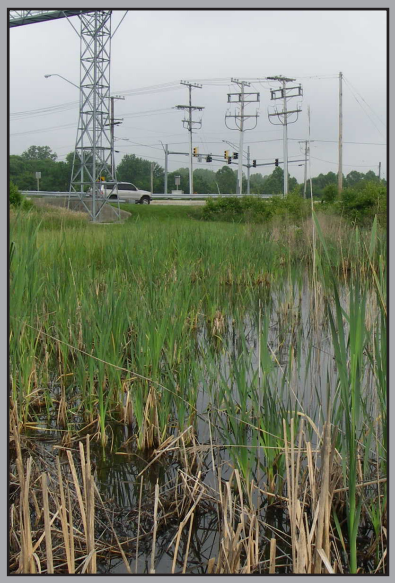

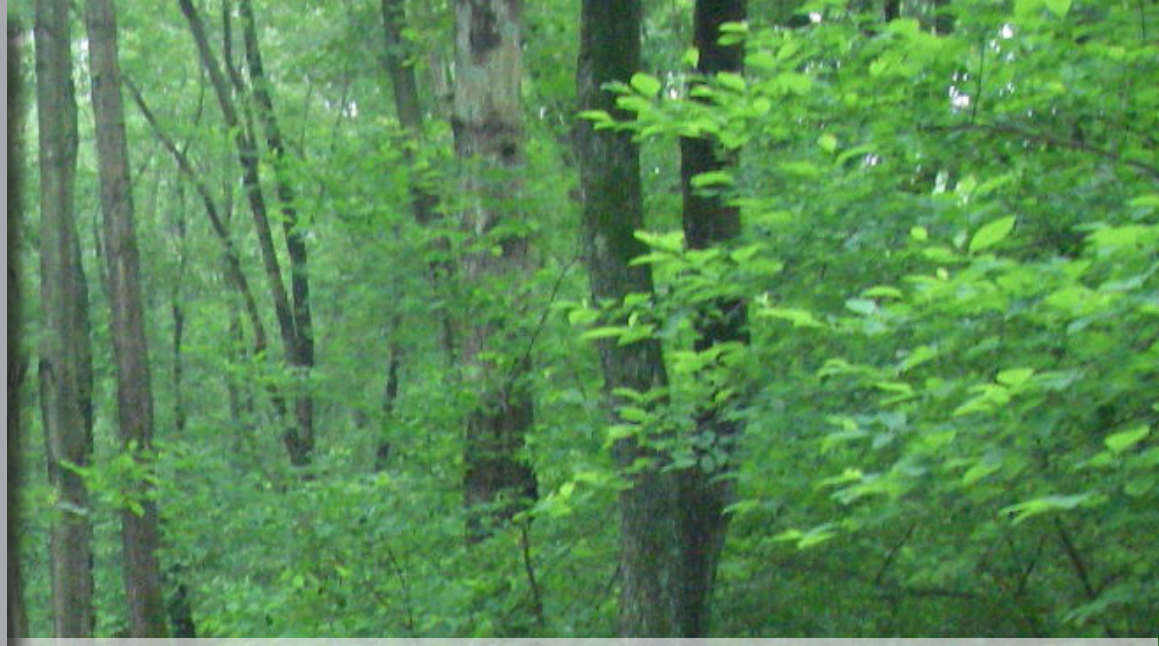

Baltimore Harbor Watershed Nutrient TMDL Restoration Plan

Anne Arundel County, Maryland
November 2016 - Final

Anne Arundel County WATERSHED Protection & Restoration PROGRAM

Baltimore Harbor Watershed
Nutrient TMDL Restoration Plan

November 2016 - Final

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List of Acronyms

AAWSA	Anne Arundel Watershed Stewards Academy
AFG	Accounting for Growth
BayFAST	Chesapeake Bay Facility Assessment Scenario Tool
BIBI	Benthic Index of Biotic Integrity
BMP	Best Management Practices
CBP	Chesapeake Bay Program
CIP	Capital Improvement Program
COMAR	Code of Maryland Regulations
CWA	Clean Water Act
CWP	Center for Watershed Protection
EOS	Edge of Stream
ESD	Environmental Site Design
DEL	Delivered
DNR	Maryland Department of Natural Resources
DPW	Department of Public Works
H&H	Hydrologic and Hydraulic
LA	Load Allocation
LULC	Land use / Land cover
MAST	Maryland Assessment Scenario Tool
MBSS	Maryland Biological Stream Survey
MDE	Maryland Department of the Environment
MEP	Maximum Extent Practicable
MS4	Municipal Separate Storm Sewer System
NGO	Non-Governmental Organizations
NPDES	National Pollutant Discharge Elimination System
OSDS	On-site Disposal Systems
PCB	Polychlorinated biphenyl
PHI	Physical Habitat Index
PSU	Primary Sampling Unit
RBP	Rapid Bioassessment Protocol
SPSC	Step Pool Storm Conveyance
SWM	Stormwater Management
SW-WLA	Stormwater Waste Load Allocation
SW to MEP	Stormwater to the Maximum Extent Practicable
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
WIP	Watershed Implementation Plan
WLA	Waste Load Allocation
WPRP	Watershed Protection and Restoration and Program
WQIP	Water Quality Improvement Projects

1 Introduction

1.1 Background and Purpose

The Anne Arundel County Department of Public Works (DPW) Watershed Protection and Restoration Program (WPRP) is developing restoration plans to address local water quality impairments for which a Total Maximum Daily Load (TMDL) has been established by the Maryland Department of the Environment (MDE) and approved by the U.S. Environmental Protection Agency (USEPA or EPA). A TMDL establishes a maximum load of a specific single pollutant or stressor that a waterbody can assimilate and still meet water quality standards for its designated use class.

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) requires the state to list these water bodies as impaired waters. States are then required to develop a TMDL for pollutants of concern for the listed impaired waters. The Patapsco River Mesohaline Stream Segment (Figure 1), hereafter referred to as the Baltimore Harbor watershed, has several impaired waters listings in Maryland's Integrated Report of Surface Water Quality [303(d) list and 305(b) Report; MDE, 2015] as described in section 2.4.2. These TMDLs apply to several jurisdictions including Baltimore City, Baltimore, Carroll, Howard, and Anne Arundel Counties. This plan will specifically address the Baltimore Harbor watershed nutrient TMDL under the responsibility of Anne Arundel County. All other listed TMDL pollutants and jurisdictions are not addressed in this plan.

Responsibility for Baltimore Harbor watershed nutrient reduction is divided among the contributing jurisdictions, listed above. 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 National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System Discharge Permit (MS4), stormwater runoff from MS4 areas is considered a point source contribution.

Anne Arundel County's current MS4 permit (11-DP-3316, MD0068306) issued in its final form by the MDE in February of 2014 requires development of restoration plans for each stormwater WLA approved by EPA prior to the effective date of the permit (permit section IV.E.2.b). This plan satisfies this permit requirement and provides the loading target, recommended management measures, load reduction estimates, schedule, milestones, cost estimates and funding sources, and the tracking and monitoring approaches to meet the stormwater WLA (SW-WLA).

The MS4 permit calls for an iterative and adaptive plan for implementation. If new methods of stormwater treatment are developed, or better approaches to source control are found subsequent to the development of the plans, the plans can be revised to incorporate the changes. Similarly, if some elements of the plans do not achieve the expected reductions in loads, adaptations and improvements can be incorporated in future updates.

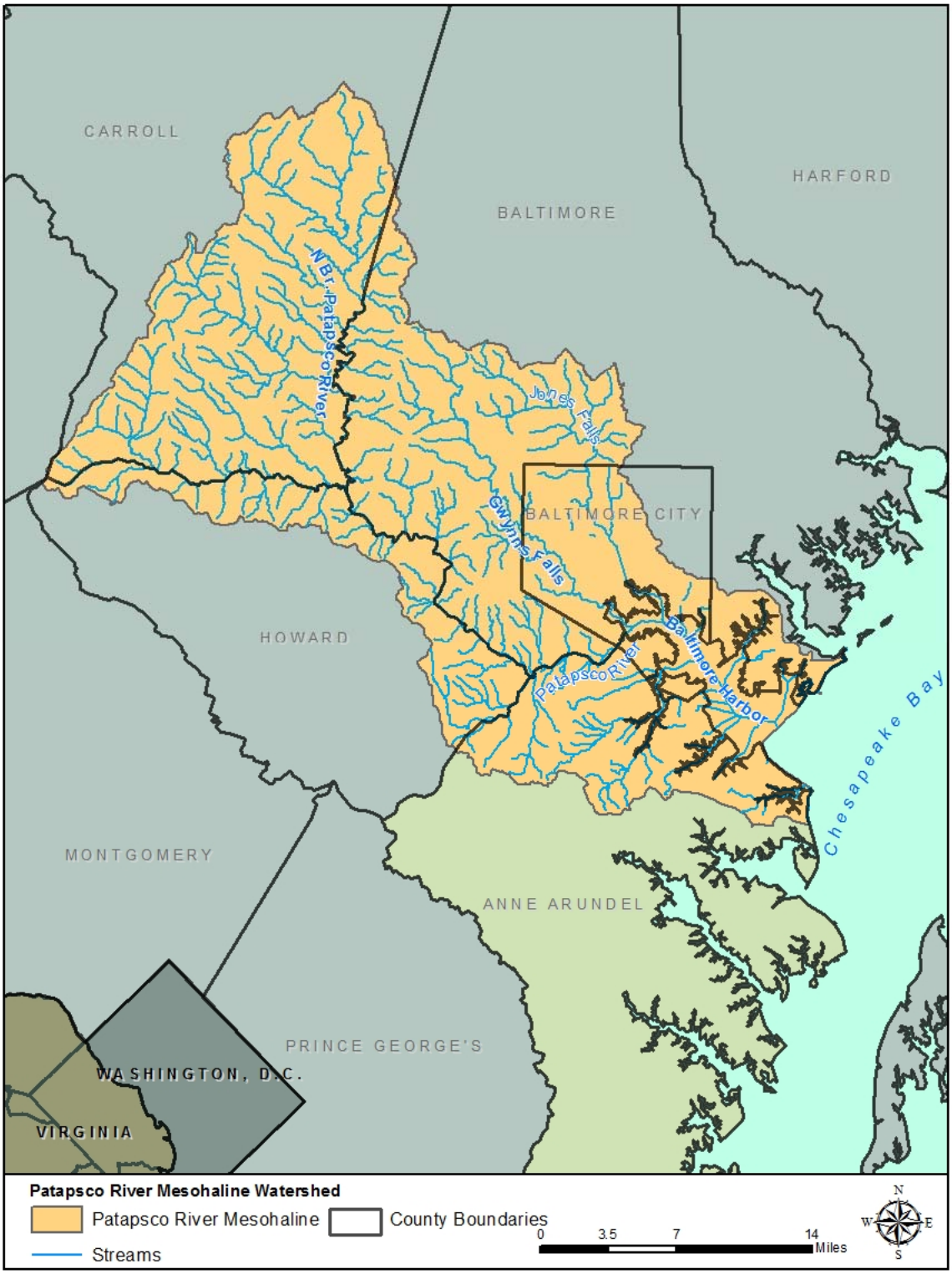

Figure 1: Patapsco River Mesohaline Watershed

1.2 TMDL Allocated and Planned Loads Summary

As noted in the previous section, the nutrient TMDL for the Baltimore Harbor watershed sets forth SW-WLAs for Anne Arundel, Baltimore, Carroll, and Howard Counties as well as Baltimore City. This restoration plan only addresses loads allocated to Anne Arundel County NPDES regulated stormwater point source nutrients for the Patapsco River Mesohaline Stream Segment, hereafter referred to as the Baltimore Harbor watershed. The Baltimore Harbor watershed consists of several of Maryland's 8-digit watersheds and shares political boundaries with Baltimore City, Baltimore, Carroll, and Howard Counties. The nutrients local TMDL does not include drainage from the Liberty Reservoir or Bodkin Creek watersheds. Additional SW-WLAs for the Baltimore Harbor watershed TMDL assigned to Baltimore City, Baltimore, Carroll, and Howard counties, Maryland State Highway Administration, and other NPDES regulated stormwater are not the responsibility of Anne Arundel County and are not addressed in this plan.

The overall watershed boundary of the Patapsco River Mesohaline stream segment (Baltimore Harbor watershed) is shown in Figure 1. Figure 2 displays the Maryland 8-digit watersheds within the Baltimore Harbor watershed with watersheds color-coded based on inclusion in the nutrient TMDL and this restoration plan. The delineation and characteristics of the Baltimore Harbor watershed is discussed in greater detail in section 2.

For this plan, the following naming conventions will be used throughout:

- Patapsco River Mesohaline stream segment will refer to the Bay segment officially listed by MDE in this nutrient local TMDL. This area is also referred to by MDE in the local TMDL document as the Baltimore Harbor watershed
- Baltimore Harbor watershed in this plan will refer to all of Anne Arundel County land draining to the Baltimore Harbor and Patapsco River Lower North Branch 8-digit watersheds
- Baltimore Harbor will refer to Anne Arundel County's portion of the Baltimore Harbor 8-digit watershed, and
- Patapsco River Lower North Branch will refer to Anne Arundel County's portion of the Patapsco River Lower North Branch 8-digit watershed.

The Baltimore Harbor watershed TMDL requires a 15.0% reduction of nutrient loads (i.e., nitrogen and phosphorus) from 1995 baseline levels to achieve the target SW-WLAs for Anne Arundel County NPDES regulated stormwater for both growing season conditions (May 1 – October 31) and for average annual flow conditions. The loads and load reductions presented in this restoration plan are for annual average loads only and it is expected that SW-WLAs for the growing season will be achieved with the implementation of this plan. Nutrient loads and SW-WLAs are presented as pounds/year in the local TMDL and are discussed as pounds/year in this restoration plan. A planning horizon of 2030 will be used as the date to achieve annual average load reductions with a proposed 2017 interim milestone.

Based on MDE guidance, growth in the stormwater load since the TMDL baseline year was not accounted for in the analysis conducted in the development of this plan. Local TMDLs are considered met, from a planning perspective, when the load reductions associated with 2015 restoration progress coupled with the planned restoration load reductions exceed the load reduction required.

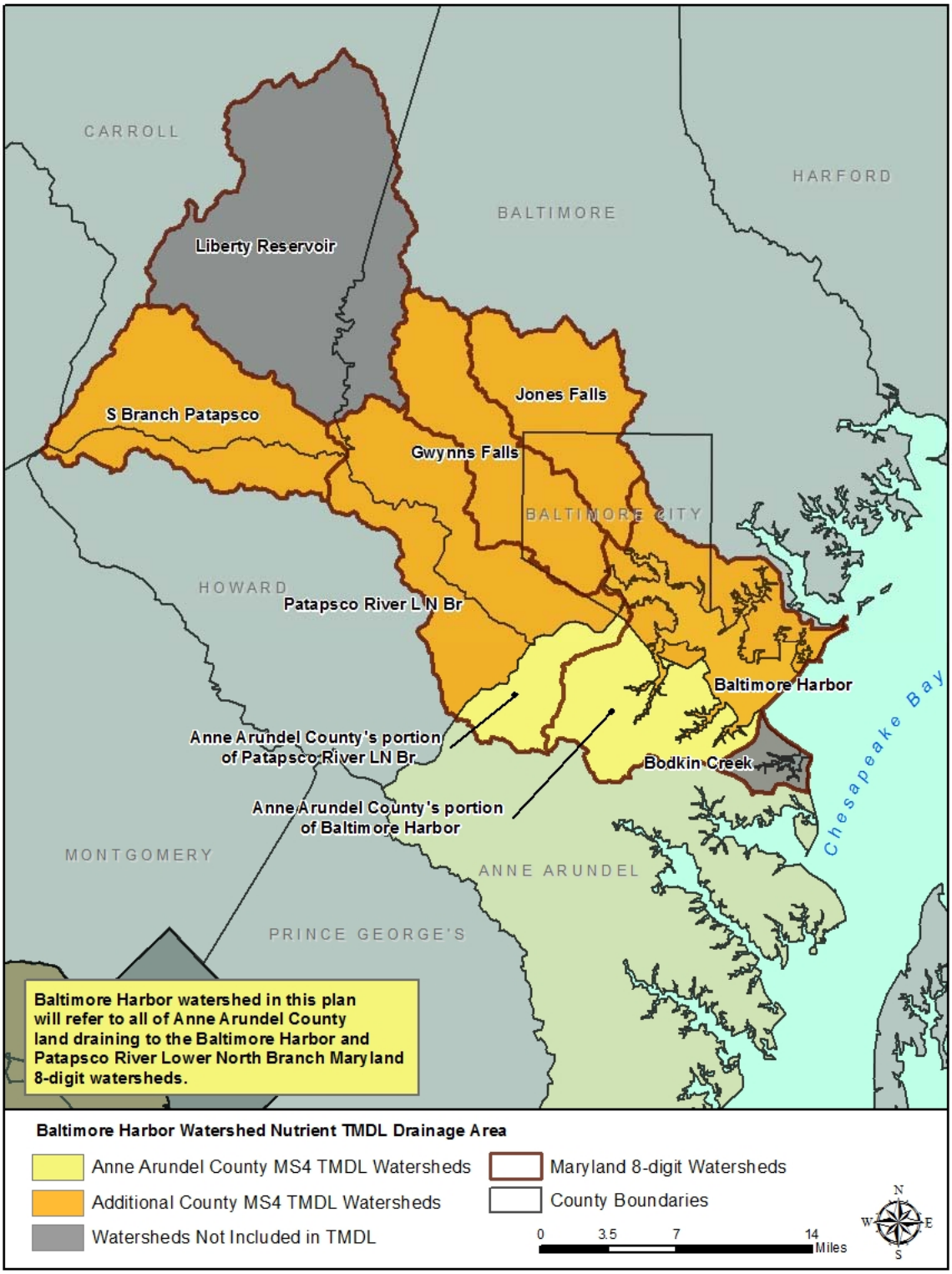

Figure 2: Baltimore Harbor Watershed Nutrient TMDL Drainage Area

This section of the plan, including Table 1, provides a concise summary of the loads and reductions at important timeline intervals including the 1995 baseline, FY2015 progress, FY2017 planned, FY2020 planned, and FY2030 final planning intervals. These terms and dates are used throughout the plan and explained in more detail in the following sections. They 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 and percent reduction achieved through full implementation of this plan. This plan demonstrates that Anne Arundel County will meet its nutrient SW-WLA for the Baltimore Harbor watershed by the end of FY2030 for nitrogen and by the end of FY2020 for phosphorus. Expected load reductions are discussed in greater detail in section 5 of this plan.

