer involves detailed, and lengthy permitting, and funding approval process, which vetting will be included.

7) **Comment: 3.1.1 20% Impervious Restoration Goal**
The MS4 Plan for "Scenario 1" to obtain compliance with the MS4 Permit's 20% restoration of untreated impervious surface identifies sufficient projects to meet the 1,409.6 acres. CBF approves of the County's consideration of cost-efficient residential practices such as downspout disconnections, rain barrels, and rain gardens. CBF also appreciates the County's work in creating Appendix A, which provides important calculations of identified projects' pollution

reductions and relation to the 20% treatment permit requirement. However, the planned projects do not have any schedule of compliance beyond what is suggested by where the project is in the process, i.e. designed, planned, etc. These projects will need to have an identified implementation schedule to allocate the appropriate funding and other resources. CBF recommends providing at least a tentative compliance schedule for the stormwater projects required to meet the 20% treatment, and a compliance schedule for the local TMDLs as required by the County's MS4 Permit Part IV.E.2. These schedules provide transparency to the public and may help the County identify and allocate the appropriate resources and build partnerships.

For the imperious surface restoration requirement, the lack of a compliance schedule makes it difficult to determine the projects planned for this permit cycle to comply by 2019. There appears to be an inconsistency in the plan's narrative, as the "Planned Impervious Restoration (Scenario 1)" states that "a total of 90 additional projects" must be implemented before 2019 to achieve permit compliance with the 20% restoration requirement. However, the Plan later states that only "52 projects (Level 2 and 3) [are] to be implemented by 2019 for the 20% restoration…" As explained in the section above, the County cannot and should not plan their restoration relying on the ability to "trade" with WWTP capacity, as that practice is not being discussed and will not be permitted. However, the practices and projects identified in Table 46 that are indicated to be implemented in 2016-2019 do appear to satisfy the 20% restoration requirement. It is CBF's belief that the County must move forward with the projects and plans found in Scenario 1 that reach the permit's requirement of 20% restoration of impervious surface by 2019. The Scenario 1 plan also provides the most local water quality and community benefits, as the projects serve multiple purposes such as alleviating localized flooding, greening communities, providing aesthetic and recreational opportunities, and supporting local jobs.

Response: The numbers of projects has been revised to be consistent between the sections of the report. A timeline for planned restoration is shown on pp. 85 and 85 on Table 46, and includes the additional projects beyond the first 10%.

8) **Comment: Additional Considerations**

CBF is pleased to see that the County has included stormwater practices aimed at treating private residential impervious areas, such as encouraging and implementing downspout disconnections, rain barrels and gardens, and other practices. The County's Stormwater Remediation provides an excellent opportunity to incentivize stormwater management practices on private land. However, the County's current fee structure that charges a minimal, flat rate to all properties may not be sufficient to provide an incentive for the properties that are discharging the most polluted runoff due to large areas of impervious surface. One successful fee structure model that has been implemented in other jurisdictions connect the area of impervious surface directly to the rate charged to the property, where properties that contribute more polluted runoff contribute more revenue to clean up that discharge. This fee structure model provides equity, as the largest contributors to stormwater pollution are contributing their fair share to the County's efforts to clean it up. It also provides the additional benefit of being a meaningful incentive for properties with large, impervious areas to provide stormwater management on their sites. Adjusting the fee structure could also help close the fiscal gap identified in the MS4 Plan, where it states that the costs of the operational and programmatic practices are not currently met by the budget. Regardless of any fee restructuring, CBF applauds the County for making the wise decision to have a dedicated funding source for this important work that provides direct payment towards projects and a steady revenue for bond debt payments.

Conclusion
In conclusion, CBF believes Charles County has provided a feasible and reasonable plan in "Scenario 1" for achieving compliance with the County MS4 Permit and working towards obtaining and maintaining clean local waters. The trading scheme proposed in "Scenario 2" is not only currently prohibited under the terms of the MS4 Permit, but also does not result in the many benefits that stem from the implementation of green practices and community stormwater management. CBF urges the County to adopt Scenario 1 and continue the good work towards cleaner, healthier local waters.