- **1995 Baseline Loads**: Baseline levels (i.e., land use loads with baseline best management practices or BMPs) from 1995 conditions in the Baltimore Harbor watershed were disaggregated and calibrated using the Chesapeake Bay Facility Assessment Scenario Tool (BayFAST) Chesapeake Bay Program Phase 5.3.2 (CBP P5.3.2) model. Baseline loads were used to calculate the stormwater allocated nitrogen and phosphorus loads, or SW-WLA. The disaggregation and calibration of Anne Arundel's portion of the Baltimore Harbor watershed local TMDL is discussed in greater detail in the section 1.2.1 Reduction Target Derivation below.
- **FY2015 Progress Loads and Reductions**: Progress loads and load reductions achieved from stormwater BMP implementation through FY2015.
- **FY2017 Planned Loads and Reductions**: Planned FY2017 loads and reductions that will result from implementation of strategies through FY2017.
- **FY2020 Planned Loads and Reductions**: Planned FY2020 loads and reductions that will result from implementation of strategies through FY2020.
- **TMDL Allocated Load**: Allocated loads are calculated from the 1995 baseline levels, calibrated to CBP P5.3.2 as noted above, using the following calculation: 1995 Baseline – (1995 Baseline x Required Percent Reduction)
- **FY2030 Planned Loads and Planned Reductions**: Loads and reductions that will result from implementation of this plan.

Table 1: Baltimore Harbor Watershed Local TMDL Allocated and Planned Annual Average Loads

	Nitrogen (lbs/year)	Phosphorus (lbs/year)
1995 Baseline Loads	161,514	13,941
FY2015 Progress Loads	160,130	13,658
FY2015 Progress Reductions	1,384	283
FY2017 Planned Loads*	156,718	12,842
FY2017 Planned Reductions	4,796	1,099
FY2020 Planned Loads*	148,308	8,356
FY2020 Planned Reductions	13,206	5,585
TMDL Allocated Loads	137,287	11,850
FY2030 Planned Loads*	134,195	7,460
FY2030 Planned Reductions	27,319	6,481
Required Percent Reduction	15.00%	15.00%
Planned Percent Reduction Achieved	16.91%	46.49%

*FY2017, FY2020 and FY2030 planned loads are calculated by subtracting planned restoration nutrient reductions from the 1995 Baseline Load. It is assumed that all new development will be treated with SW to the MEP implementation to achieve 50% nitrogen removal and 60% phosphorus removal and Accounting for Growth policies will address the remaining 50% and 40%, respectively.

1.2.1 Reduction Target Derivation

In order to derive the County MS4-specific SW-WLA load reduction targets, MDE's published baseline values for each TMDL need to be *disaggregated* and *calibrated* before the percent reduction is applied to calculate the load reduction required. The two procedures are described below. Disaggregated and calibrated load reductions calculated based on TMDL percent reductions and baseline loads modeled in BayFAST using Anne Arundel County Phase I MS4 baseline land use and baseline treatment within the Baltimore Harbor watershed are the target reductions used in this plan. These values are presented in bold in Table 2.

Disaggregation

The Baltimore Harbor watershed SW-WLAs were developed by MDE as aggregate loads from NPDES point sources including load contributions from municipal and industrial wastewater treatment plants. Aggregate values must be first disaggregated to determine the portion of the load that each source sector (i.e., Anne Arundel County MS4) is responsible for. This restoration plan uses the BayFAST (Bay Facility Assessment Scenario Tool) model, which is described in detail below, to calculate the baseline loads and SW-WLAs for Anne Arundel County's portion of the Baltimore Harbor watershed nutrients TMDL.

Calibration

Anne Arundel 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) or BayFAST, which are 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, 2014a), 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, 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.

Disaggregating and Calibrating Baltimore Harbor Watershed Nutrient Baseline Loads and SW-WLAs

Baltimore Harbor watershed local TMDL nutrient baseline loads were disaggregated and calibrated in BayFAST. BayFAST allows users to specify the watershed and jurisdiction to model; therefore, the results include only Anne Arundel MS4 baseline loads and do not include other municipalities or source sectors. 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. BayFAST functions similarly to MAST, which is described further in section 4.1: 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. Anne Arundel County MS4's portion of the Baltimore Harbor watershed nutrient local TMDL with baseline loads and SW-WLAs calibrated to BayFAST are included in Table 2. The general calibration procedure is as follows:

1. A facility boundary for the Baltimore Harbor watershed within Anne Arundel 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 baseline year. MAST does not include local TMDL data prior to 2000, so pervious and impervious acres for the year 2000 were used. 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 edge of stream (EOS)-lbs/yr.
5. A calibrated SW-WLA was calculated by subtracting the calibrated reduction from the BayFAST baseline load.

Table 2: Disaggregated and Calibrated Baltimore Harbor Watershed Local TMDL SW-WLAs and Load Reductions

Watershed Name	MDE 8-digit Watershed Code	Baseline Year	Pollutant	Unit	Published by MDE			Disaggregated and Calibrated		
					Reduction %[1]	Baseline Loads[2]	WLA[2]	Baseline Loads[3]	Load Reductions[4]	WLA[5]
Baltimore Harbor	02130903	1995	Nitrogen	EOS-lbs/yr	15%	187,433	159,318	161,514	**24,227**	137,287
	02130906									
	02130903	1995	Phosphorus	EOS-lbs/yr	15%	20,288	17,245	13,941	**2,091**	11,850
	02130906									

Target load reductions used in this plan shown in bold text.

1) Published Reduction % from the MDE TMDL Data Center SW-WLAs for County Storm Sewer Systems in Anne Arundel County
2) Published baseline loads and WLAs from the MDE TMDL Data Center SW-WLAs for County Storm Sewer Systems in Anne Arundel County. These are aggregate values and contain load contributions from municipal and industrial wastewater treatment plants.
3) Baseline loads calibrated and disaggregated in BayFAST using County BMPs installed prior to the TMDL baseline year on top of baseline land use background load. These values are the sum of two BayFAST baseline models – one for Patapsco Lower North Branch (02130906) and the other for Baltimore Harbor (02130903).
4) Calibrated and disaggregated reductions calculated by applying the MDE published percent reduction to the BayFAST calibrated baseline loads.
5) Calibrated and disaggregated WLAs calculated by subtracting the calibrated reduction from the BayFAST calibrated baseline load.

1.3 Restoration Plan Elements and Structure

This plan is developed within in the context of on-going watershed management planning, restoration, and resource protection being conducted by Anne Arundel County. The County initiated comprehensive watershed assessment and management plans in 2000 and has currently completed plans for seven of the 12 major watersheds. Two comprehensive watershed assessments were completed for the Baltimore Harbor watershed, one for the Patapsco Non-Tidal and one for the Patapsco Tidal and Bodkin Creek (Anne Arundel County, 2011 and 2012b). Together these two plans cover the County's portion of Baltimore Harbor watershed. The County also prepared a Phase II Watershed Implementation Plan (WIP) in 2012 in response to requirements set forth in the Chesapeake Bay TMDL for nitrogen, phosphorus and sediment. Information synthesized and incorporated into this plan for the Baltimore Harbor watershed draws upon these sources with updates and additions where necessary to meet the specific goals of the SW-WLA. The TMDL analyses and reports developed by MDE are also referenced. These primary sources include:

- Patapsco Non-Tidal Watershed Assessment (Anne Arundel County, 2011)
- Patapsco Tidal and Bodkin Creek Watershed Assessment (Anne Arundel County, 2012b)
- Chesapeake Bay TMDL, Phase II Watershed Implementation Plan, Final (Anne Arundel County, 2012a)
- Total Maximum Daily Loads of Nitrogen and Phosphorus for the Baltimore Harbor in Anne Arundel, Baltimore, Carroll and Howard Counties and Baltimore City, Maryland (MDE, 2006; revised MDE, 2015)

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, 2014c)
- Guidance for Using the Maryland Assessment Scenario Tool to Develop Stormwater Wasteload Allocation Implementation Plans for Local Nitrogen, Phosphorus, and Sediment TMDLs (MDE, 2014a)
- Guidance for Developing Stormwater Wasteload Allocation Implementation Plans for Nutrient and Sediment Total Maximum Daily Loads (MDE, 2014d)
- Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated (MDE, 2014b)

This restoration plan was prepared in accordance with the EPA's nine essential elements for watershed planning. These elements, commonly called the 'a through i criteria' are important for the creation of thorough, robust, and meaningful watershed plans and incorporation of these elements is of particular importance when seeking implementation funding. The EPA has clearly stated that to ensure that Section 319 (the EPA Nonpoint Source Management Program) funded projects make progress towards restoring waters impaired by nonpoint source pollution, watershed-based plans that are developed or implemented with Section 319 funds to address 303(d)-listed waters must include at least the nine elements.

This restoration plan is organized based on these elements. A modification to the order has been incorporated such that element c., a description of the management measures, is included before element b., the expected load reductions. We feel this modified approach is easier to follow. The letters (a. through i.) are included in the headers of the plan's major sections to indicate to the reader the elements included in that section. The planning elements are:

a. An identification of the causes and sources that will need to be controlled to achieve the load reductions estimated in the plan and to achieve any other watershed goals identified in the plan, as discussed in item (b) immediately below. (Section 3)

b. An estimate of the load reductions expected for the management measures described under paragraph (c) below, recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time. (Section 5)

c. A description of the management measures that will need to be implemented to achieve the load reductions estimated under paragraph (b) above as well as to achieve other watershed goals identified in the plan, and an identification of the critical areas in which those measures will be needed to implement this plan. (Section 4)

d. An estimate of the amount of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. (Section 6)

e. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the recommended management measures. (Section 7)

f. A schedule for implementing the management measures identified in this plan that is reasonably expeditious. (Section 8)

g. A description of interim, measurable milestones for determining whether management measures or other control actions are being implemented. (Section 8)

h. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether the plan needs to be revised. (Section 9)

i. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above. (Section 10)

The outcome of this planning effort is to guide the strategic implementation of the watershed protection and restoration efforts that will advance progress toward meeting Anne Arundel County's local Baltimore Harbor watershed nutrient TMDL pollutant loading allocations, and ultimately meeting water quality standards. Successful implementation of the plan will lead to improvements in local watershed conditions and aquatic health.

2 Watershed Characteristics

2.1 Watershed Delineation

The Patapsco River Mesohaline stream segment, also referred to as the Baltimore Harbor watershed, consists of several of Maryland's 8-digit watersheds; Liberty Reservoir, South Branch of Patapsco River, Patapsco River Lower North Branch, Baltimore Harbor, Gwynns Falls, and Jones Falls. In addition to Anne Arundel County, the watershed shares political boundaries with Baltimore City, Baltimore, Carroll, and Howard Counties. The Baltimore Harbor watershed is a part of the Chesapeake Bay watershed with the Baltimore Harbor joining the Chesapeake Bay at North Point near Fort Howard and Rock Point near Fort Smallwood. The Baltimore Harbor watershed in Anne Arundel County, Maryland consists of two of the County's twelve (12) major watersheds, and is situated in the northern portion of the County. Anne Arundel County refers to the Baltimore Harbor 8-digit watershed as the Patapsco Tidal, and to Patapsco Lower North Branch 8-digit watershed as Patapsco Non-Tidal. The overall watershed boundary of the Patapsco River Mesohaline stream segment (Baltimore Harbor watershed) is shown in Figure 1. Figure 2 displays the Maryland 8-digit watersheds within the Baltimore Harbor watershed with watersheds color-coded based on inclusion in the nutrient TMDL and this restoration plan.

For this plan, the following naming conventions will be used throughout:

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- Baltimore Harbor watershed in this plan will refer to all of Anne Arundel County land draining to the Baltimore Harbor and Patapsco River Lower North Branch 8-digit watersheds
- Baltimore Harbor will refer to Anne Arundel County's portion of the Baltimore Harbor 8-digit watershed, and
- Patapsco River Lower North Branch will refer to Anne Arundel County's portion of the Patapsco River Lower North Branch 8-digit watershed.

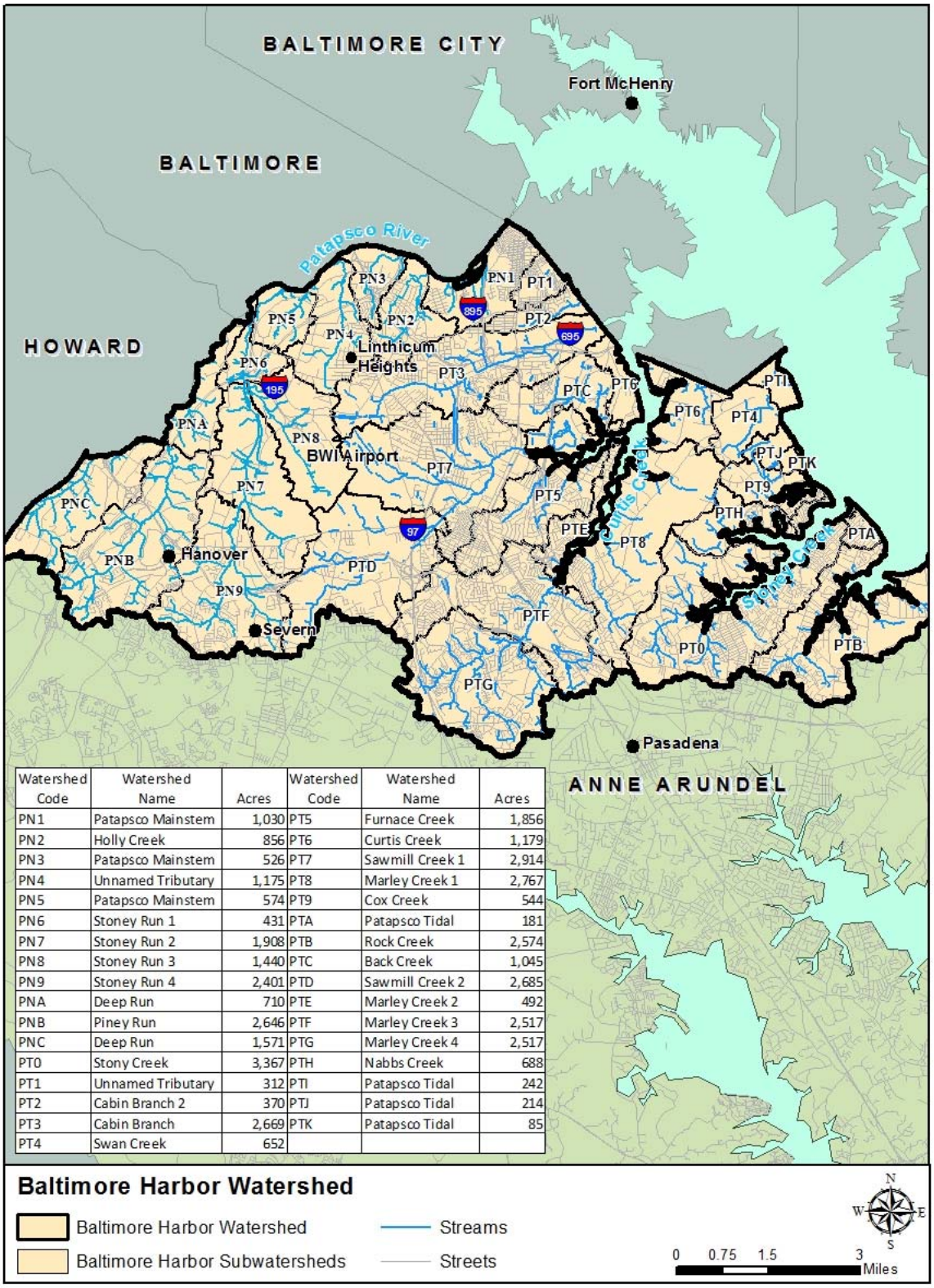
2.2 Baltimore Harbor Watershed

The Baltimore Harbor watershed in Anne Arundel County is approximately 45,134 acres (70.5 square miles) in area and contains approximately 202 total miles of stream reaches. The watershed includes several named streams including Back Creek, Cabin Branch, Cox Creek, Curtis Creek, Deep Run, Furnace Creek, Holly Creek, Marley Creek, Nabbs Creek, Patapsco River Lower North Branch Mainstem, Piney Run, Rock Creek, Sawmill Creek, Stoney Run, Swan Creek, and the mainstem of the tidal Patapsco River. These named streams are distributed among 33 subwatersheds, as shown below in Table 3 and on Figure 3. These subwatersheds were used as planning units for the watershed assessments completed for this watershed by the County in 2011 and 2012. Although the average subwatershed size is 1,368 acres, the subwatersheds range in size from 85 acres in PTK to 3,367 acres in PTO. The channel length in each subwatershed also varies similarly.

Communities within the Baltimore Harbor watershed include Hanover, Linthicum Heights and Severn. Baltimore Washington International Airport is also located in the western portion of the watershed (Figure 3).

Table 3: Baltimore Harbor Watershed Drainage Area and Stream Miles

Subwatershed Code	Subwatershed Name	Drainage Area (Acres)	Drainage Area (Square Miles)	Stream Miles
PT0	Stoney Creek	3,367	5.3	10.8
PT1	Unnamed Tributary	312	0.5	0.1
PT2	Cabin Branch 2	369	0.6	1.6
PT3	Cabin Branch	2,667	4.2	12.8
PT4	Swan Creek	652	1.0	2.5
PT5	Furnace Creek	1,856	2.9	6.2
PT6	Curtis Creek	1,179	1.8	2.5
PT7	Sawmill Creek 1	2,914	4.6	13.2
PT8	Marley Creek 1	2,767	4.3	7.1
PT9	Cox Creek	544	0.9	1.7
PTA	Patapsco Tidal	181	0.3	0.1
PTB	Rock Creek	2,573	4.0	6.0
PTC	Back Creek	1,045	1.6	4.4
PTD	Sawmill Creek 2	2,684	4.2	9.0
PTE	Marley Creek 2	492	0.8	0.6
PTF	Marley Creek 3	2,517	3.9	8.4
PTG	Marley Creek 4	2,517	3.9	14.6
PTH	Nabbs Creek	688	1.1	3.0
PTI	Patapsco Tidal	242	0.4	0.6
PTJ	Patapsco Tidal	215	0.3	1.1
PTK	Patapsco Tidal	85	0.1	0
PN1	Patapsco Mainstem	1,030	1.6	6.5
PN2	Holly Creek	856	1.3	4.5
PN3	Patapsco Mainstem	526	0.8	4.3
PN4	Unnamed Tributary	1,175	1.8	6.3
PN5	Patapsco Mainstem	575	0.9	5.4
PN6	Stoney Run 1	429	0.7	4
PN7	Stoney Run 2	2,078	3.2	10.6
PN8	Stoney Run 3	1,421	2.2	6
PN9	Stoney Run 4	2,252	3.5	12.2
PNA	Deep Run	709	1.1	7.4
PNB	Piney Run	2,646	4.1	17.5
PNC	Deep Run	1,571	2.5	11.4
Baltimore Harbor Watershed Total		**45,134**	**70.5**	**202.4**



Watershed Code	Watershed Name	Acres	Watershed Code	Watershed Name	Acres
PN1	Patapsco Mainstem	1,030	PT5	Furnace Creek	1,856
PN2	Holly Creek	856	PT6	Curtis Creek	1,179
PN3	Patapsco Mainstem	526	PT7	Sawmill Creek 1	2,914
PN4	Unnamed Tributary	1,175	PT8	Marley Creek 1	2,767
PN5	Patapsco Mainstem	574	PT9	Cox Creek	544
PN6	Stoney Run 1	431	PTA	Patapsco Tidal	181
PN7	Stoney Run 2	1,908	PTB	Rock Creek	2,574
PN8	Stoney Run 3	1,440	PTC	Back Creek	1,045
PN9	Stoney Run 4	2,401	PTD	Sawmill Creek 2	2,685
PNA	Deep Run	710	PTE	Marley Creek 2	492
PNB	Piney Run	2,646	PTF	Marley Creek 3	2,517
PNC	Deep Run	1,571	PTG	Marley Creek 4	2,517
PT0	Stony Creek	3,367	PTH	Nabbs Creek	688
PT1	Unnamed Tributary	312	PTI	Patapsco Tidal	242
PT2	Cabin Branch 2	370	PTJ	Patapsco Tidal	214
PT3	Cabin Branch	2,669	PTK	Patapsco Tidal	85
PT4	Swan Creek	652			

Figure 3: Anne Arundel County's Portion of Baltimore Harbor Watershed

2.3 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 stormflow affects stream habitat negatively by increasing bank erosion and decreasing instream and riparian habitat. Agricultural land, if managed incorrectly, can also impair streams with increased nutrients and bacteria.

Aerial imagery of the Baltimore Harbor watershed is shown in Figure 4. The most recent land use / land cover (LULC) data available from the Anne Arundel County Office of Information Technology (2014) is presented in Figure 5. Data presented in the tables below were used in this plan solely to characterize the watershed 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 LULC from the Chesapeake Bay Program Partnership Watershed Model.

2.3.1 Existing Land Use/Land Cover

According to 2014 LULC data (Table 4), the largest category in the Baltimore Harbor watershed is forested land, or woods (26.7%) followed by residential 1/8 acre (16.7%). Developed land accounts for 60.6% of the watershed and largely consists of residential (1/8 acre 16.7%, 1/4 acre 10.7%), commercial (8.7%), and industrial (6.1%). Residential areas as a total make up 36.4% of the watershed.

Table 4: 2014 Land Use / Land Cover

Land Use / Land Cover	Acres	Percent of Watershed
Airport	1,149	2.5%
Commercial	3,946	8.7%
Forested Wetland	97	0.2%
Industrial	2,771	6.1%
Mining	111	0.2%
Open Space	4,457	9.9%
Open Wetland	462	1.0%
Pasture/Hay	69	0.2%
Residential 1-acre	1,386	3.1%
Residential 1/2-acre	1,674	3.7%
Residential 1/4-acre	4,833	10.7%
Residential 1/8-acre	7,543	16.7%
Residential 2-acre	1,010	2.2%
Row Crops	46	0.1%
Transportation	2,716	6.0%
Utility	326	0.7%
Water	489	1.1%
Woods	12,049	26.7%
Total	**45,134**	**100.0%**

2.3.2 Impervious Surfaces

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.

Impervious surfaces make up 29.7% of the overall Baltimore Harbor watershed drainage (Table 5; impervious surfaces data obtained from Anne Arundel County Office of Information Technology - 2014). Impervious surface is highest in areas surrounding Glen Burnie, the Baltimore Washington International Airport, and Arundel Mills Mall in Hanover.

Table 5: Baltimore Harbor Watershed Percent Impervious Cover

Subwatershed Code	Subwatershed Name	% Impervious Cover
PT0	Stoney Creek	24.3%
PT1	Unnamed Tributary	44.1%
PT2	Cabin Branch 2	30.0%
PT3	Cabin Branch	30.2%
PT4	Swan Creek	17.1%
PT5	Furnace Creek	41.1%
PT6	Curtis Creek	31.7%
PT7	Sawmill Creek 1	42.1%
PT8	Marley Creek 1	17.1%
PT9	Cox Creek	39.0%
PTA	Patapsco Tidal	37.8%
PTB	Rock Creek	22.9%
PTC	Back Creek	44.0%
PTD	Sawmill Creek 2	21.6%
PTE	Marley Creek 2	34.3%
PTF	Marley Creek 3	40.7%
PTG	Marley Creek 4	33.9%

Subwatershed Code	Subwatershed Name	% Impervious Cover
PTH	Nabbs Creek	15.3%
PTI	Patapsco Tidal	12.7%
PTJ	Patapsco Tidal	35.4%
PTK	Patapsco Tidal	32.4%
PN1	Patapsco Mainstem	36.7%
PN2	Holly Creek	29.3%
PN3	Patapsco Mainstem	39.1%
PN4	Unnamed Tributary	32.5%
PN5	Patapsco Mainstem	17.3%
PN6	Stoney Run 1	22.4%
PN7	Stoney Run 2	23.7%
PN8	Stoney Run 3	46.6%
PN9	Stoney Run 4	28.7%
PNA	Deep Run	10.7%
PNB	Piney Run	30.2%
PNC	Deep Run	19.0%
Baltimore Harbor Watershed Total		**29.7%**

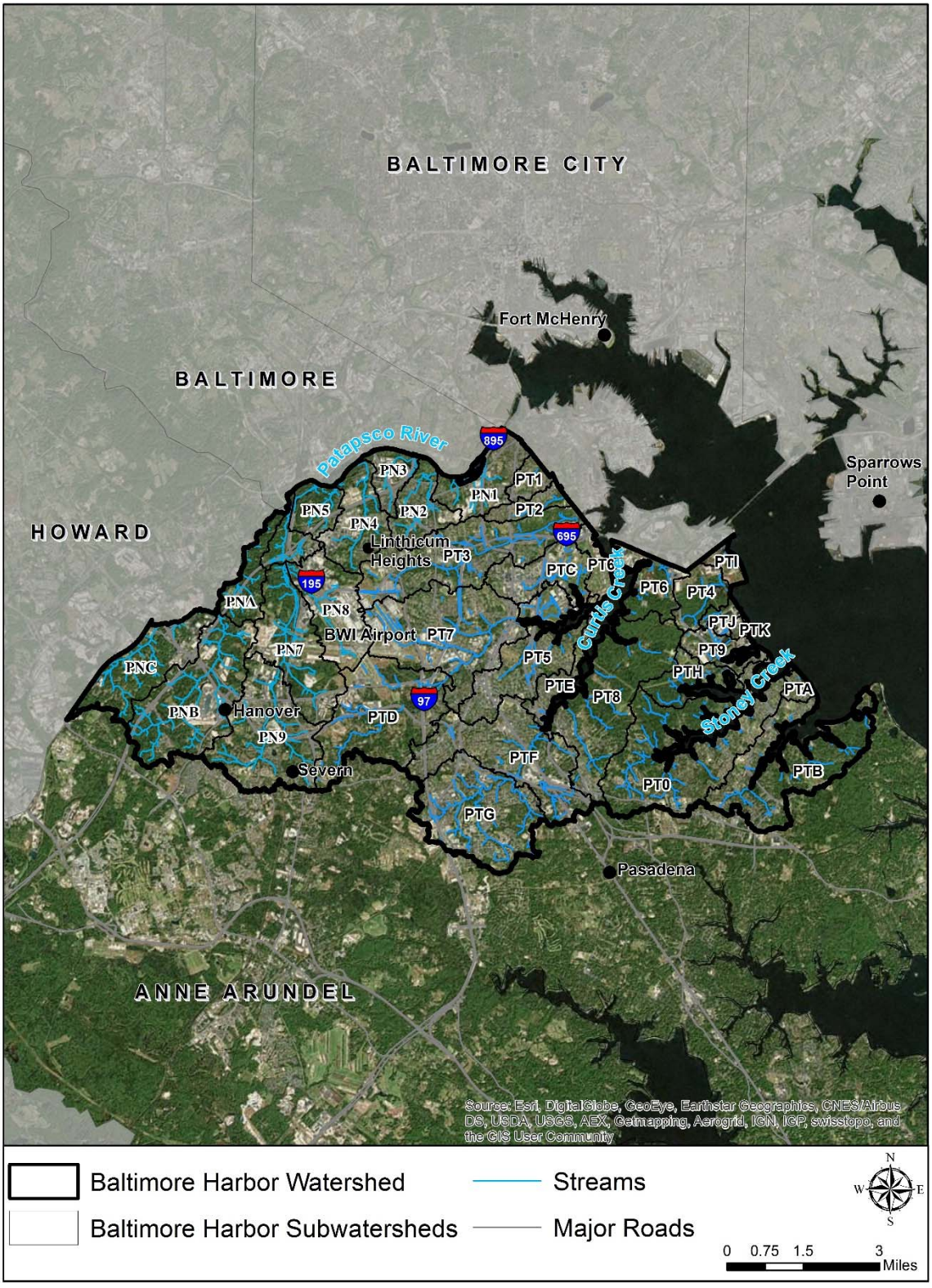


Figure 4: Baltimore Harbor Watershed Aerial Imagery (2014)

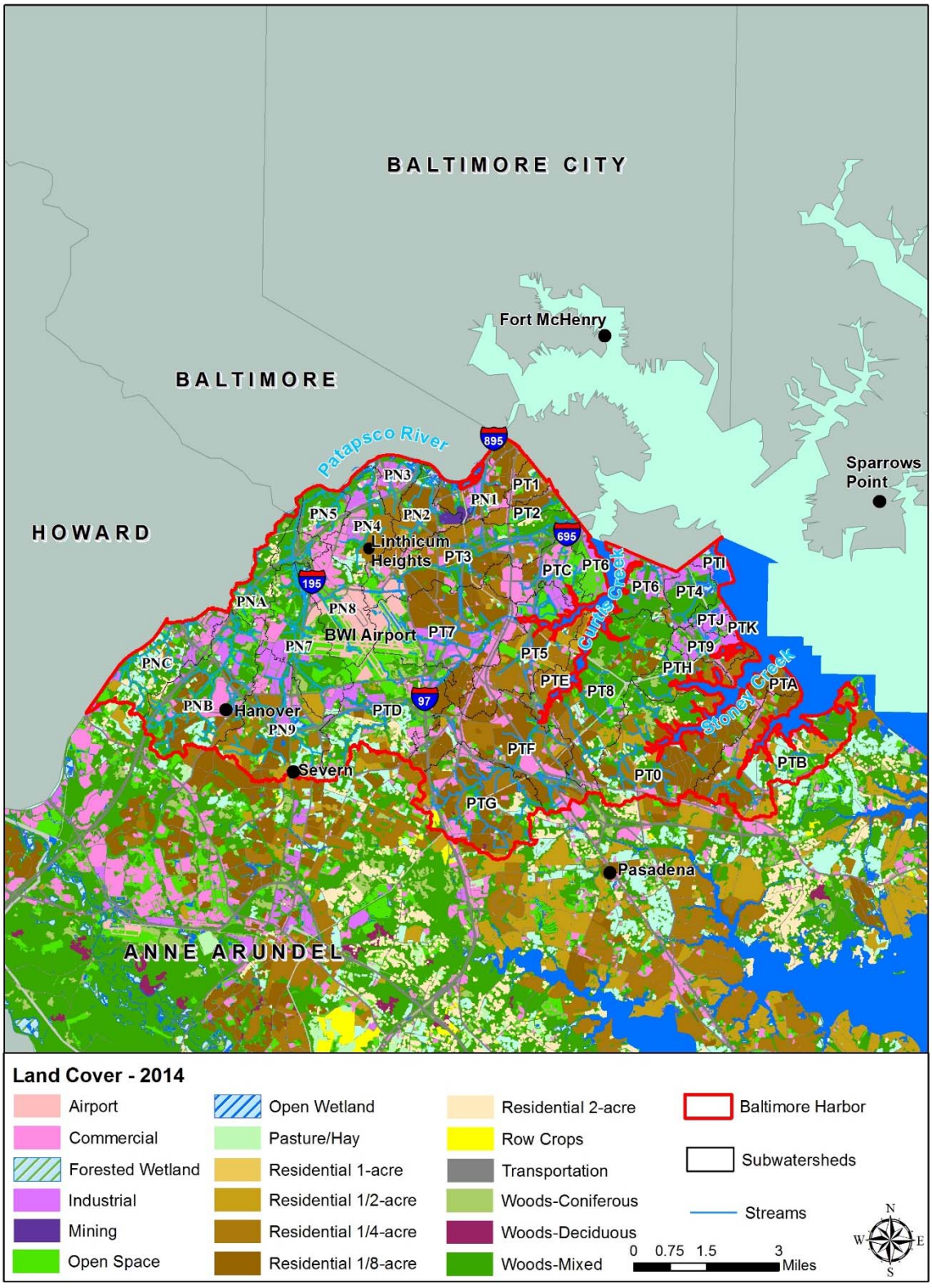


Figure 5: Baltimore Harbor Watershed Land Cover (2014)

2.4 Water Quality

2.4.1 Use Designations

According to water quality standards established by MDE in the Code of Maryland Regulations (COMAR) 26.08.02.03-.03 - Water Quality, Anne Arundel's portion of the Baltimore Harbor watershed is classified as Use I and II waters which are designated to support water contact recreation, shellfish harvesting, protection of tidal aquatic life, and protection of non-tidal warmwater aquatic life. As previously mentioned, the Patapsco River Mesohaline stream segment (PATMH) is also identified as the Baltimore Harbor watershed and includes several Maryland 8-digit watersheds. As shown in Figure 2, Anne Arundel County's portion of the Baltimore Harbor watershed contains two Maryland 8-digit watersheds: Baltimore Harbor (02130903) and Patapsco River Lower North Branch (02130906). Use designations for Patapsco River Mesohaline, Baltimore Harbor, and Patapsco River Lower North Branch are included in Table 6. Designations for Anne Arundel County watersheds draining to the Baltimore Harbor watershed include recreation; industrial and agricultural water supply; and fish, aquatic life, and wildlife.

Table 6: Use Designations of the Baltimore Harbor Watershed

Designated Uses	Baltimore Harbor	Patapsco River Lower North Branch	Patapsco River Mesohaline
Growth and propagation of fish (not trout), other aquatic life and wildlife	X	X	X
Water contact sports	X	X	X
Leisure activities involving direct contact with surface water	X	X	X
Fishing	X	X	X
Agricultural water supply	X	X	X
Industrial water supply	X	X	X
Propagation and harvesting of shellfish	-	-	X
Seasonal migratory fish spawning and nursery use	-	-	X
Seasonal shallow-water submerged aquatic vegetation use	-	-	X
Open-water fish and shellfish use	-	-	X
Seasonal deep-water fish and shellfish use	-	-	X
Seasonal deep-channel refuge use	-	-	X
Growth and propagation of trout	-	-	-
Capable of supporting adult trout for a put and take fishery	-	-	-
Public water supply	-	-	-

Source: http://www.mde.state.md.us/programs/Water/TMDL/Water%20Quality%20Standards/Pages/programs/waterprograms/tmdl/wqstandards/wqs_designated_uses.aspx

2.4.2 TMDLs and 303(d) Impairments

TMDLs are established for waterbodies on Maryland's 303(d) integrated list of impaired waterbodies to set pollutant limits to achieve attainment of the designated use. For each combination of waterbody and pollutant, the State must estimate the maximum allowable pollutant load, or TMDL, that the waterbody can receive and still meet water quality standards. TMDLs are required by the Clean Water Act. Category

4a of the 303(d) list describes impaired waters with a TMDL or other reduction measure in place. Category 5 lists impaired waters in need of a TMDL.

According to Maryland's final 2014 303(d) list of impaired waters (MDE, 2015), several segments within the Baltimore Harbor watershed are listed for water quality impairments. Category 4a and 5 303(d) listings for Patapsco River Mesohaline, Baltimore Harbor, and Patapsco River Lower North Branch are included in Table 7. Final approved TMDLs within Anne Arundel County with either an individual or aggregate SW-WLA are shown in bold text.

Table 7: Category 4a and 5 Listings for Anne Arundel County's Portion of the Baltimore Harbor Watershed

Impairment	Applicable Segment – Water Type Detail	303(d) List Category	Approval Date
Chlorides	Baltimore Harbor – 1st thru 4th order streams	5	
Sulfates	Baltimore Harbor – 1st thru 4th order streams	5	
Total Suspended Solids	Baltimore Harbor – 1st thru 4th order streams	5	
Chlordane - sediments	Baltimore Harbor Watershed – Chesapeake Bay segment	4a	3/20/2001
PCB - Fish Tissue	Baltimore Harbor Watershed – Tidal subsegment	4a	10/1/2012
Escherichia coli	**Patapsco River Lower North Branch - Subwatershed**	**4a**	**12/3/2009**
Total Suspended Solids	**Patapsco River Lower North Branch - Non-tidal 8-digit watershed**	**4a**	**3/20/2001**
Chlorides	Patapsco River Lower North Branch - Non-tidal 8-digit watershed	5	
Sulfates	Patapsco River Lower North Branch - Non-tidal 8-digit watershed	5	
Enterococcus	Patapsco River Mesohaline - Subwatershed	4a	3/10/2011
Nitrogen (Total)	**Patapsco River Mesohaline – Non-Navigation Channel**	**4a**	**12/17/2007**
Nitrogen (Total)	Patapsco River Mesohaline – Navigation Channel	4a	12/29/2010
PCBs - Sediments and Fish Tissue	Patapsco River Mesohaline – Tidal subsegment	4a	10/1/2012
Phosphorus (Total)	**Patapsco River Mesohaline – Non-Navigation Channel**	**4a**	**12/17/2007**
Phosphorus (Total)	Patapsco River Mesohaline – Navigation Channel	4a	12/29/2010
Total Suspended Solids	Patapsco River Mesohaline – SAV Grow Zone	4a	12/29/2010
Cause Unknown	Patapsco River Mesohaline – Chesapeake Bay segment	5	

Impairment	Applicable Segment – Water Type Detail	303(d) List Category	Approval Date
Debris/Floatables/Trash	Patapsco River Mesohaline – Tidal subsegment	5	
Zinc - Sediments	Patapsco River Mesohaline – Tidal subsegment	5	

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

Category 4a: Impaired waters with a TMDL or other reduction measure in place

Category 5: Impaired waters in need of a TMDL

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

This restoration plan focuses on implementing strategies to address the nitrogen and phosphorus TMDLs for non-navigation channels of the Patapsco River Mesohaline stream segment (Baltimore Harbor watershed), shown as two bold 4a listings in the table above. In addition to local TMDLs in the Baltimore Harbor watershed, the County must also meet WLAs allocated from the *Chesapeake Bay Total Maximum Daily Loads for Nitrogen, Phosphorus, and Sediment* (USEPA, 2010). The Bay TMDL is a result of requirements under the CWA to meet water quality standards and executive order 13508 signed by President Barack Obama in 2009 that put a renewed emphasis and focus on the Chesapeake Bay. The local nutrient TMDL for the Baltimore Harbor watershed is more geographically specific than the Bay-wide allocated loads assigned in the Bay TMDL. However, all load reductions achieved from implementation efforts described in this plan will help support the County's Bay TMDL goals.

2.4.3 NPDES

Section 402(p) of the Clean Water Act required the 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. Anne Arundel County holds a Phase I – Large Jurisdiction (greater than 250,000 population) MS4 permit (11-DP-3316, MD0068306) issued by the MDE. The County's first generation permit was issued in 1993. The current fourth generation permit was issued in February of 2014.

TMDL Permit Requirements

The objective of this plan is to meet the County's MS4 NPDES permit requirement to develop restoration plans for local TMDLs per permit condition IV.E.2.b.