Response: CBF's applaud for the County's dedicated funding source and support of the County's good work towards cleaner, healthier waters is appreciated.

Mattawoman Watershed Society Letter dated June 9, 2016

1) **Comment:** The Mattawoman Watershed Society (MWS) is pleased to submit these comments on the subject documents to supplement those made at the May 9th public meeting. These comments are focused on Mattawoman Creek. Even so, these comments are necessarily abbreviated given the compressed schedule to evaluate such lengthy and highly technical documents, when at the same time the Financial Assurance Plan (FAP) is out for public comment.

   It is clear that substantial effort by the county and consultants was expended in assessing the Mattawoman watershed, and in devising the RP relevant to the stormwater component of TMDLs. Nonetheless, we believe that the RP does not satisfy MS4 requirements in at least two regards:

   (i) the restoration of 20% of untreated impervious surface county-wide relies on an *unapproved* trading scheme employing extra capacity at the Mattawoman waste-water treatment plant (WWTP);
   (ii) there is no end date or schedule for meeting Mattawoman's local TMDL for total nitrogen (TN) (and total phosphorus).

   Response: Introduction to following comments. No response necessary.

2) **Comment:** (i) The RP provides two scenarios for meeting the 20% retrofit requirement. The FAP chooses the scenario that substitutes WWTP capacity for half the retrofit requirement in the current permit cycle, with the expectation that the "credits" would be paid back with extra effort in the next cycle ("trading-in-time").

   The trading scheme relies on a *draft* MDE document that has not been approved. Furthermore, as reported by the Chesapeake Bay Foundation at the June 7th hearing on the FAP, EPA has stated that it would not approve WWTP trading. For these reasons, it should not be proposed as a viable approach for the present permit cycle.

Furthermore, the FAP is not obligated to assure that the extra funds in the next cycle are forthcoming. Finally, trading of this nature does nothing to address problems in water quality. The county should make a stronger effort to raise the necessary restoration funds through a more equitable, tiered stormwater utility fee (see below).

Response: As noted in Section 1 of the plan, in December 2014 the County's MS4 permit was expanded from the Development District to countywide. The expansion added extensive 'new permit territory' that needs: infrastructure mapping, environmental study, restoration needs identified, and new projects prioritized against pre-identified restoration projects, in an extremely short amount of time. No other Maryland Phase I MS4 jurisdiction has been in this situation.

There are number of impediments and time constraints to implementing stormwater restoration, which available funding cannot resolve. (See response to CBF comment #3.) Trading-in-time, will allow the County to maintain permit compliance while continuing to work towards cleaner waters.

3) **Comment:** (ii) The MS4 permit requires a RP for those waterways with a TMDL having a stormwater component to its Waste Load Allocation (WLA). In particular, the MS4 permit states that the RP "shall:"

"Include the final date for meeting applicable WLAs and a detailed schedule for implementing all structural and nonstructural water quality improvement projects, enhanced stormwater management programs, and alternative stormwater control initiatives necessary for meeting applicable WLA;" [Part IV.E.2.b.i]

The RP appears not to meet this requirement of the MS4 permit: it provides neither a date nor a specific schedule for meeting Mattawoman's TMDL for nitrogen. It does state that it meets the goal for phosphorus, but appears to provide no clear schedule.

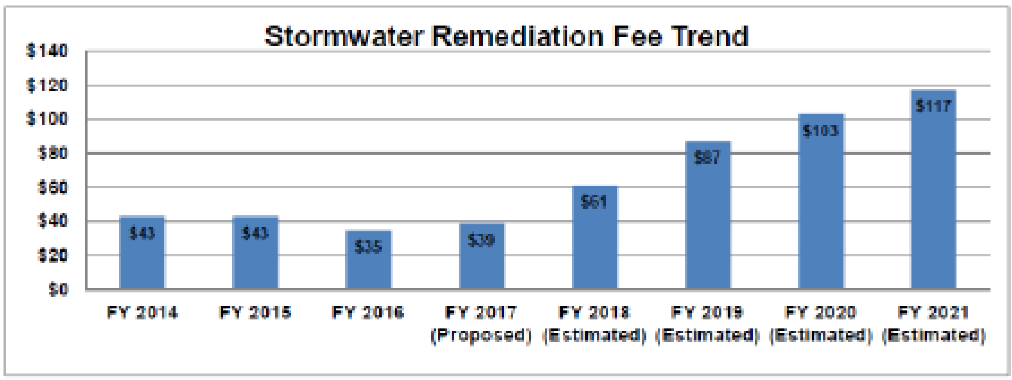
Regarding nitrogen, the RP notes on p. 48 that the plan is only able to achieve a reduction of 30.8% of the regulatory year-2000 baseline, compared to the goal of 54%. It goes on to explain that (p. 48):