The permit states the County must submit "…a restoration plan for each stormwater Waste Load Allocation (WLA) approved by EPA prior to the effective date of the permit." For each WLA, the County is required to:

PART IV. Standard Permit Conditions

E. Restoration Plans and Total Maximum Daily Loads

2. Restoration Plans

b. Within one year of permit issuance, Anne Arundel 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, Anne Arundel 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 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 to include 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 will include: 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 IV.E.4.a-e).

Impervious Surface Permit Requirements

The County's permit requires implementation of restoration efforts for 20% of the County's impervious surface area that has not already been restored to the maximum extent practicable (MEP) (permit section (IV.E.2.a). Though projects and strategies outlined in this plan will certainly add treatment of impervious surfaces, accounting for impervious treatment is not included in this report.

3 Causes and Sources of Impairment (a)

3.1 Impairments

Elevated levels of nutrients currently impair the Baltimore Harbor watershed as evident through the 303(d) listings and local TMDL requirement. 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. Located upstream in the watershed, Liberty Reservoir is part of the City of Baltimore's drinking water system. Sources of nutrients include agricultural runoff, urban stormwater, municipal wastewater treatment plants, phosphorus bound to sediments supplied to the stream system, and discharge from upstream impoundments.

3.2 Sources

The majority of nutrient loads in the Baltimore Harbor watershed originate from urban stormwater runoff from development, in-stream sources, and municipal and industrial wastewater treatment plants. Municipal and industrial wastewater treatment plants are assigned loads in the TMDL and are not addressed in this plan.

3.2.1 Urban Stormwater Runoff

The contribution of urban stormwater to nutrient loading was analyzed in the Patapsco Non-Tidal Watershed Assessment (Anne Arundel County, 2011) and the Patapsco Tidal and Bodkin Creek Watershed Assessment (Anne Arundel County, 2012b). Figure 6 presents the annual total nitrogen runoff load as the relative quantity of nitrogen contributed from each subwatershed (i.e., lowest to highest). Figure 7 presents the annual total phosphorus runoff load as the relative quantity of phosphorus contributed from each subwatershed (i.e., lowest to highest). The water quality model used for the assessment was based on EPA's Simple Method (Schueler, 1987) and PLOAD models (USEPA, 2001) using event mean concentrations (EMCs) for each land use / land cover (LULC) type. The results presented here are only the nutrients associated with runoff, and do not reflect in-stream sources. The most significant contributing LULC categories related to urban stormwater in terms of loading rates include airport, transportation, and commercial and industrial areas. Residential development, while a lower loading rate, makes up a large portion of the watershed (36.2%) and is therefore also a significant contributor.

Subwatersheds contributing the lowest amount of existing nutrient loads include Swan Creek (PT4), Nabbs Creek (PTH), Patapsco Tidal (PTA, PTI, PTJ, and PTK), Stoney Run 1 (PN6), and Deep Run (PNA). Subwatersheds contributing the highest amount of existing nutrient loads include Cox Creek (PN9), Sawmill Creek 1 (PT7), Marley Creek 3 and 4 (PTF and PTG), and Stoney Creek (PT0). Management measures targeted in subwatersheds with high existing nutrient loads will be the priority of this restoration plan to ensure required reductions are achieved and maintained.

3.2.2 In-stream Sources

Although channel bed and bank erosion occurs naturally as streams work to maintain a state of dynamic equilibrium, excessive erosion can occur due to increased stream velocities associated with development activities that increase imperviousness within the watershed. Channel erosion can deliver excessive pollutants, such as sediment and phosphorus, downstream, where water quality can be impacted and important habitat for fish spawning and benthic invertebrates can be smothered. Phosphorus bound to sediments supplied in the stream system could be a source of increased phosphorus amounts to the Baltimore Harbor watershed.

Approximately 227 miles of streams were assessed in the Baltimore Harbor watershed and characterized for the Patapsco Non-Tidal and Patapsco Tidal and Bodkin Creek Watershed Assessments (Anne Arundel County, 2011 and 2012b). Collected data included stream classifications, physical habitat condition assessment, inventory of infrastructure and environmental features, habitat scores, channel geomorphology, road crossing flood potential, bioassessments, and aquatic resource indicators. Within each perennial reach, channel erosion was assessed and scored based on severity. A score of 5 was considered Moderate impact, a score of 7 was considered Severe, and a score of 10 was considered an Extreme condition. A total of 585 erosion locations impacting approximately 73,750 linear feet of stream reaches were cataloged in the Baltimore Harbor with the majority of points scored as moderate or severe erosion (Table 8 and Table 9).

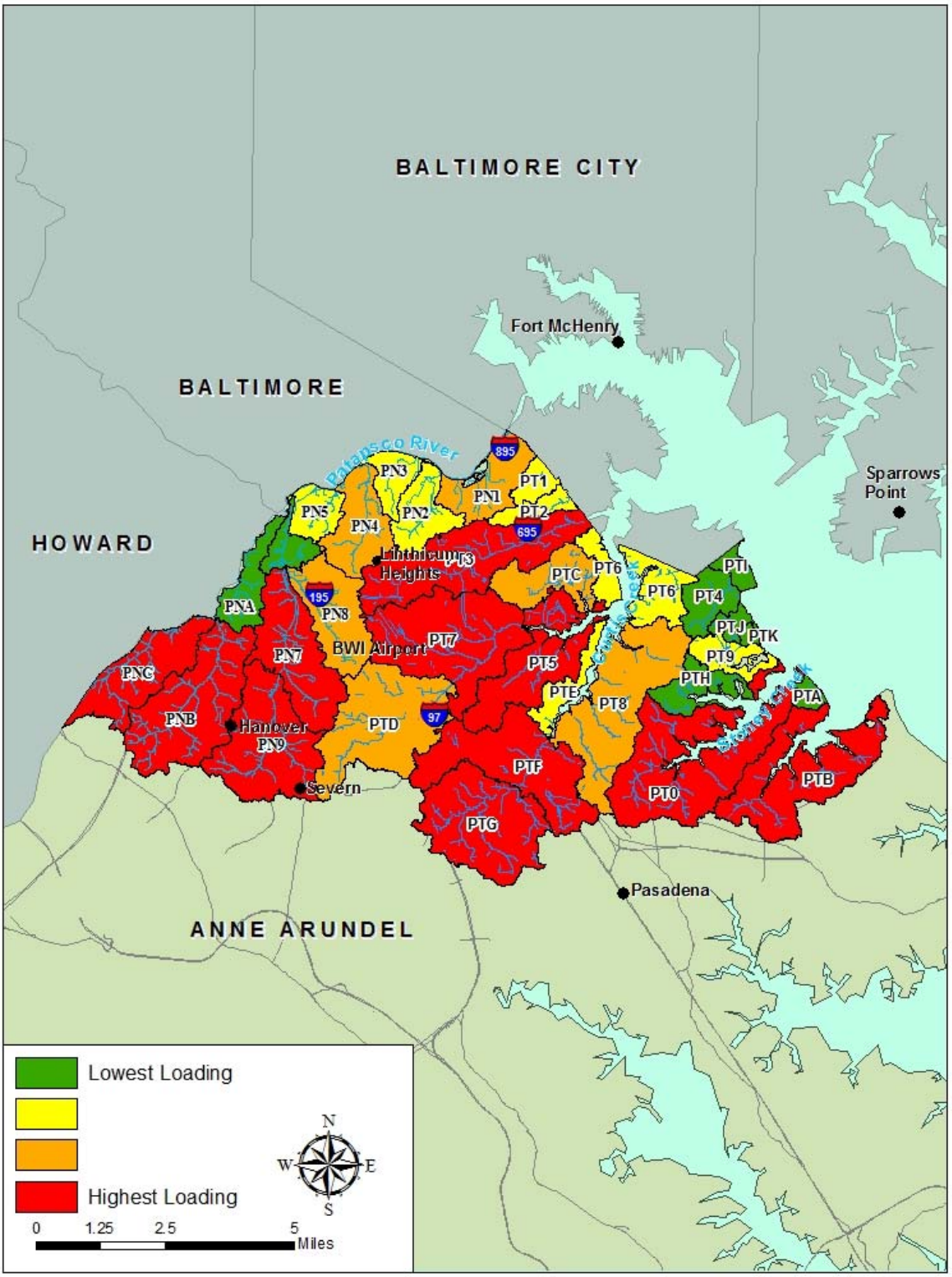


Figure 6: Total Nitrogen Load from Runoff Based on Existing Conditions - Includes BMP Reductions (Anne Arundel County, 2011 and 2012b)

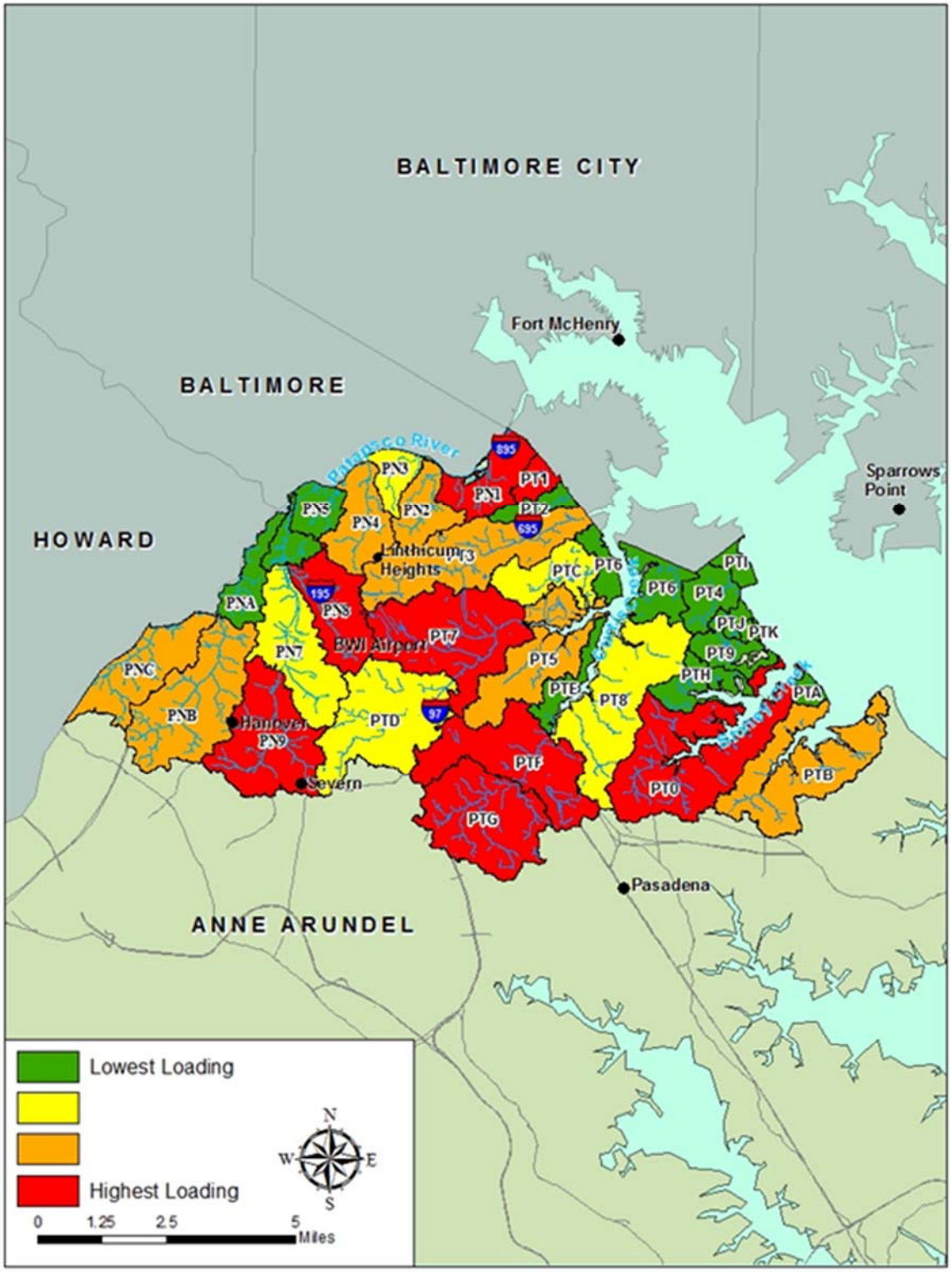


Figure 7: Total Phosphorus Load from Runoff Based on Existing Conditions - Includes BMP Reductions (Anne Arundel County, 2011 and 2012b)

Table 8: Erosion Inventory and Severity per Subwatershed (Anne Arundel County, 2011 and 2012b)

Gray =<5 sites Green = 5-10 sites Yellow = 11-20 sites Orange = 21-50 sites

Subwatershed and stream miles assessed		Number of Erosion Impacts			Total
		5	7	10	
PT0	14.6	38	10	-	48
PT1	0.0	Not Assessed			
PT2	2.0	15	4	-	19
PT3	16.7	44	24	-	68
PT4	3.3	2	-	-	2
PT5	7.0	4	1	1	6
PT6	3.2	3	3	-	6
PT7	13.9	24	5	-	29
PT8	8.2	29	7	-	36
PT9	2.1	2	-	-	2
PTA	0.6	-	-	-	0
PTB	7.5	16	6	1	23
PTC	4.8	2	3	1	6
PTD	13.3	2	-	-	2
PTE	0.6	1	1	-	2
PTF	11.4	19	11	-	30
PTG	16.5	43	20	4	67
PTH	4.1	11	3	-	14
PTI	0.5	-	-	-	0
PTJ	0.8	-	-	-	0
PTK	0.0	Not Assessed			
PN1	6.6	3	2	-	5
PN2	4.6	-	5	-	5
PN3	4.3	-	2	-	2
PN4	6.2	2	6	-	8
PN5	5.4	18	17	2	37
PN6	4.0	6	7	-	13
PN7	10.6	10	-	-	10
PN8	6.0	17	4	-	21
PN9	12.3	21	6	-	27
PNA	7.4	6	4	-	10

Subwatershed and stream miles assessed		Number of Erosion Impacts			Total
		5	7	10	
PNB	17.4	18	27	1	46
PNC	11.4	26	15	-	41
Total number per rating		**382**	**193**	**10**	
Total number per type		**585**			

Table 9: Linear Feet of Erosion per Subwatershed (Anne Arundel County, 2011 and 2012b)

Subwatershed	Erosion Impacts and Linear Feet			Total Linear Feet
	5	7	10	
PT0	4,290	1,350	-	5,640
PT1	Not Assessed			
PT2	1,590	1,050	-	2,640
PT3	7,288	5,305	-	12,593
PT4	950	-	-	950
PT5	310	15	50	375
PT6	165	250	-	415
PT7	2,995	395	-	3,390
PT8	5,495	545	-	6,040
PT9	440	-	-	440
PTA	-	-	-	-
PTB	1,570	750	40	2,360
PTC	175	205	60	440
PTD	225	-	-	225
PTE	30	45	-	75
PTF	4,120	1,644	-	5,764
PTG	5,374	3,290	380	9,044
PTH	820	495	-	1,315
PTI	-	-	-	-
PTJ	-	-	-	-
PTK	Not Assessed			
PN1	650	470	-	1,120
PN2	-	225	-	225
PN3	-	130	-	130

Subwatershed	Erosion Impacts and Linear Feet			Total Linear Feet
	5	7	10	
PN4	120	290	-	410
PN5	1,555	1,440	125	3,120
PN6	465	180	-	645
PN7	705	-	-	705
PN8	2,370	180	-	2,550
PN9	1,200	695	-	1,895
PNA	1,580	255	-	1,835
PNB	1,495	4,060	40	5,595
PNC	2,240	1,570	-	3,810
Total	**48,217**	**24,834**	**695**	**73,746**

An assessment of channel geomorphology utilizing Rosgen Level I geomorphic classifications was also administered for each single-threaded, perennial reach throughout the watershed as part of both the Patapsco Non-Tidal and Patapsco Tidal and Bodkin Creek Watershed Assessments (Anne Arundel County, 2011 and 2012b). An assessment of channel geomorphology is useful to better understand the stability of a stream and its associated behaviors including channel entrenchment. The Rosgen classification system has four levels (Rosgen, 1996). The Level I classification is a geomorphic characterization that groups streams as Types A through G based on aspects of channel geometry, including water surface slope, entrenchment, width/depth ratio, and sinuosity. Nearly one third of streams (29%) were Type B channels, which are stable, moderate gradient channels with low sinuosity and low erosion rates. Almost a third of the assessed perennial streams (28%) in the Baltimore Harbor watershed were Type C channels, which exhibit a well-developed floodplain, higher sinuosity, and susceptibility to de-stabilization when flow regimes are altered. Thirty-three percent were Type F and G channels (18% and 15%, respectively), which are generally low gradient, entrenched channels with high erosion rates.

3.3 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 3.3.1.

3.3.1 Offsetting Loads from Future Growth

Growth and development is expected to occur throughout Anne Arundel 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." As such Anne Arundel County has updated Articles 16 and 17 of the County Code to incorporate the requirements for ESD. Anne Arundel County finalized the *Anne Arundel County Stormwater Management Practices and Procedures Manual* to incorporate criteria specific to the County that are not addressed within the Maryland Design Manual (Anne Arundel County, 2010).

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% and 60% of nitrogen and phosphorus, respectively, for new development.

Anticipated "Accounting for Growth" policies will address the residual load (TN: 50% and TP: 40%) 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* (MDE, 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.

3.3.2 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, 2014c):

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.

The Anne Arundel County General Development Plan was finalized April 2009 and was adopted in October 2009 (Bill No. 64-09; Anne Arundel County, 2009). The next update of the plan is due by 2019. Anne Arundel County is considered one of the fastest growing counties in the region with 14.6% population growth (427,239 to 489,656 persons) over 1990-2000 compared to 6.9% growth in the

Baltimore region and 10.8% growth throughout the State of Maryland (Anne Arundel County, 2009). The population in Anne Arundel County is projected to increase to 564,925 persons by 2025, which is an increase of 15.4% from 2000 data and to 579,137 persons by 2035, an increase of 18.3% from 2000 data.

The primary developed areas located in Baltimore Harbor watershed are Glen Burnie, Hanover, Severn, and Linthicum Heights which include Baltimore-Washington International Airport and various commercial developments, specifically Arundel Mills Mall. The majority of the Baltimore Harbor watershed is a part of the County's Priority Funding Areas which are areas where the County directs new growth. Anne Arundel County continues to utilize strategies such as promoting low impact development and implementing stormwater BMPs for water quality treatment. However, increased urban stormwater related loads will inevitably occur as growth continues.

To estimate increases in loads over time due to growth, an analysis was completed using a combination of MAST modeled loading estimates and estimates based on recent growth patterns. Projected TN and TP EOS 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 in the Baltimore Harbor watershed. Baltimore Harbor watershed average percent change in County Phase I MS4 background TN and TP loads were both 0.8% as shown in Table 10. In this manner a 0.8% annual increase in loads would be expected from 2015 to 2025 if development were to occur at the same rate and be implemented without BMPs. Because in actuality new development will follow Maryland's stormwater regulations, the resultant loading increases were reduced by 50% for TN and 60% for TP based on the MAST removal rates for nutrients treated by SW to the MEP.

Projected loading with application of SW to the MEP is shown in Table 11. 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 10: Increases in Land Use and Pollutant Loads from 2010 through 2015

	County Phase I MS4 Urban Land Use Acres	No BMP County Phase I MS4 Urban Land Use Loads	
		TN EOS-lbs/yr	TP EOS-lbs/yr
2010	16,913	148,902	13,231
2015	17,561	154,615	13,745
Average % Change	0.8%	0.8%	0.8%

Table 11: Estimated Future Increases in Pollutant Loads

Additional Land Use Loads - With SW to MEP	TN EOS-lbs/yr	TP EOS-lbs/yr
2017 Estimate	1,187	85
2019 Estimate	2,373	171
2025 Estimate	5,933	427

Figure 8 and Figure 9 depict nutrient runoff loading by watershed based on a future conditions modeling scenario with the implementation of projects funded in the County's Capital Improvement Program (CIP) as recommended in the Baltimore Harbor Watershed Assessment (Anne Arundel County, 2011 and 2012b) and discussed further in Section 4: Management Measures. In general, future nutrient loading is projected to be highest in the Cabin Branch (PT3), Marley Creek 3 and 4 (PTF and PTG), Piney Run (PNB), Sawmill Creek 1 (PT7), and Stony Creek (PT0) subwatersheds.

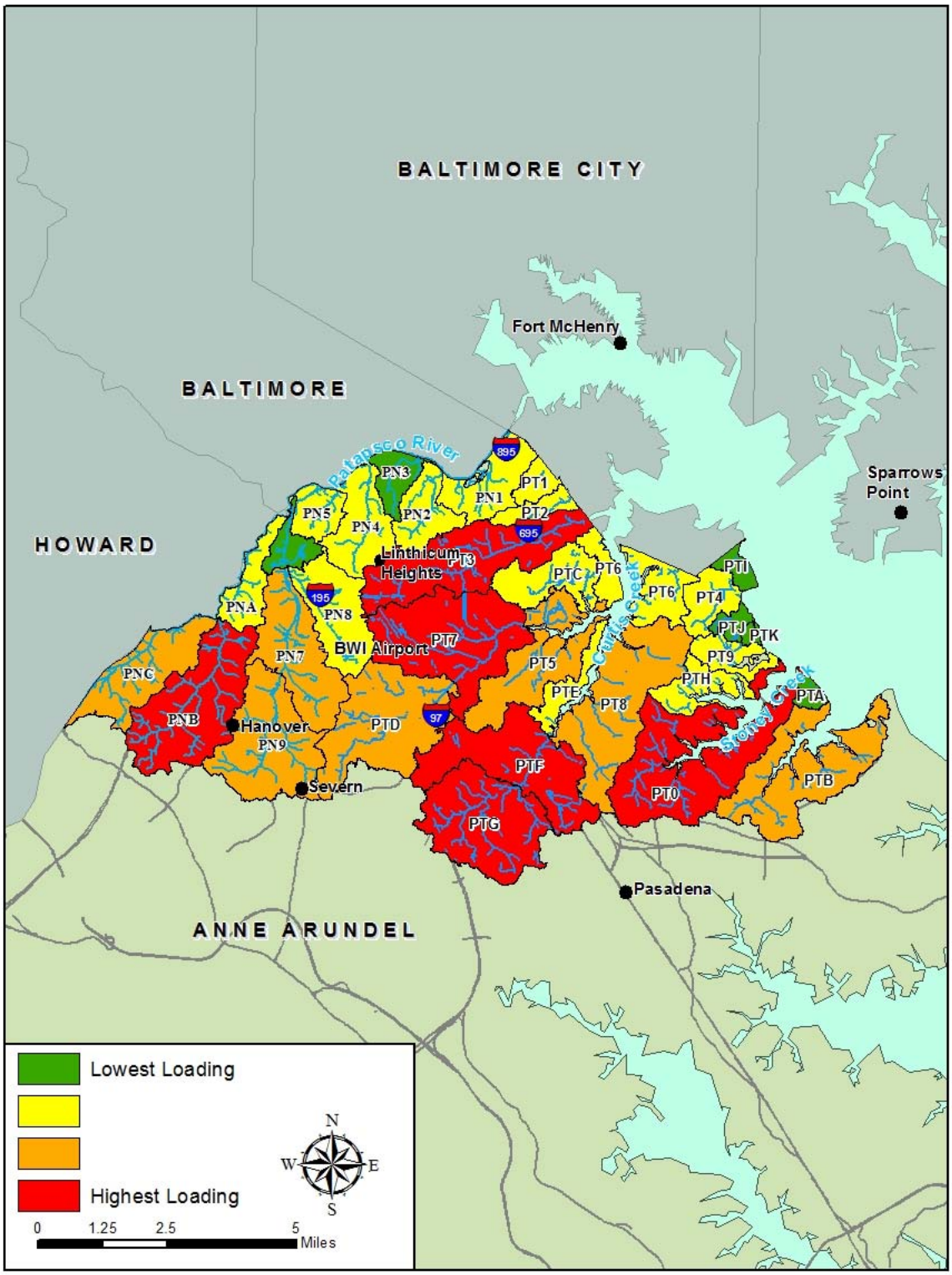


Figure 8: Total Nitrogen Loads from Runoff Based on Future Conditions - Includes BMP Reductions (Anne Arundel County, 2011 and 2012b)

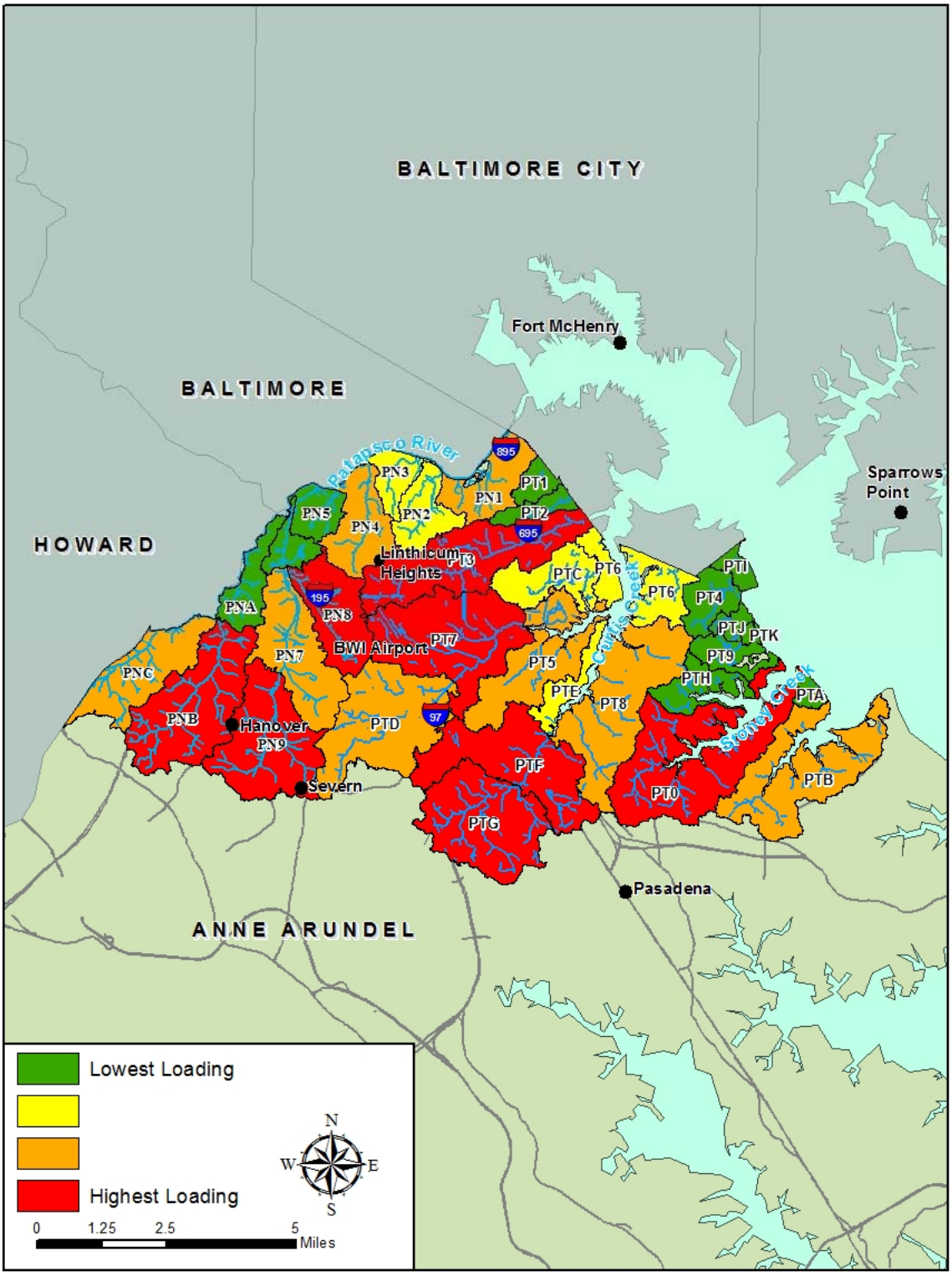


Figure 9: Total Phosphorus Loads from Runoff Based on Future Conditions - Includes BMP Reductions (Anne Arundel County, 2011 and 2012b

4 Management Measures (c)

BMPs are either already implemented or are planned for implementation to achieve and maintain the Baltimore Harbor watershed local TMDL load reductions. This section serves to describe the types of BMPs and management measures being implemented in the watershed. Load reductions that result from these measures are discussed in the following section, Section 5: Expected Load Reductions.

4.1 Modeling Approach

Each BMP provides a reduction for nitrogen, phosphorus, and sediment, along with other pollutants. Baseline, progress, and planned pollutant load modeling for the Baltimore Harbor watershed was determined using BayFAST, which calculates pollutant loads and reductions calibrated to the Chesapeake Bay Program Partnership Watershed Model. Local TMDL baseline loads were disaggregated and calibrated in BayFAST by modeling BMPs installed prior to the TMDL baseline year on top of baseline land use background loads. The procedure of disaggregating and calibrating baseline loads and SW-WLAs is discussed in greater detail in section 1.2.1: Reduction Target Derivation.

BayFAST, created by Devereux Environmental Consulting for MDE, is a web-based pollutant load estimating tool that streamlines environmental planning. Users specify, delineate facility boundaries (e.g., watershed, parcel, drainage area), and alter land use information within the delineated boundary depending on the model year. BayFAST 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 BayFAST and the Chesapeake Bay Program Partnership 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 the load reduction can vary depending on which BMPs are implemented.

Pollutant load reductions achieved by maintenance efforts (e.g., street sweeping and inlet cleaning) are calculated outside of BayFAST. As discussed in the following section 4.2: Best Management Practices, inlet cleaning and street sweeping will be practiced in the Baltimore Harbor watershed. Nutrient reduction credit for street sweeping and inlet cleaning is calculated following methods described in MDE (2014b) and Center for Watershed Protection (CWP), 2008. Regenerative air and vacuum-assisted street sweeping at a rate of 2 times per month reduces the load on the swept area by 5% for nitrogen and 6% for phosphorus. Inlet cleaning receives credit based on the mass of material collected, at the rate of 3.5 lbs TN and 1.4 lbs TP per ton of wet material.

Both the Watershed Model and 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. This TMDL plan focuses on reducing load on the land, so EOS estimates are more appropriate and were used for all the modeling analysis.

This section presents the level of BMP implementation. Section 9 presents information on how progress toward load reductions will be evaluated and management plans adapted on an on-going basis.

4.2 Best Management Practices

Many stormwater BMPs address both water quantity and quality, however, some BMPs are more effective at reducing nutrients 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 Anne Arundel County DPW 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 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 practices include:

- **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. BayFAST 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 nutrients, sediments, 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 examples of 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 BayFAST as bioswales.
- **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 –** Anne Arundel County plans to construct a variety of retrofits throughout the County. 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 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
- **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.

The measured effectiveness for each of these practices may be found in Table 12.

Table 12: Typical Nutrient Reduction from Stormwater BMPs

BMP	Nitrogen Reduction	Phosphorus Reduction
Bioretention A/B soils	70%	75%
Bioretention C/D soils	25%	45%
Bioswales	70%	75%
Dry Detention Ponds	5%	10%
Dry Extended Detention Ponds	20%	20%
Impervious Surface Reduction*	-	-
Infiltration	85%	85%
Outfall Enhancement with SPSC**	70%	75%
Stream Restoration	0.075 lbs/linear ft	0.068 lbs/linear ft
Urban Tree Plantings*	-	-
Wet Ponds or Wetlands	20%	45%

Sources: Simpson and Weammert, 2009; and Maryland Assessment Scenario Tool (MAST) documentation

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

**Outfall enhancement with SPSC modeled as bioswales in BayFAST

Along with the structural BMPs listed above, treatment will also be provided through non-structural operational measures. These are treatments that rely on programs that continue throughout the year and are repeated annually.

- **Inlet Cleaning -** Storm drain cleanout practice ranks among the oldest practices used by communities for a variety of purposes to provide a clean and healthy environment, and more recently to comply with their NPDES stormwater permits. Nutrient reduction credit is based on the mass of material collected, at the rate of 3.5 lbs TN and 1.4 lbs TP per ton of wet material (MDE, 2014b).
- **Street sweeping** —For full credit by MDE, street sweeping should occur twice a month or 26 times a year on urban streets. This frequent sweeping of the same street will reduce nitrogen and phosphorus as well as sediment. Regenerative air and vacuum-assisted street sweeping at a rate of 2 times per month reduces the nitrogen load on the swept area by 5% and phosphorus load by 6% (MDE, 2014b).

5 Expected Load Reductions (b)

WLAs in the nutrient TMDL were developed using the Chesapeake Bay Program Phase 5 (CBP P5) watershed model. Currently, BayFAST is using a computational framework that is compatible with an updated version of the model: CBP P5.3.2. Because the TMDL was developed under an older version of the model, the TMDL WLA needed to be translated into a BayFAST-compatible target load. In order to do this, the 1995 baseline nutrient load was re-calculated in BayFAST by modeling baseline BMPs in Baltimore Harbor (02130903) and Patapsco Lower North Branch (02130906) on top of baseline impervious and pervious Anne Arundel County Phase I MS4 acres. The required reduction percent assigned to the Anne Arundel County Phase I MS4 source (15.0%) in the local TMDL regulation was applied to the new baseline load to calculate the required reduction. The required reduction was subtracted from the new baseline load to calculate the BayFAST-compatible target TMDL WLA. Nutrient loads required for the Baltimore Harbor watershed Anne Arundel County Phase I MS4 are in Table 13.

Table 13: Nutrient Loads Required for the Baltimore Harbor Watershed Local TMDL – Disaggregated to Anne Arundel County Phase I MS4 Source and Calibrated to BayFAST

Nutrient	1995 Baseline Load (lbs/yr)	Required Reduction %	Required Reductions (lbs/yr)	TMDL Load Allocation (lbs/yr)
Nitrogen	161,514	15.00%	24,227	137,287
Phosphorus	13,941	15.00%	2,091	11,850

5.1 2015 Progress – Actual Implementation

Anne Arundel County maintains an extensive geodatabase of stormwater urban BMP facilities and water quality improvement projects (WQIP). Approximately 350 acres of County Phase I MS4 land has been treated through FY2015 by restoration BMPs in addition to 500 linear feet of stream restoration and the implementation of other non-structural BMPs (source: WPRP urban BMP and WQIP database, 2015). Current BMP implementation through FY2015 in the Baltimore Harbor watershed is shown in Table 14. Details on specific projects can be viewed in Appendix A. Starting Fiscal Year 2015, Anne Arundel County has enhanced their street sweeping program which now includes sweeping streets (curb-miles) and

parking lots within the Baltimore Harbor (Anne Arundel County DPW, 2015; Figure 10; Table 15). The program targets impaired watersheds and curbed streets that contribute trash/litter, sediment, nutrients, and other pollutants. The County is sweeping streets within the Baltimore Harbor watershed on a bi-weekly basis (26 times a year) using a regenerative air street sweeper to obtain full credit per MDE guidance.

Table 14: Current BMP Implementation through FY2015 for Baltimore Harbor Watershed

BMP	Unit	1995 Baseline	FY1996-FY2015 Restoration
Dry Ponds	acre	1,143.6	37.1
Extended Detention Dry Ponds	acre	284.7	44.7
Impervious Surface Reduction	acre	3.0	0.1
Infiltration	acre	235.8	3.8
Inlet Cleaning	no. of inlets	0	729
Outfall Enhancement with SPSC	acre	0	100.2
Permeable Pavement	acre	9.3	0
Street Sweeping (roads)[1]	curb-miles	0	96.1
Urban Stream Restoration	linear feet	0	500.0
Wet Ponds or Wetlands	acre	645.2	164.2

Source: WPRP urban BMP and WQIP database

[1]Includes curb-miles for arterial, collector, and local streets. All streets swept bi-weekly (26 times a year).