"Charles County will need to explore additional and alternative avenues to meet the TN reductions, which could come from additional structural and programmatic practices, or through intra-jurisdictional crosssector trading particularly with the septic sector."

The RP suggests that finding sufficient stormwater restoration projects may not be feasible. Even so, restoration should not be financially limited if reasonable additional funds can be located.

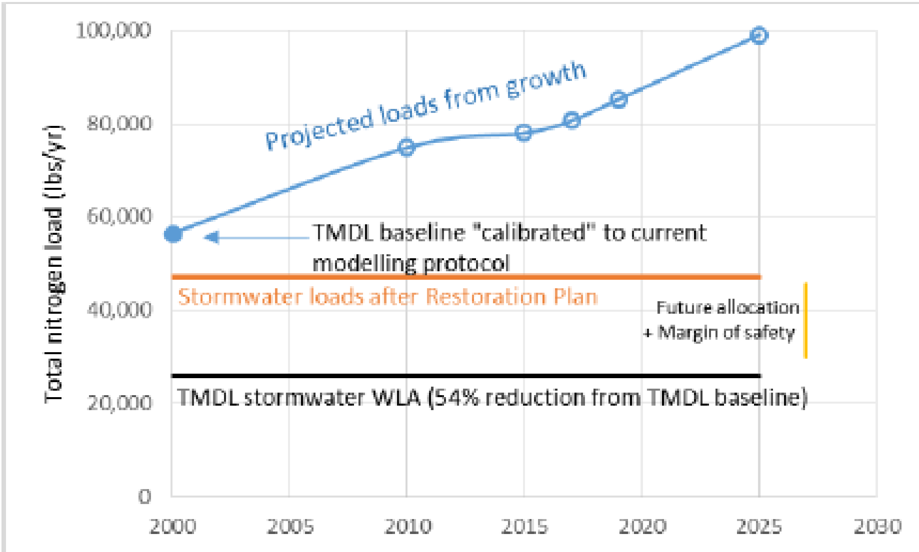
Response: An end date for meeting the Mattawoman local TMDL has been added, and is shown on Tables 19 and 20 on pages 48 and 49, respectively. The date has been estimated in accordance with the complexity, permitting time frames, right-of-way acquisition time frames, construction time frames, and cost of completing the proposed restoration projects. However, as noted in Section 1 of the plan, and in the MS4 permit itself, the stormwater restoration plan is to include an iterative and adaptive process, to take changes into account.

4) **Comment:** ***MWS strongly advocates that the Watershed Protection and Restoration Fee (WPRF) be restructured with a more equitable schedule***. A tiered schedule that accords greater responsibility to owners of large amounts of impervious surface should be considered. The schedule could consider tests to relieve costs to farms that might have several equivalent-dwelling-units due to barns and outbuilding if the overall percentage of impervious cover is low on the property. *The RP could include recommendation for a tiered system among its other suggestions.* A financial analysis for various tiered arrangements, with comparison to other jurisdictions, would be helpful. We note that in this spring's budget process, the WPRF was projected to climb significantly in future years if a flat fee is maintained. See figure below from the "Fiscal year 2017 Watershed Protection and Restoration Fund":



Response: The concerns regarding the fee increase are under consideration.

5) **Comment:** The NPDES framework purports to reduce pollution to acceptable levels for impaired waters that have an approved TMDL. To date, the framework has failed to account for new growth that occurred after the TMDL baseline was established. *The county is to be commended for estimating the new loads in the RP*. Our understanding of the increases in nitrogen loading to Mattawoman Creek is summarized in the graph below. We include the graph in part to test the clarity of the RP in communicating to the public.