Table 15 – List of streets swept in Baltimore Harbor watershed

STREET	SQ FT	CURB MILES	CLASS
5th Ave SE		0.57	Arterial
Aero Dr		0.18	Collector
Alley 28		0.68	Local
Alley 44		0.65	Local
Arundel Mills Blvd		5.80	Arterial
Ashton Rd		0.92	Local
Barkwood Ct		0.18	Local
Cabover Dr		0.32	Collector
Candlewood Rd		3.00	Local
Cape Saint Claire Rd		0.20	Collector
Central Ave		0.22	Local
Charter Oaks Blvd		2.36	Collector
Charwood Rd		0.96	Local
Concourse Dr		0.46	Local
Connelley Dr		0.74	Collector
Corporate Blvd		1.78	Local
Dorsey Rd		1.54	Collector
Elkridge Landing Rd		2.56	Arterial

STREET	SQ FT	CURB MILES	CLASS
Fairview Ave		0.03	Local
Furnace Ave		0.20	Collector
Furnace Rd		0.50	Collector
Gibbons Ave		0.96	Local
Hammonds Ferry Rd N (included in Patapsco River Outfall)		1.13	Arterial
Hammonds Ln		0.84	Arterial
Harmans Rd		1.42	Arterial
Hoffman Ave		0.60	Local
International Dr		0.84	Local
Jacobs Rd		0.39	Collector
Jennifer Rd		2.39	Collector
Magellan Rd		0.88	Local
Mercedes Dr		0.46	Local
National Dr		0.20	Local
New Ridge Rd		3.32	Arterial
Old Elkridge Landing Rd		0.56	Arterial
Old Riverside Rd		0.93	Local
Oregon Ave		0.26	Local
Park Cir		0.60	Local
Parkway Dr		1.08	Local
Parkway Dr South		0.46	Local
Progress Dr		0.12	Local
Race Rd (South)		0.27	Arterial
River Rd		0.10	Collector
Shenandoah Ave		0.30	Local
Standard Dr		1.20	Local
Stewart Ave		1.25	Collector
W Nursery Rd (included in Patapsco River Outfall)		0.96	Arterial
Winterson Rd		1.66	Arterial
13th Ave		0.33	Local
5th Ave SW		0.77	Arterial
8th Ave NE		0.08	Local
8th Ave NW		0.94	Arterial
Airport Park Rd		0.54	Local
Aquahart Rd		1.90	Arterial
Baymeadow Dr		1.62	Arterial
Blades Ln		0.52	Local
Blue Ridge Dr		0.40	Collector
Blue Water Blvd		3.00	Local
Brandon Woods Blvd		0.24	Local

STREET	SQ FT	CURB MILES	CLASS
Cabot Dr		0.50	Local
Central District Odenton	28,429		
Central District St Margarets	54,941		
Chesapeake Center Dr		0.50	Collector
Chestnut Tree Dr		0.40	Collector
Cromwell Park Dr		1.56	Local
Curtis Ct		0.28	Local
Digiulian Blvd		0.40	Local
Dover Rd		0.84	Arterial
Dover Rd		0.58	Local
Energy Ct		0.24	Local
Energy Pky		1.02	Local
Furnace Branch Rd West		2.00	Arterial
Gambrills Cove Rd		0.50	Local
Hammonds Ferry Rd S		0.87	Arterial
Hospital Dr		3.70	Arterial
Jumpers Hole Rd		1.84	Arterial
Mae Wagner Rd		0.14	Local
Marley Neck Blvd		3.20	Arterial
Marley Station Rd		0.69	Arterial
Marshall Rd		1.30	Local
Mayo Rd		1.12	Arterial
McCormick Dr		0.86	Local
McLean Way		0.24	Local
Northern District Dover Rd	39,692		
Oak Ln NW		0.24	Arterial
Oakwood Rd		5.20	Arterial
Old Mill Blvd		1.70	Arterial
Oxbow Pl		2.46	Local
Park 100 Dr		0.52	Local
Penrod Ct		0.80	Local
Peppermill Dr		0.40	Local
Perryman Ct		0.36	Local
Resource Ct		0.20	Local
Severna Park Park & Ride	20,854		
Solley Rd		0.04	Arterial
Swan Creek Dr		0.82	Local
W Ordnance Rd		0.95	Arterial
Waterview Ct		0.28	Local
Wellham Ave		2.24	Arterial
Wellham Ave		0.30	Arterial
TOTALS	**143,916**	**96.1**	

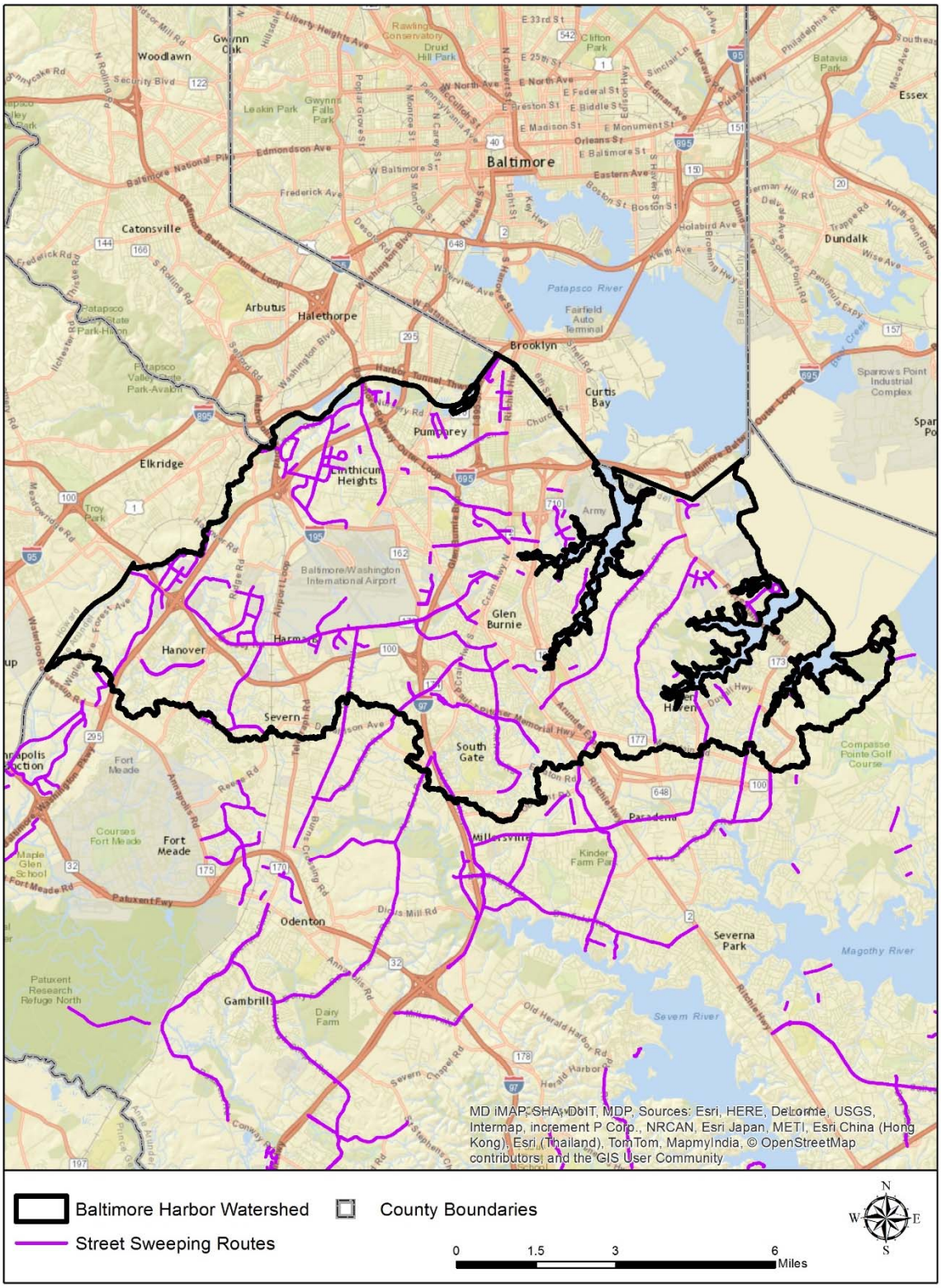


Figure 10: Street Sweeping Routes in Baltimore Harbor watershed

FY2015 Progress results are shown in Table 16. The implementation of FY2015 Progress BMPs listed in Table 14 has achieved 0.86% reduction of nitrogen and 2.03% of phosphorus loads.

Table 16: FY2015 Progress Reductions Achieved

Baseline Load and TMDL WLA	TN-EOS lbs/yr	TP-EOS lbs/yr
1995 Baseline Scenario Load	161,514	13,941
Required Percent Reduction	15.00%	15.00%
Required Reduction	24,227	2,091
Local TMDL WLA	137,287	11,850
FY2015 Progress Results	**TN-EOS lbs/yr**	**TP-EOS lbs/yr**
FY2015 Progress Scenario Load	160,130	13,658
FY2015 Progress Reduction Achieved	1,384	283
FY2015 Percent Reduction Achieved	0.86%	2.03%

5.2 Planned Implementation

Table 17 compares implementation of existing BMPs (FY2015 Implementation), planned levels of implementation through FY2030, as well as the cumulative total restoration BMPs for the watershed. This increase in implementation will achieve the loads required in the local TMDL by the end of FY2030. These loads meet the TMDL required reductions for the Baltimore Harbor watershed (Table 18).

Management strategies planned for the Baltimore Harbor include retrofitting existing BMPs and impervious surfaces using bioretention, infiltration, permeable pavement, or wet ponds and wetlands. The plan calls for installation of wet ponds and wetlands treating 749.5 acres for a total implementation of 913.7 acres by the end of FY2030. Other strategies relied upon heavily include urban stream restoration for just under 15 miles of stream, outfall enhancement using SPSC treating close to 3,000 acres, and non-structural BMPs including inlet cleaning and street sweeping. Details on specific projects included in full implementation are available in Appendix A. Inlet cleaning and street sweeping are on-going practices that will be repeated each year at the required frequencies to obtain the treatment credit annually over time.

Pollutant load reduction modeling results of planned implementation for projects currently identified by Anne Arundel County's CIP program and operation practices program (street sweeping and inlet cleaning) for Baltimore Harbor watershed resulted in a 6.23% reduction in nitrogen and 38.83% reduction in phosphorus. These results showed the 15% phosphorus reduction being met, but also the need for additional implementation above what was identified to date by Anne Arundel County's CIP and operational programs to meet the 15% reduction for nitrogen. Recommendations for additional treatment were taken from the Patapsco Tidal and Bodkin Creek Watershed Assessment Comprehensive Summary Report (Anne Arundel County, 2012b) to incorporate additional SPSC projects. The watershed assessment initially identified an additional 9,291 acres of potential SPSC projects at degraded outfall locations. Based on results of recent County feasibility studies, it was assumed that only 30% of that potential treatment would move forward after feasibility studies are completed for those sites. This

resulted in 2,878.3 acres of new SPSC treatment which was added to the modeled scenarios in this plan. This additional SPSC treatment would result in another 10.15% reduction in nitrogen (16.91% total), thereby meeting the 15% reduction required for the local TMDL. These additional acres of SPSC treatment were evenly distributed at the rate of 232.3 acres/year across future years from FY2019 through FY2030.

The majority of FY2030 planned management strategies incorporate CIP stormwater retrofits and outfall enhancement (SPSC) projects. Feasibility studies of the planned strategies may reveal that some existing structures identified for retrofitting or enhancement may not be feasible candidates for future projects and may be eliminated from consideration. The County will take an adaptive management approach and will reevaluate treatment needs as feasibility studies progress. The County will continue to track the overall effectiveness of the various BMP strategies and will adapt the suite of solutions based on the results. In addition, new technologies are continuously evaluated to determine if the new technologies allow more efficient or effective pollution control.

Figure 11 and Figure 12 show baseline and progress loads (green bars) and planned loads (yellow bars) compared to the Baltimore Harbor watershed Local TMDL WLAs (red bars and red line) for nitrogen and phosphorus, respectively. This comparison shows that both nitrogen and phosphorus WLAs will be treated to the required TMDL allocated load with current and future BMP implementation. This plan demonstrates that Anne Arundel County will meet its nutrient SW-WLA for the Baltimore Harbor watershed by the end of FY2030 for nitrogen and by the end of FY2020 for phosphorus.

Table 17: BMP Implementation - Current FY2015, Planned FY2030, and Total Restoration Levels for the Baltimore Harbor Watershed

BMP	Unit	FY1996-FY2015 Implementation	FY2016-FY2030 Planned	Total Restoration
Bioretention	acre	0	29.1	29.1
Dry Ponds	acre	37.1	0	37.1
Extended Detention Dry Ponds	acre	44.7	0	44.7
Impervious Surface Reduction	acre	0.1	0	0.1
Infiltration	acre	3.8	82.4	86.2
Inlet Cleaning	no. of inlets/yr	729	729	729
Outfall Enhancement with SPSC	acre	100.2	2,943.1	3,043.3
Permeable Pavement	acre	0	0	0
Street Sweeping (roads)[1]	curb-miles	96.1	96.1	96.1
Urban Stream Restoration	linear feet	500.0	78,671.0	79,171.0
Wet Ponds or Wetlands	acre	164.2	749.5	913.7

[1]Includes curb-miles for arterial, collector, and local streets. All streets swept bi-weekly (26 times a year).

Table 18: FY2030 Planned Reductions

Baseline Load and TMDL WLA	TN-EOS lbs/yr	TP-EOS lbs/yr
1995 Baseline Scenario Load	161,514	13,941
Required Percent Reduction	15.00%	15.00%
Required Reduction	24,227	2,091
Local TMDL WLA	137,287	11,850
FY2030 Planned Results	**TN-EOS lbs/yr**	**TP-EOS lbs/yr**
FY2030 Planned Load[1]	134,195	7,460
FY2030 Planned Reduction Achieved	27,319	6,481
FY2030 Percent Reduction Achieved	16.91%	46.49%

[1]FY2030 Planned load is the FY2030 Planned Reduction Achieved subtracted from the 1995 Baseline Loads. It is assumed that all new development will be treated with SW to the MEP implementation to achieve 50% nitrogen removal and 60% phosphorus removal and Accounting for Growth policies will address the remaining 50% and 40%, respectively.

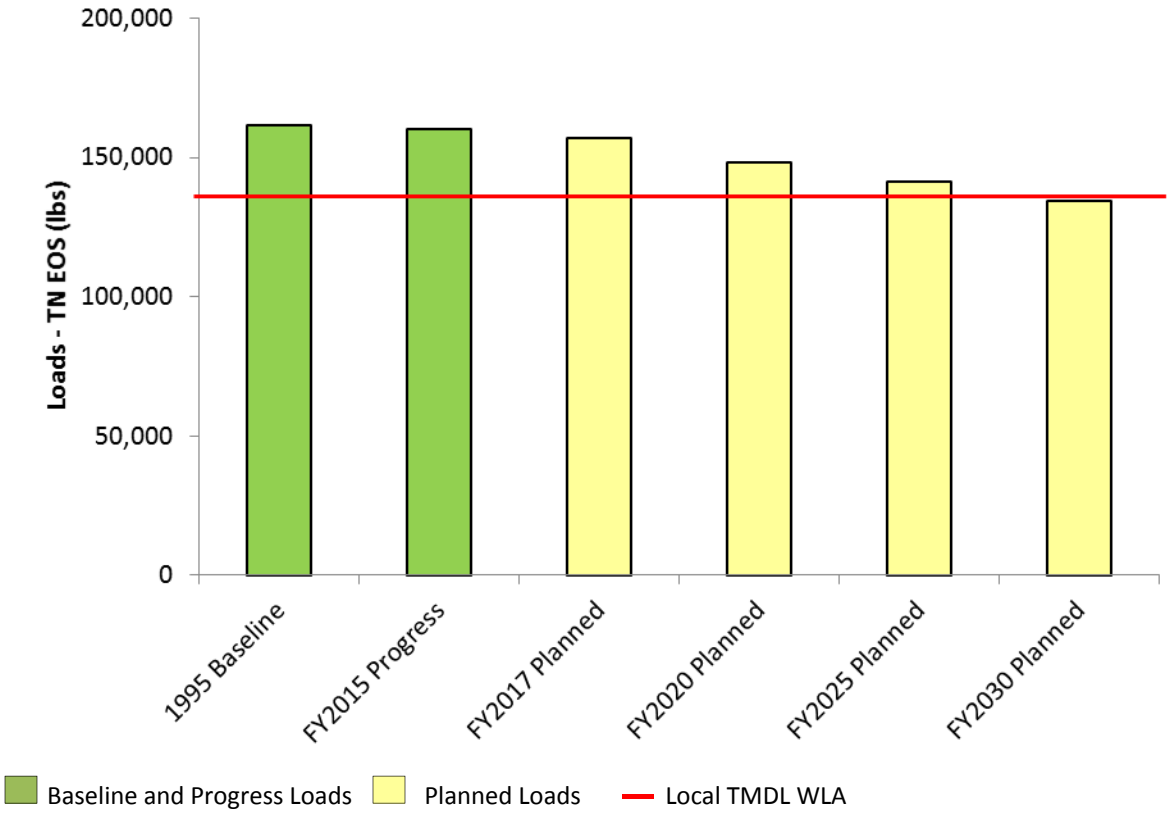


Figure 11: Progress and Planned Nitrogen Loads in the Baltimore Harbor Watershed

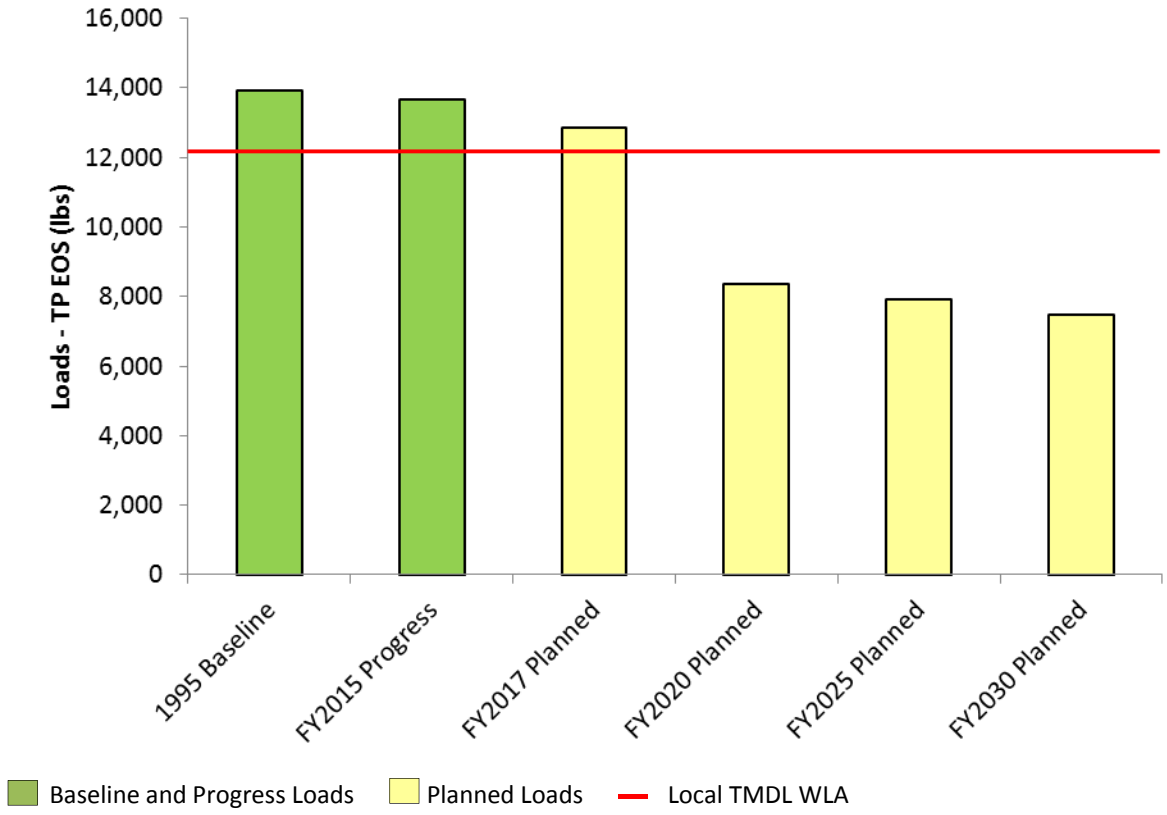


Figure 12: Progress and Planned Phosphorus Loads in the Baltimore Harbor Watershed

6 Technical and Financial Assistance Needs (d)

Technical Needs

Technical assistance to meet the reductions and goals of a TMDL takes on many forms including MDE assistance to local governments, state and local partner assistance to both MDE and municipalities, and technical consultants contracted to provide support across a wide variety of service areas related to BMP planning and implementation.

MDE has and will provide technical assistance to local governments through training, outreach and tools, including recommendations on ordinance improvements, technical review and assistance for implementation of BMPs at the local level, and identification of potential financial resources for implementation (MDE, 2014b).

Anne Arundel County DPW contracts with consultants through several contract vehicles including open-end task based assignments, to provide a variety of technical services. These services, provided by planners, engineers, environmental scientists and GIS specialists, include watershed assessment and management, stream monitoring, stormwater planning and design, stream restoration design, outfall enhancement, and environmental permitting, among others. The County itself has complementary staff in DPW and other County departments to manage contracts, provide review and approval of planning and design work, conduct assessments, and develop and administer planning and progress tracking tools.

Anne Arundel County has many partners that provide outreach to homeowners and communities in the form of technical assistance, education, and funding for implementation of best management practices within local communities. The Watershed Stewards Academy, further discussed in section 7: Public Participation/Education, routinely engages and informs the public on reducing pollution sources and employing stormwater/rainscaping retrofits to reduce their impacts.

Technical assistance for Public Participation and Education and for Monitoring will also be necessary to fully implement and track progress towards meeting the goals of the local TMDL. These elements are discussed in sections 7 and 10 of this plan.

Financial Needs

The total projected cost to implement the County's Capital Improvement Program (CIP) projects and operation practices program described in this plan for the Baltimore Harbor watershed is $121,765,030 including $2,064,130 towards outfall enhancements with SPSC, $11,641,990 towards stormwater pond retrofits, $781,328 for inlet cleaning, and $2,318,701 for street sweeping. Additional yet to be identified SPSC projects total an estimated $67,733,658. Planned structural BMP project costs are estimated using the average cost per acre treated based on a group of completed and budgeted projects consisting of similar BMP types. This included one stream restoration project that is currently in the conceptual design stages using $503 per linear foot of restoration, and the unidentified SPSC projects estimated at $24,300.81 per acre treated. Details for specific projects and associated costs are presented in Appendix A.

Non-structural BMP costs for inlet cleaning and street sweeping are based on current County contractor operating costs for those practices. Operating costs do not include the purchase and maintenance of street sweeping equipment. Inlet cleaning costs assumed each inlet required mechanical cleaning at $67 per inlet. Street sweeping costs are $58 per curb mile swept, or $116 dollars per mile when both sides of a street are swept. Annual costs for these programs in the Baltimore Harbor watershed are estimated at $48,833 per fiscal year for inlet cleaning and $144,919 per fiscal year for street sweeping. The annual values were extrapolated out for the number of years in each planning period in the table below.

Table 19 includes a summary of funding needs per project type. Project costs are inclusive of all project elements and include design, obtaining land ROW, construction, and County overhead/administrative costs. The costs are presented based on restoration planning periods out to FY2030. Projects and their related costs were grouped over time based on the period in which the project would be completed.

Table 19: Baltimore Harbor Watershed Local TMDL Restoration Cost Over Milestone Periods

Project type	FY2015	FY2016-FY2017	FY2018-FY2020	FY2021-FY2025	FY2026-FY2030	Total Cost
Outfall Stabilization - SPSC		$1,645,139	$418,991			$2,064,130
Additional unidentified SPSC projects				$39,510,693	$28,222,965	$67,733,658
					SPSC Subtotal	**$69,797,788**
SWM Pond Retrofit		$4,742,583	$6,899,407			**$11,641,990**
Stream Restoration	$114,422	$1,505,744	$35,605,057			**$37,225,223**

Project type	FY2015	FY2016-FY2017	FY2018-FY2020	FY2021-FY2025	FY2026-FY2030	Total Cost
Inlet Cleaning	$48,833	$97,666	$48,833	$341,830	$244,165	**$781,328**
Street Sweeping	$144,919	$289,838	$434,756	$724,594	$724,594	**$2,318,701**
					Grand Total	**$121,765,030**

6.1 Funding Sources

A major source of funding for the implementation of local stormwater management plans through stormwater management practices and stream and wetland restoration activities is the County's Watershed Protection and Restoration Fee. To comply with forthcoming requirements of the Phase I NPDES MS4 permit, and to support restoration efforts towards reducing pollutant loads required for both the Chesapeake Bay TMDL and local TMDLs throughout Maryland, the State Legislature passed a law in 2012 (House Bill 987) mandating that Maryland's 10 largest jurisdictions (those with Phase I MS4 permits), including Anne Arundel County, develop a Watershed Protection and Restoration Program and establish a Stormwater Remediation Fee. To comply with the State legislation, Anne Arundel County passed legislation in 2013, Bill 2-13.

The County's Stormwater Remediation Fee, which is termed the Watershed Protection and Restoration Fee is assessed to Anne Arundel County property owners based on the amount of impervious surface on their property and was included as a separate line item on the owner's real property tax bill. The fee is structured to provide sufficient funding for projects to meet the pollutant load reduction required by the Chesapeake Bay TMDL, EPA approved individual TMDLs with a SW-WLA and to meet the impervious surface management requirements as well as other stormwater obligations set forth in the County's NPDES MS4 Permit.

In 2015, the Maryland Legislature passed Senate Bill 863 (Watershed Protection and Restoration Programs – Revisions) which repealed House Bill 987 (Stormwater Management – Watershed Protection and Restoration Program). Senate Bill 863 removed the *requirement* that jurisdictions adopt the Stormwater Remediation Fee but did still allow for the jurisdictions to adopt and collect the fee. As a replacement of the stormwater remediation fee requirement, jurisdictions are now to develop financial assurance plans, due July 1, 2016, and every two years, that describe how stormwater runoff will be treated and paid for over the next five years to meet TMDL and impervious surface treatment requirements. Anne Arundel County's financial assurance plan was adopted by County Council on July 5th, 2016. The County is currently awaiting comment from MDE.

Prior to adoption of the Watershed Protection and Restoration Fee and, as stated in the Anne Arundel County Phase II WIP (Anne Arundel County, 2012a), the County's funding capacity to implement urban stormwater restoration/retrofit projects was limited by the County's CIP budget for environmental restoration and water quality improvement projects. Anne Arundel County actively pursues grant funding from Federal, State and non-governmental organizations (NGOs) to leverage funding for its restoration projects. The County has also developed a Grant Program to provide funding to local NGOs to facilitate implementation of restoration projects that further the County's ability to meet its regulatory requirements.

7 Public Participation / Education (e)

7.1 County Outreach Efforts

Anne Arundel County has given numerous public presentations throughout the development of the County's Phase II WIP in order to disseminate information on the Chesapeake Bay TMDL, WIP process, and strategies for meeting the County's assigned pollutant load reductions. In addition to providing a level of understanding to the public, the County uses the presentations as an opportunity to receive input and comment on restoration efforts. Anne Arundel County has a variety of organizations interested in water quality, including Severn River Association; South River Federation; Anne Arundel County Commercial Owners; Anne Arundel Watershed Stewards Academy; Anne Arundel County Chamber of Commerce, Environmental Committee; Leadership Anne Arundel; and, Chesapeake Environmental Protection Association (Anne Arundel County, 2012a).

In order to implement an effective strategy to meet water quality standards and achieve pollutant load reduction, an effort to engage a very broad audience of landowners was a necessity. The Anne Arundel Watershed Stewards Academy (AAWSA), a pre-eminent non-profit 501(c)(3) environmental organization, was formed through Anne Arundel County Department of Public Works and the County Board of Education's Arlington Echo Outdoor Education Center (Anne Arundel County, 2012a). AAWSA's mission is to identify, train, and support citizens to become Master Watershed Stewards who take action with their neighbors to restore local waterways in Anne Arundel County. This program is a unique way to integrate education as a vital element in its role in preservation, conservation and advocacy. There are currently more than 100 certified Master Watershed Stewards throughout Anne Arundel County and adjacent areas.

The AAWSA has extensive resources through the Consortium of Support Professionals which is composed of over 80 governmental, non-profit and business professionals who provide technical assistance to Master Watershed Stewards. Consortium members are experts in their field of conservation, ecology, government laws, landscape architecture, low impact design, water quality monitoring, and watershed assessment and provide consulting on design and development of watershed restoration projects. The AAWSA is also supported by staff that provides day to day guidance to Master Watershed Stewards, connecting Stewards to Anne Arundel County resources, coordinating Stewards certification, post certification professional development, and networking opportunities for Stewards and Consortium of Support Professionals.

The AAWSA has an interactive website (www.aawsa.org) that provides guidance to common water quality problems including information on the following:

- Reduce Your Pollution
    - Practice Bay-Friendly Lawn Care
    - Maintain and Upgrade your Septic System
    - Pick Up Pet Waste
    - Choose Non-Toxic Household Products
    - Maintain your Car and Boat
    - Reduce your Energy Use
- Capture Stormwater
    - Install a Rain Barrel or Cistern
    - Build a Rain Garden
    - Choose to Have Conservation Landscapes

  - Plant Native Trees
  - Direct Water with Swales and Berms
  - Use Permeable Pavers and Pavement
- Clean Up!
  - Invasive Species Removal
  - Dump Site Cleanup
- Conserve and Preserve
  - Land Preservation

These programs and others like them could be more focused on the Baltimore Harbor watershed.

In addition to the AAWSA, the following organizations have been identified for possible partnerships and education and outreach for the Baltimore Harbor watershed:

- Master Gardeners
- Audubon Society
- Students for the Environment
- Maryland civic associations and service clubs:
  - Maryland Home Builders Assoc.
  - Audubon Naturalist Society of the Central Atlantic States
  - Audubon Society of Central Maryland
  - Blue Water Baltimore
  - Chesapeake Audubon Society
  - Chesapeake Bay Program
  - Chesapeake Bay Foundation
  - Chesapeake Bay Trust
  - Chesapeake Ecology Center
  - Center for Watershed Protection
  - Alliance for the Chesapeake Bay
  - Alliance for Sustainable Communities
  - Baywise Master Gardeners
  - Sierra Club – Maryland Chapter
  - Nature Conservancy
  - Smithsonian Environmental Research Center
  - Anne Arundel Community College
  - University of Maryland
  - University of Maryland Extension
  - Volunteer Center for Anne Arundel County

WPRP also provides public outreach tools through web and social media platforms. WPRP has developed a comprehensive web-based informational program including a dedicated webpage, Facebook page, and Twitter account to provide information to the public. WPRP's website (www.aarivers.org) offers valuable information on Anne Arundel County watersheds including an interactive clickable map that displays geographically referenced environmental, utility, and land use data in addition to restoration project locations, descriptions, and drainage areas. This outreach platform is also used to notify the public of the opportunity to review and comment on this and other TMDL restoration plans.

7.2 Public Comment Period

Part 4.E.3 of the County's NPDES MS4 permit outlines requirements for public involvement in the development of TMDL restoration plans. The County fulfilled these requirements by providing notice in *The Capital* and *Maryland Gazette* newspapers, which serve all of Anne Arundel County, detailing how the public may obtain information on the plan and provide comments. The County made the reports available for review on the WPRP website at www.aarivers.org and made copies of the restoration plan available at the County office to parties upon request. The County provided for a minimum 30-day comment period from September 28, 2016 to October 28, 2016 before finalizing the plan. No public comments were received at the end of the 30-day review period. Appendix B includes documentation of the public review period notices.

8 Implementation Schedule and Milestones (f & g)

This section presents the activities and target load reductions with milestone intervals out to the FY2030 final loads and implementation target year. The following schedule and milestones generally follow the Chesapeake Bay TMDL milestone date framework with two and three year intervals used in the near term, FY2025 used to align with the Chesapeake Bay TMDL implementation date and FY2030 as the final. This schedule framework has previously been approved by the CBP for the applicable Bay TMDLs and is believed to be a good option for tracking progress towards reduction goals of the Baltimore Harbor watershed local TMDL.

8.1 Implementation Milestones

To meet the loading allocations and milestones outlined in the previous section, implementation of programs and BMPs must keep pace and meet planned implementation targets. Table 20 details the implementation for each tracked BMP with the associated unit of measure. The FY2015 data reflects restoration BMPs installed after the local TMDL baseline year (6/30/1995) while the FY2016-FY2017, FY2018-FY2020, FY2021-FY2025, and FY2026-FY2030 values reflect the planned implementation for those periods.

The majority of FY2030 planned management strategies incorporate CIP stormwater retrofits and outfall enhancement projects. Specific CIP projects are currently identified through FY2020. Additional projects above what are planned through FY2020 will be necessary to meet the nutrient reductions specified in the Baltimore Harbor watershed nutrient TMDL. As site specific projects after FY2020 are not yet identified, amounts of restoration BMPs recommended from the Patapsco Non-Tidal Watershed Assessment and the Patapsco Tidal and Bodkin Creek Watershed Assessment (Anne Arundel County, 2011 and 2012b) were used to meet the planned reductions by the end of FY2030. It was assumed that only 30% of the recommended BMPs from the assessments would be feasible for implementation. Feasibility studies of the planned strategies may reveal that some existing structures identified for retrofitting or enhancement may not be feasible candidates for future projects and may be eliminated from consideration. The County will take an adaptive management approach and will reevaluate treatment needs as feasibility studies progress. The County will continue to track the overall effectiveness of the various BMP strategies and will adapt the suite of solutions based on the results. In addition, new technologies are continuously evaluated to determine if the new technologies allow more efficient or effective pollution control.

Table 20: Baltimore Harbor Watershed Planning Milestones for Implementation –Restoration after 6/30/1995

BMP	Unit	FY1996-FY2015 Implementation	FY2016-FY2017 Planned	FY2018-FY2020 Planned	FY2021-FY2025 Planned	FY2026-FY2030 Planned	Total Implementation
Bioretention	acre	0	29.1	0	0	0	29.1
Dry Ponds	acre	37.1	0	0	0	0	37.1
Extended Detention Dry Ponds	acre	44.7	0	0	0	0	44.7
Impervious Surface Reduction	acre	0.1	0	0	0	0	0.1
Infiltration	acre	3.8	82.4	0	0	0	86.2
Inlet Cleaning	no. of inlets/yr	729	729	729	729	729	729
Outfall Enhancement with SPSC	acre	100.2	155.7	464.6	1,161.4	1,161.4	3,043.3
Permeable Pavement	acre	0	0	0	0	0	0
Street Sweeping (roads)[1]	curb-miles	96.1	96.1	96.1	96.1	96.1	96.1
Urban Stream Restoration	linear feet	500.0	6,000.0	72,671.0	0	0	79,171.0
Wet Ponds or Wetlands	acre	164.2	694.4	55.1	0	0	913.7

[1]Includes curb-miles for arterial, collector, and local streets. All streets swept bi-weekly (26 times a year).

8.2 Loading Allocations and Milestone Targets

Planning loads for FY2017, FY2020, FY2025, and FY2030 for the Baltimore Harbor watershed are presented in Table 21 below. As mentioned in section 5: Expected Load Reductions (b) (see Tables Table 14 and Table 17), progress is already underway with the implementation of strategies throughout the watershed. As shown in Table 21, Anne Arundel County will meet its nutrient SW-WLA for the Baltimore Harbor watershed by the end of FY2030 for nitrogen and by the end of FY2020 for phosphorus.

Table 21: Baltimore Harbor Watershed Planning and Target Loads (edge-of-stream loads)

	Nitrogen (lbs/year)	Phosphorus (lbs/year)
1995 Baseline Loads	161,514	13,941
FY2015 Progress Loads	160,130	13,658
FY2015 Progress Reductions	1,384	283
FY2017 Planned Loads*	156,718	12,842
FY2017 Planned Reductions	4,796	1,099
FY2020 Planned Loads*	148,308	8,356

	Nitrogen (lbs/year)	Phosphorus (lbs/year)
FY2020 Planned Reductions	13,206	5,585
FY2025 Planned Loads*	141,157	7,908
FY2025 Planned Reductions	20,357	6,033
TMDL Allocated Loads	137,287	11,850
FY2030 Planned Loads*	134,195	7,460
FY2030 Planned Reductions	27,319	6,481
Required Percent Reduction	15.00%	15.00%
Planned Percent Reduction Achieved	16.91%	46.49%

*FY2017, FY2020 and FY2030 planned loads are calculated by subtracting planned restoration nutrient reductions from the 1995 Baseline Load. It is assumed that all new development will be treated with SW to the MEP implementation to achieve 50% nitrogen removal and 60% phosphorus removal and Accounting for Growth policies will address the remaining 50% and 40%, respectively.

8.3 Implementation Priorities

To meet the loading allocations and milestones outlined in the previous sections, implementation will be planned based on prioritization analyses presented in the Patapsco Non-Tidal Watershed Assessment (Anne Arundel, 2011) and the Patapsco Tidal and Bodkin Creek Watershed Assessment (Anne Arundel, 2012b). Baltimore Harbor subwatersheds were prioritized for restoration/retrofit project selection potential using four separate prioritization models. The models integrated historical environmental data, current stream assessment monitoring data, drainage area characteristics (GIS data), and watershed modeling results into indicators of watershed condition and need. The indicators are combined into the four models:

- Stream Reach Restoration
- Subwatershed Restoration
- Subwatershed Preservation
- Parcel Preservation

The models were designed to operate at three management scales, first at the individual stream reach scale, second at the subwatershed scale, and lastly at the parcel scale. Additionally the models differentiated between identification of restoration opportunities for the degraded portions of the watershed (reach and subwatershed scale), and identification of preservation opportunities (subwatershed and parcel scale) for high quality sensitive areas that could be subject to additional stressors in future scenarios. For the purpose of this restoration plan, prioritization results for Stream Reach Restoration and Subwatershed Restoration are presented below to address in-stream sources and urban stormwater runoff, respectively.

8.3.1 Stream Reach Restoration

The stream restoration prioritization uses a suite of indicators that are weighted and then combined into a final relative rating for each perennial reach as identified in the Physical Habitat Condition Assessment. The suite of stream restoration indicators used in the Baltimore Harbor watershed, along with the indicator weight is presented in Table 22.

Table 22: Stream Restoration Assessment Indicators (Anne Arundel County, 2011 and 2012b)

Category	Indicator	Weight
Stream Habitat	2003 MPHI score	31.6%
Stream Morphology	Rosgen Level I classifications	5.3%
Land Cover	Percent Imperviousness	5.3%
Infrastructure	Buffer impacts	5.3%
	Erosion impacts	10.5%
	Head cut impacts	5.3%
	Dump site impacts	5.3%
	Other infrastructure impacts (pipes, ditches, crossings, and obstructions)	15.8%
Hydrology and Hydraulics	Road Crossing flooding potential	15.8%

A total of 484 reaches (142 in Patapsco Non-Tidal Watershed, 342 in Patapsco Tidal Watershed) were processed in the stream restoration model. Thirty-seven (9 in Patapsco Non-Tidal Watershed, 28 in Patapsco Tidal Watershed) reaches were categorized as "High" priority or worst condition, 90 (31 in Patapsco Non-Tidal Watershed, 59 in Patapsco Tidal Watershed) were "Medium High", 184 (48 in Patapsco Non-Tidal Watershed, 136 in Patapsco Tidal Watershed) were "Medium", and 173 (54 in Patapsco Non-Tidal Watershed, 119 in Patapsco Tidal Watershed) were "Low" priority or best condition (Table 23 and Figure 13). The Deep Run subwatersheds (PNA, PNC) ranked as a very high priority for Patapsco Non-Tidal Watershed, as seven of the nine "High" reaches and 13 of the 31 "Medium High" reaches are located in Deep Run. Deep Run contains 36.4% of the "High" and "Medium High" reaches in the Patapsco Non-Tidal Watershed. For the Patapsco Tidal Watershed, Marley Creek subwatersheds (PT8, PTE, PTF, and PTG) contained 39.3% of the "High" and 37.3% of the "Medium High" priority ranked reaches.