In the figure, the year 2000 baseline for Mattawoman Creek was obtained from Table 15, p. 44 of the RP (26,002 EOS-lbs/yr, as calibrated to modern modelling protocols). Loads for 2010 and 2015 are from Table 4 on p. 17. For later years, the accrued load increases in Table 4 were added to the 2015 load. Mattawoman's TMDL contains a future allocation (FA) and margin of safety (MOS) to account for future growth. We have not attempted to disentangle the stormwater components of the FA and MOS, and plot the sum of FA + MOS on the graph for comparison. It is clear that even if the entire FA + MOS were assigned to stormwater, growth has already far exceeded the supposed margins.

Response: The chart is correct in that the disaggregated and calibrated baseline (year 2000) load is 56,526 lbs/yr, and the allocation (the goal) is a reduction of 30,524 lbs/yr. The SW-WLA is 26,002 lbs/yr, however MDE has instructed MS4s to focus on the reduction percent (54%) and the resulting reduction load (32,524 lbs/yr) from the baseline. Further, MDE has instructed that the TMDL SW-WLA relates to the footprint of the urban land that existed at that time of the TMDL baseline so addressing loads from growth after the baseline is not included in the plan.

6) **Comment: MWS is skeptical of Step Pool Stormwater Conveyances in most circumstances**. The RP and Watershed Assessment should recommend against these measures if forest clearing is required. The use of nonnative sandstone should be prohibited because the likelihood of altering the iron chemistry of downstream resources. The RP and Watershed Assessment should justify the use of this approach.

Similarly, the practice of restoring streams when upstream problems are allowed to persist should be justified, with scientific backing and likely water quality and biological outcomes explained.

Response: SPSC's can be effective if placed in the correct situation as you suggest. The County, and it's consultants, always seek to minimize impacts to forests when implementing restoration projects. And all restoration projects include additional new planting. If tree removal is required it is typically edge specimens located at the edge of the project and not full forest clearing as is suggested in the comment. It is also noted that restoration projects are subject to MDE review for wetland impact and forest conservation regulations. SPSCs, best sited, will be located in a degraded outfall channel with on-going erosion, and very poor in-channel habitat and biological condition. The County prioritizes projects based on having good access to the site with little to no tree clearing.

Regarding sandstone and iron release, the County is aware of the matter and is following the Bay Trust funded Smithsonian Institution's study of these systems to investigate sources of dissolved iron and transfers of nutrients from surface to groundwater flow.

The County looks to combine upstream stormwater treatment with stream restoration whenever possible. During site selections the County's consultants look into combined projects but it is not always feasible. Ownership and cost become a factor, the County typically has more access to stream valley corridors than multiple, private upstream properties. The goal with adding upstream management is to reduce the stormwater flow to lower the shear stress (erosion potential) in the stream so that a softer approach with more focus on the biological components can be used in the restoration. Update sizing of channel to its current flow regime can help bring habitat functions back. A project can still be successful when the upstream catchment is not retrofitted. Many Counties in Maryland have used this approach with good success, particularly with outcomes related to channel stability, infrastructure protection and public safety, and pollutant loading reduction. Biological outcomes are tougher to meet with this approach, however the restored channel is typically in a very degraded biological state at the outset.

MDE has accepted stream restoration as an important tool for meeting MS4 impervious surface goals and TMDL requirements. The Chesapeake Bay Program's Urban Stormwater Workgroup published the Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects. The document details the types of approved projects and protocols for crediting impervious treatment and pollutant removal. The document also includes an extensive list of References Cited, which includes much of the current scientific literature on the subject.
http://www.chesapeakebay.net/documents/Stream_Panel_Report_Final_08282014_Appendices_A_G.pdf

The Bay Program has also published a fact sheet with useful stream restoration information.
http://www.chesapeakebay.net/documents/U4._Urban_Stream_Restoration_Fact_Sheet_in_Chesapeake_Bay_Watershed.pdf

7) Recommended clarifications to the Restoration Plan:
Comment: Last paragraph on p. 72 is confusing because it refers to "1% of the impervious goal" when it means "5% of the impervious goal." Similarly 10% of the goal should be corrected to 50%. This confusion may occur elsewhere, as well.

Response: Agreed, language was confusing. It has been updated to be more clear. The range of credits goes from 1% impervious baseline treatment to 10% impervious baseline treatment.

Comment: Figure 5 appears to be missing crosshatching, or needs relabeled to explain that salinity refers only to the Potomac sub-watersheds *per se.*

Response: Clarified that salinity hatching is only for Potomac subwatersheds

Comment: Make clear, perhaps in an executive summary, where the RP meets and doesn't meet MS4 requirements. In the same manner, make the end date of 2035 more prominent.

Response: End date for the Mattawoman Local TMDL of 2035 has been made more prominent.

Comment: On p. 14, Section 1.5.1, Offsetting Loads from Future Growth, the text should acknowledge the significant pipeline of housing units (22,400 as given in the draft Comprehensive Plan) and estimate how many of these are grandfathered and will not be subject to ESD to the MEP.

Response: Text has been added to section 1.5.2 to address the pipeline of new development.

Thomas J. Brown E-mail Dated 5/18/2016

1) **Comment:** I would like to commend Charles County Department of Planning and Growth Management for producing an insightful, and valuable municipal storm water restoration plan. I believe this document, when implemented, will contribute greatly to an improvement in water quality levels throughout the County.

   I do however have one comment and recommended addition for your Department to consider:

   Response: Introduction to following comments. No response necessary.

2) **Comment:** I note that one of the purposes of this plan is to "educate[s[and involve[s] residents, businesses, and stakeholders in achieving measurable water quality improvements." However, information and best management practices (BMPs) for Charles County residents and businesses in this draft plan are mostly limited to septic pumping awareness, enhanced pet disposal practices, and new rain garden construction incentives. All these issues are important BMPs to help reduce excess nutrient and storm-water runoff loads throughout the County but I would also recommend your Department consider an additional BMP action that would enhance, inform, and increase community awareness about our watersheds, specifically at where we reside and do business.

   Recommend the Department of Planning and Growth Management establish, in concert with the County's Transportation Department, a network of county-wide highway signs that inform residents and businesses as to what specific sub-watershed they are entering, residing, or working in. These signs would help enhance community knowledge of the many sub-watersheds in the County; provide a visible point of reference to educate and inform about the ecological importance of sub-watersheds to the Potomac, Patuxent, and Chesapeake Bay; and could act as a future catalyst to generate micro-level interest and activism in preserving, protecting, and improving our County's ecologically diverse sub-watershed systems.

While there would be an initial cost in producing and placing these signs believe this cost to be worthwhile as it would help to involve the community in better understanding the sub-watersheds in which they reside and work. It would also enable County planners and elected officials to better explain developmental impacts on the sub and primary watersheds, and would help to educate residents about future mitigation and stream restoration efforts county-wide. Ultimately, this program would assist in achieving measurable water quality improvements through education, information, and community involvement.

Thank you for the opportunity to provide comment to this plan and I hope you will include my recommendation in its final publication.

Response: A similar idea for road signs identifying the watershed upon entering the boundaries, was established over ten years ago for the Wicomico River Watershed in Charles and St. Mary's Counties, by the Wicomico Scenic River Commission. The idea is a good outreach tool, and will be noted in the Plan.

Bruce Gilmore

1) **Comment:** In this letter, I am conveying my comments on the Restoration Plan (Plan) prepared pursuant for the Charles County Phase I MS4 permit. These comments are submitted for myself and I also join in supporting the comments to be submitted by the Mattawoman Watershed Society and the Chesapeake Bay Foundation.

   There are two issues I would like to bring to your attention: the approbation given to trading as a means to achieving the 20% impervious cover restoration goal and the statement in the Plan that the TN reduction goal for the nitrogen TMDL for Mattawoman Creek will not be reached.

   Response: Introduction to following comments. No response necessary.

2) The Plan sets forth a great deal of text on a proposal to use trading for the 20% reduction of impervious cover in the County by 2019. The County has a goal to bring stormwater management to 7048 acres of impervious cover throughout the County. Twenty percent of this acerage for this permit term is 1410 acres and the Plan discusses the benefit of using "cross-sector trading in time" with the waste water treatment sector through the Mattawoman wastewater treatment plant for one-half of this acreage amount, 705 acres.

   While the Plan does set forth that the general proposition for trading is still under discussion, it also makes clear its support for trading to be used to reduce the need for stormwater management practices to reach 10 % of the impervious cover restoration goal. It fails to mention, that there has been no approval of trading in this capacity by the Environmental Protection Agency. It simply pushes forward with the text and chart discussion of how the trading would be effectuated. It is recommended that the Plan be revised to put in place the full panoply of stormwater restoration/retrofit options to reach the 20% goal. If and when trading is approved, it can be used in a more realistic fashion.

Response: The text on page 72 of the Plan has been revised to clarify the intent of 'trading-in-time', which is intended to be a temporary holding pattern, allowing additional time for the County can complete the necessary stormwater restoration projects. As noted in responses above, completing the large number of projects necessary, hinges on a number of factors that extend beyond funding.

3) The second area of concern is the Plan's admission that TN pollutant loads will not be met for the Mattawoman Creek SW/WLA TMDL for TN. The fact that this TMDL has a stormwater WLA calculation means that it should receive a great deal of attention and effort to reduce the TN load.

It is unfortunate that the Plan fails to set forth the "additional and alternative avenues" to achieve the TN reductions including the "additional structural and programmatic practices." (See section 2.1.6 , p. 48 of the Plan) The purpose of full implementation of the MS4 permit TMDL requirements is to reach nutrient reduction. Therefore it is recommended that the Plan be revised to set forth adequate stormwater borne TN reduction in Mattawoman Creek.

Response: The Plan has been revised to show that adequate reductions can be achieved by septic connections to meet the non-point source TN reductions necessary to meet the Mattawoman Creek TMDL.

APPENDIX D – MATTAWOMAN CREEK INVENTORY OF BASELINE BMPS

Mattawoman Creek

Inventory of 2000 Baseline Condition BMPs

BMP ID	INSTALL DATE	STRUCTURE TYPE	MAST TYPE
850021_1	5/1/1985	DP	Dry Pond
850074_1	8/13/1986	IB	Infiltration
850074_2	8/13/1986	IB	Infiltration
850074_3	8/13/1986	IB	Infiltration
860021_1	4/4/1986	DP	Dry Pond
860022_1	5/29/1986	DP	Dry Pond
860024_1	6/13/1986	WP	Wet Pond
860078_1	9/1/1988	DP	Dry Pond
860103_1	12/9/1988	DW	InfiltWithSV
860103_2	12/9/1988	DW	InfiltWithSV
860103_3	12/9/1988	DW	InfiltWithSV
860103_4	12/9/1988	DW	InfiltWithSV
870004_1	1/12/1990	ITWQE	Infiltration
870011_1	5/5/1988	DW	InfiltWithSV
870011_2	5/5/1988	DW	InfiltWithSV
870017_1	10/9/1987	WP	Wet Pond
870039_1	9/20/1988	ITWQE	Infiltration
870039_2	9/20/1988	ITWQE	Infiltration
870039_3	9/20/1988	ITWQE	Infiltration
870080_1	8/16/1988	WP	Wet Pond
870113_1	6/22/1997	IB	Infiltration
880012_1	8/9/1990	WP	Wet Pond
880038_1	11/8/1990	WP	Wet Pond
880047_1	7/29/1988	DP	Dry Pond
880053_1	4/20/1989	DP	Dry Pond
880053_2	4/20/1989	DP	Dry Pond
880090_1	7/31/1993	ITPE	Infiltration
880091_1	4/30/1991	EDSW	WetPondWetland
880092_1	7/23/1992	ITPE	Infiltration
880095_1	11/17/1988	WP	Wet Pond
880099_1	4/19/1989	WP	Wet Pond
880156_2	10/17/1991	IB	Infiltration
880156_3	10/17/1991	IB	Infiltration
880156_4	10/17/1991	IB	Infiltration
880156_5	10/17/1991	IB	Infiltration
880156_6	10/17/1991	IB	Infiltration
880156_7	10/17/1991	IB	Infiltration
880156_8	10/17/1991	IB	Infiltration
890038_1	1/1/1993	OGS	Dry Pond
890038_2	1/1/1993	OGS	Dry Pond
890112_1	8/13/1991	OGS	Dry Pond
890129_1	1/8/1992	WP	Wet Pond
890131_1	8/26/1996	WP	Wet Pond
890131_2	8/26/1996	WP	Wet Pond
900018_1	11/20/1995	DP	Dry Pond
900018_2	11/20/1995	DP	Dry Pond

Mattawoman Creek
Inventory of 2000 Baseline Condition BMPs

BMP ID	INSTALL DATE	STRUCTURE TYPE	MAST TYPE
900018_3	11/20/1995	WP	Wet Pond
900037_1	5/24/1994	WP	Wet Pond
900037_2	5/24/1994	DP	Dry Pond
900037_3	5/24/1994	WP	Wet Pond
900041_1	3/4/1998	WP	Wet Pond
900042_1	2/26/1993	DP	Dry Pond
900072_1	10/24/1996	WP	Wet Pond
900072_2	10/24/1996	WP	Wet Pond
900072_3	10/24/1996	WP	Wet Pond
900072_4	10/24/1996	OGS	Dry Pond
900072_5	10/24/1996	DP	Dry Pond
900118_1	9/28/1999	FS	Urban Filtering
900118_2	9/28/1999	FS	Urban Filtering
910026_1	7/14/1994	DP	Dry Pond
910026_2	7/14/1994	DP	Dry Pond
910040_1	2/24/1992	WP	Wet Pond
910058_1	11/20/1995	DP	Dry Pond
910060_1	5/24/1999	DP	Dry Pond
910074_1	10/2/1991	DP	Dry Pond
910117_1	12/24/1997	EDSD	ExtDryPonds
910117_2	12/24/1997	EDSD	ExtDryPonds
910117_3	12/24/1997	EDSD	ExtDryPonds
910117_4	12/24/1997	EDSD	ExtDryPonds
910117_5	12/24/1997	EDSD	ExtDryPonds
910119_1	10/13/1997	WP	Wet Pond
920001_1	7/28/1995	DP	Dry Pond
920001_2	7/28/1995	EDSD	ExtDryPonds
920003_1	9/25/1997	OGS	Dry Pond
920039_1	2/2/1994	DP	Dry Pond
920039_2	2/2/1994	DP	Dry Pond
920043_1	7/21/1994	WP	Wet Pond
920043_2	7/21/1994	WP	Wet Pond
920058_1	12/20/1995	DP	Dry Pond
920090_1	10/30/1992	DP	Dry Pond
920093_1	1/1/1993	DP	Dry Pond
920094_1	3/11/1993	WP	Wet Pond
920112_1	12/27/1997	EDSD	ExtDryPonds
920112_2	12/27/1996	EDSD	ExtDryPonds
920126_1	12/23/1994	OGS	Dry Pond
920129_1	2/1/2000	WP	Wet Pond
920129_2	2/1/2000	WP	Wet Pond
920129_3	2/1/2000	WP	Wet Pond
920129_4	2/1/2000	WP	Wet Pond
930030_1	2/20/1995	WP	Wet Pond
930042_1	3/16/1998	DP	Dry Pond
930044_1	6/1/1994	DP	Dry Pond

Mattawoman Creek

Inventory of 2000 Baseline Condition BMPs

BMP ID	INSTALL DATE	STRUCTURE TYPE	MAST TYPE
930066_1	10/18/1994	DP	Dry Pond
930067_1	11/4/1999	DP	Dry Pond
930079_1	2/16/1994	DP	Dry Pond
930094_1	7/29/1998	DP	Dry Pond
940009_1	3/4/1998	WP	Wet Pond
940013_1	11/9/1999	DP	Dry Pond
940013_2	11/9/1999	DP	Dry Pond
940014_1	11/4/1999	WP	Wet Pond
940016_1	4/18/1996	WP	Wet Pond
940016_2	4/18/1996	ITPE	Infiltration
940019_1	6/12/1998	IT	InfiltWithSV
940019_2	6/12/1998	IT	InfiltWithSV
940019_3	6/12/1998	IT	InfiltWithSV
940019_4	6/12/1998	IT	InfiltWithSV
940020_1	12/26/1996	DP	Dry Pond
940020_2	12/26/1996	IT	InfiltWithSV
940020_3	12/26/1996	IT	InfiltWithSV
940024_1	11/3/1994	DP	Dry Pond
940027_1	8/6/1998	WP	Wet Pond
940034_1	5/16/1994	DP	Dry Pond
940041_1	1/30/1998	OGS	Dry Pond
940052_1	5/2/1996	SM	WetPondWetland
940059_1	3/21/1997	IB	Infiltration
940059_2	3/21/1997	IB	Infiltration
940080_1	9/20/1999	DP	Dry Pond
940080_2	9/20/1999	DP	Dry Pond
940127_1	1/20/1998	WP	Wet Pond
940127_2	1/20/1998	DP	Dry Pond
950016_1	6/12/1998	IT	InfiltWithSV
950016_3	6/12/1998	IT	InfiltWithSV
950024_1	11/22/1996	WP	Wet Pond
950024_2	11/22/1996	DP	Dry Pond
950036_1	7/13/1998	DP	Dry Pond
950038_1	9/11/1995	WP	Wet Pond
950041_1	1/22/1998	WP	Wet Pond
950045_1	7/27/1999	DP	Dry Pond
950048_1	2/7/1997	DP	Dry Pond
950063_1	5/14/1998	IT	InfiltWithSV
950063_2	5/14/1998	EDSD	ExtDryPonds
950063_3	5/14/1998	EDSD	ExtDryPonds
950067_1	2/10/1999	ITWQE	Infiltration
950067_2	2/10/1999	ITWQE	Infiltration
950067_3	2/10/1999	ITWQE	Infiltration
950086_1	12/17/1999	WP	Wet Pond
950086_2	12/17/1999	WP	Wet Pond
950102_1	11/15/1996	WP	Wet Pond

Mattawoman Creek

Inventory of 2000 Baseline Condition BMPs

BMP ID	INSTALL DATE	STRUCTURE TYPE	MAST TYPE
950102_2	11/15/1996	WP	Wet Pond
960025_1	12/16/1996	WP	Wet Pond
960042_1	1/22/1997	WP	Wet Pond
960048_1	5/1/1997	WP	Wet Pond
960064_1	6/28/1999	DP	Dry Pond
960064_2	6/28/1999	OGS	Dry Pond
960067_1	10/20/1999	EDSW	WetPondWetland
960074_1	12/9/1997	DP	Dry Pond
960074_2	12/9/1997	WP	Wet Pond
960082_1	3/4/1997	WP	Wet Pond
960082_2	3/4/1997	WP	Wet Pond
960082_3	3/4/1997	WP	Wet Pond
960086_1	1/1/1993	DP	Dry Pond
970006_1	12/8/1999	SC	Dry Pond
970006_2	12/8/1999	SC	Dry Pond
970006_3	12/8/1999	SC	Dry Pond
970015_1	11/4/1999	DP	Dry Pond
970035_1	12/11/1997	DP	Dry Pond
970035_2	12/11/1997	DP	Dry Pond
970035_3	12/11/1997	WP	Wet Pond
970059_1	12/14/1998	DP	Dry Pond
970060_1	1/1/1993	SC	Dry Pond
970067_1	10/15/1998	UGS	Dry Pond
980037_1	7/1/1998	DP	Dry Pond
980040_1	3/31/1998	DP	Dry Pond
980041_1	8/13/1999	UGS	Dry Pond
980041_2	8/13/1999	OGS	Dry Pond
980041_3	8/13/1999	OGS	Dry Pond
980051_1	5/26/1999	ED	ExtDryPonds
980061_1	4/18/2000	WP	Wet Pond
980071_1	6/1/1998	IT	InfiltWithSV
980089_1	5/26/2000	DP	Dry Pond
980106_1	6/28/1999	DP	Dry Pond
980106_2	6/28/1999	SC	Dry Pond
990008_1	2/17/2000	DP	Dry Pond
990082_1	12/16/1999	WP	Wet Pond