Table 23: Stream Restoration Assessment Results (Anne Arundel County, 2011 and 2012b)

Subwatershed	Number of Reaches with Priority Rating			
	High	Medium High	Medium	Low
Patapsco Non-Tidal				
PN1	0	0	0	1
PN2	0	0	1	1
PN3	0	0	0	0
PN4	0	0	5	0
PN5	0	1	4	1
PN6	0	1	1	2
PN7	0	0	4	6
PN8	1	8	6	0
PN9	1	2	6	5

Subwatershed	Number of Reaches with Priority Rating			
	High	Medium High	Medium	Low
PNA	1	4	1	0
PNB	0	6	8	16
PNC	6	9	12	22
Patapsco Tidal				
PT0	0	3	11	31
PT2	2	4	2	1
PT3	9	7	4	4
PT4	0	0	1	1
PT5	0	4	5	9
PT6	0	1	1	1
PT7	2	11	17	11
PT8	2	3	7	3
PT9	0	1	4	0
PTB	4	3	20	10
PTC	0	0	6	1
PTD	0	3	13	22
PTE	0	0	1	0
PTF	4	11	7	4
PTG	5	8	35	19
PTM	0	0	2	2
Total	**28**	**69**	**184**	**173**

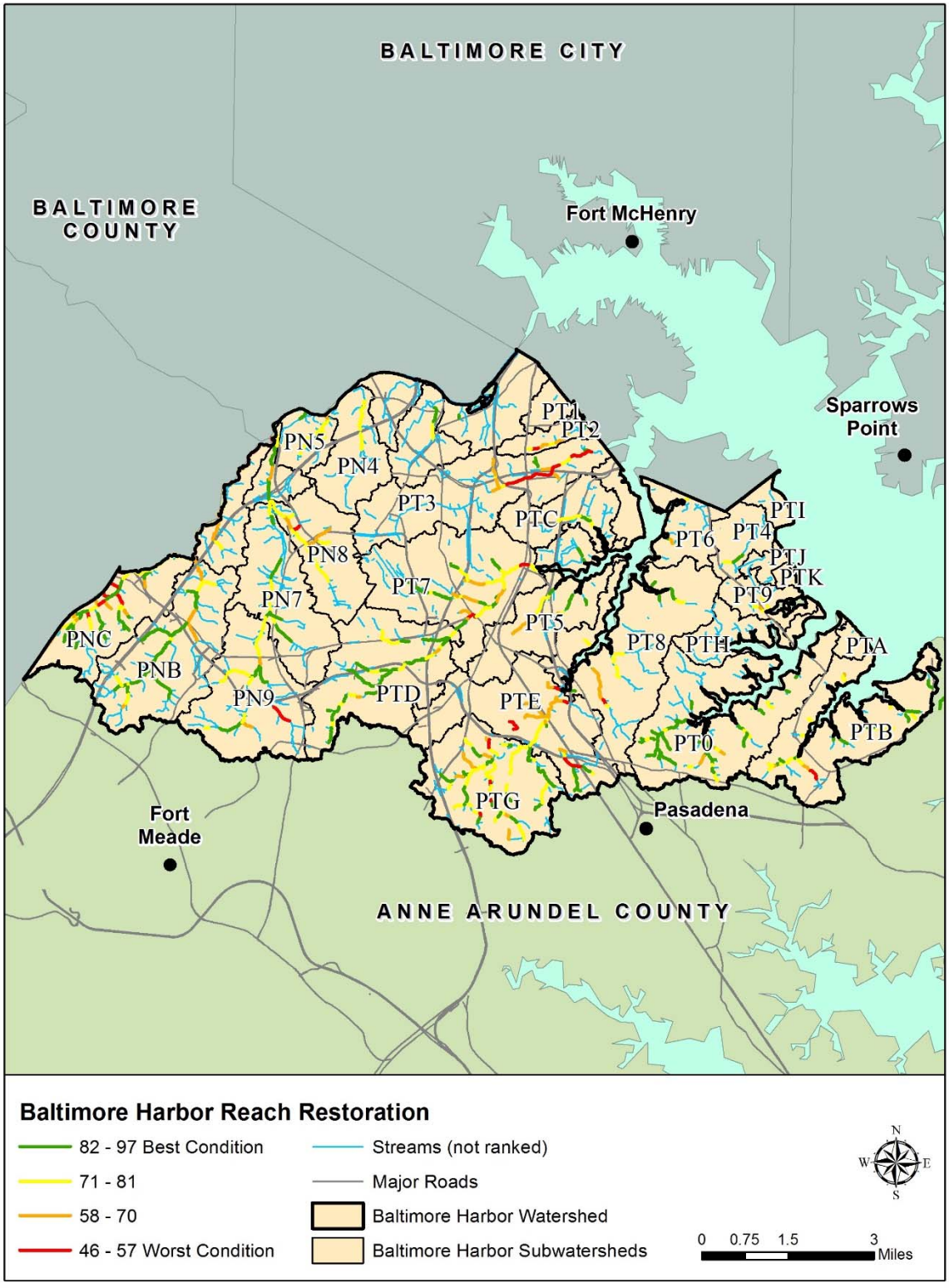


Figure 13: Stream Reach Priorities for Restoration (Anne Arundel County, 2011 and 2012b)

8.3.2 Subwatershed Restoration

Similarly to the stream restoration assessment, the subwatershed assessment used a collection of restoration indicators to assign a rating to each subwatershed. The indicators were weighted and combined into a single restoration rating for each subwatershed. Restoration indicators fell into one of six categories: stream ecology, TMDL impairments, On-site Disposal Systems (OSDS), BMPs, Hydrologic and Hydraulic (H&H) Modeling, Water Quality, and Landscape. Each category contains one to four different indicators. Table 24 provides a summary of the categories, indicators, and relative weighting assigned by the County.

Table 24: Subwatershed Priority Rating Indicators for Restoration (Anne Arundel, 2011 and 2012b)

Category	Indicator	Weight
Stream Ecology	Final habitat score	8.1%
	Bioassessment score	8.1%
303(d) List	Number of TMDL impairments	8.1%
OSDSs (Septics)	Nitrogen Loads from septics (lbs)	2.0%
BMPs	Impervious area treated by BMPs (%)	6.4%
H&H (Land and Soils only)	Peak flow from 1-year storm event (cfs/acre)	4.4%
	Peak flow from 2-year storm event (cfs/acre)	4.4%
	Runoff volume from 1-year storm event (inches/acre)	5.6%
	Runoff volume from 2-year storm event (inches/acre)	5.6%
Water Quality (Land only)	Nitrogen load from runoff (lbs/acre/yr)	6.7%
	Phosphorus load from runoff (lbs/acre/yr)	6.7%
	Total Suspended Solids from runoff (Tons/acre/yr)	0.0%
Landscape	Impervious cover (%)	9.3%
	Forest within the 100 ft stream buffer (%)	10.1%
	% of existing wetlands to potential wetlands	9.3%
	Acres of developable critical area	5.2%

The final ratings range from “Lowest Priority for Restoration” to “Highest Priority for Restoration” where “Lowest Priority” indicates that a subwatershed is a low priority for restoration and therefore in good condition whereas “Highest Priority” indicates that a subwatershed should be a priority for restoration. The Patapsco Mainstem (PN1), Back Creek (PTC), Cabin Branch (PT3), Furnace Creek (PT5), Marley Creek (PTE and PTF), and Sawmill Creek (PT7) subwatersheds were rated the highest priority for restoration. Seven subwatersheds were rated the lowest priorities for restoration (Figure 14); PNA, PNC, PN7, PTN, PTO, PTP, and PT4. It is also important to focus restoration efforts in subwatershed that ranked highest for existing TN and TP loads from urban runoff, which include subwatersheds PNB, PNC, PN8, PN9, PTO, PT7, PTF, and PTG (Figure 6, Figure 7).

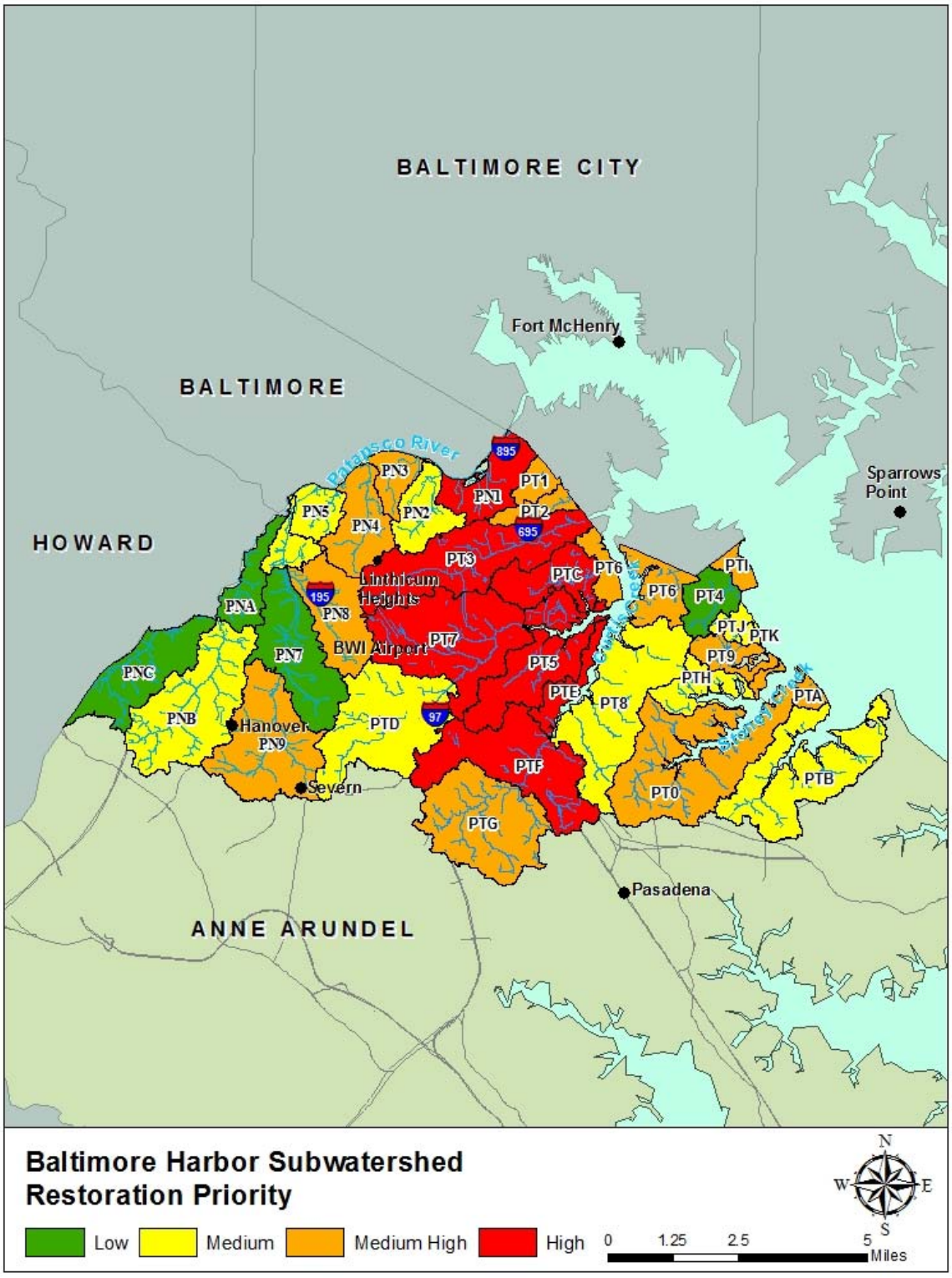


Figure 14: Subwatershed Priorities for Restoration (Anne Arundel County, 2011 and 2012b)

8.3.3 Prioritization of Strategy Implementation

As stated in the Anne Arundel County's Phase II WIP, the County uses three major categories to classify urban stormwater strategies: Core Strategy Tier I, Core Strategy Tier II, and Potential Load Reductions Outside the Tier I and Tier II Core Strategy (Anne Arundel County, 2012a). BMP planning and implementation will be prioritized based on these three categories with highest priority given to Tier I and Tier II strategies.

Core Urban Stormwater Strategy Tier I includes the following:

- Restoration of ephemeral and perennial streams with a Maryland Department of Natural Resources (DNR) Maryland Biological Stream Survey's (MBSS) Maryland Physical Habitat Index (PHI) score of severely degraded or degraded,
- Implementing stormwater management treatment at currently untreated major pipe outfalls; and,
- Retrofitting stormwater management ponds built prior to 2002 to optimize the pollutant reduction and ecosystem functions for the facilities

Core Urban Stormwater Strategy Tier II includes additional pollutant reduction activities that must be implemented to meet the 2025 allocations; which includes the following:

- Monthly vacuum assisted street sweeping and associated inlet cleaning for all closed section roads,
- Reforestation plan for available public open space land; and,
- SW to the MEP retrofits for County-owned properties including recreation areas

Potential Load Reductions Outside the Tier I and Tier II Core Strategies include the following:

- Focuses on the work of private citizens and Watershed Master Stewards in implementing SW to the MEP for residential rooftops, in high density areas, and for private commercial and industrial properties.
- These areas have been selected geographically outside the area treated by the WIP core strategy.

9 Load Reduction Evaluation Criteria (h)

Adaptive management is a critical component of achieving and maintaining the Baltimore Harbor watershed nitrogen and phosphorus TMDLs and this restoration plan. The milestones proposed in section 8: Implementation Milestones (FY2017, FY2020, FY2025, and FY2030) provide interim planning targets. The planning targets will be used to reevaluate against progress and will be revised, if necessary, to ensure that Anne Arundel County continues to maintain TMDL requirements. 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.

9.1 Tracking Implementation of Management Measures

Implementation will be measured by determining whether the targets for implementation shown in Table 20 are maintained according to the milestone schedule presented. Anne Arundel County manages a comprehensive system for adding and tracking projects and accounting for new programs. New BMPs constructed through new development and redevelopment projects are entered into the County's BMP database as they come on line. WPRP is responsible for implementing and tracking Water Quality

Improvement Projects (WQIP; i.e., restoration and retrofit projects and programs). Additional internal County groups including Bureau of Highway Road Operation Division who are responsible for maintenance efforts (i.e., street sweeping and inlet cleaning) report back to WPRP. Another way the County is capturing and tracking projects is through the AAWSA. Stewards enter their data via the Watershed Stewards Academy website www.aaswa.org. Once these data are reviewed and validated by the County, they are incorporated into the County's master list of environmental restoration projects.

The majority of FY2030 planned management strategies incorporate CIP stormwater retrofits and outfall enhancement projects. Specific CIP projects are currently identified through FY2020. Additional projects above what are planned through FY2020 will be necessary to meet the nutrient reductions specified in the Baltimore Harbor watershed nutrient TMDL. Feasibility studies of the planned strategies may reveal that some existing structures identified for retrofitting or enhancement may not be feasible candidates for future projects and may be eliminated from consideration. The County will take an adaptive management approach and will reevaluate treatment needs as feasibility studies progress. The County will continue to track the overall effectiveness of the various BMP strategies and will adapt the suite of solutions based on the results. In addition, new technologies are continuously evaluated to determine if the new technologies allow more efficient or effective pollution control.

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 is required to report two-year milestones representing near-term commitments and progress to MDE 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 is 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).

Annual NPDES Reporting

As a requirement of the NPDES permit described in section 2.4.4, the County must submit on or before the anniversary date of the permit 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:

a. 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

b. A narrative summary describing the results and analyses of data, including monitoring data that is accumulated throughout the reporting year

c. Expenditures for the reporting period and the proposed budget for the upcoming year

d. A summary describing the number and nature of enforcement actions, inspections, and public education programs

e. 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,

f. The identification of any proposed changes to the County's program when WLAs are not being met

g. 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 Reporting

The County's Financial Assurance Plan (FAP) outlines the County's financial ability to meet its local and Chesapeake Bay TMDL obligations. The FAP demonstrates the County's ability to fund projects which

will reduce pollutants of concern and make measureable progress towards improving water quality. Anne Arundel County's first FAP was submitted to MDE in July of 2016, and will be updated every two years.

9.2 Estimating Load Reductions

Progress assessments are scheduled by the Chesapeake Bay Program for 2017 and 2021. At this time, multiple lines of evidence including: several models, monitoring data, and the most recent science on BMP effectiveness and water quality response will be evaluated. The milestones and progress assessments will contribute to constant reassessment of management plans, and adapting 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 at interim (even years) and milestone (odd years) points in time, which equates to about once a year at minimum.

9.3 Tracking Overall Program Success through Monitoring

Overall program success will be evaluated using trends identified through the long term monitoring program described below in section 10: Monitoring. TMDL compliance status will be evaluated to determine if the restoration plan needs to be updated. If it is found during the evaluation of BMP implementation and load reductions that the milestone targets are no longer being met, a revision of the plan may be necessary.

9.4 Best Management Practices Inspection and Maintenance

Anne Arundel County has established policies and procedures in place for stormwater management facility inspection, maintenance and enforcement.

Background

Both the State and County Stormwater Management (SWM) Codes require maintenance inspections be performed on all SWM practices during the first year of operation and every 3 years thereafter. The first year of operation inspections are performed by the Environmental Control Inspectors before Certificates of Completion is issued for the grading permits under which the practices were constructed. The 3-year maintenance inspections are the responsibility of the WPRP inspection staff.

Phase 1 Inspection and Enforcement

Phase 1 reflects the first time a SWM practice receives a 3-year maintenance inspection and maintenance is required. Using the proper Maintenance Inspection Checklists the Inspector performs the required 3-year maintenance inspection indicating on the Checklist boxes if maintenance is required, not required or the item is non-applicable. The information on the completed Checklist will serve to comply with the inspection requirements of COMAR 26.17.02.11 and be used to complete a Phase 1 Correction Notice issued in the field or mailed to the property owner. The Phase 1 Correction Notices shall be prepared using the Inspections and Permits (I&P) standard computerized inspection report software, contain a detailed description of the maintenance required and the compliance date by which the required maintenance is to be completed. If necessary Phase 1 Correction Notices can be completed by hand using the standard Environmental Programs Inspection Report Form. Phase 1 Correction Notices shall contain the proper contact information, be written in a clear and concise fashion with no speculation, editorial comments or superfluous information. The Urban BMP Database shall be updated to show a 3-year Maintenance Inspection was performed. For monthly reporting purposes, all re-inspections shall only be recorded as inspections and not as facilities inspected or as new correction

notices issued. Depending on the degree of maintenance required, a Compliance Schedule may be appropriate. All proposed Compliance Schedules must be authorized by the WPRP Supervisor.

Phase 2 Inspection and Enforcement

Phase 2 reflects situations where Phase 1 Enforcement was not successful in obtaining compliance. Phase 2 Enforcement consists of a formal Phase 2 Violation Notice in the form of a certified letter to the property owner or responsible party. The Phase 2 Violation Notice shall be prepared by the WPRP Inspector using the appropriate form letter, reviewed by the WPRP Supervisor/Environmental Code Administrator as appropriate and signed by the WPRP Supervisor. The Phase 2 Notice shall establish final compliance dates for the completion of the required maintenance. The final compliance dates may reflect agreed upon Compliance Schedules as authorized by the WPRP Supervisor.

Phase 3 Inspection and Enforcement

Phase 3 reflects situations where Phase 2 Enforcement was not successful in obtaining compliance. Phase 3 enforcement consists of a legal referral to the Office of Law for the enforcement of the Private Inspection and Maintenance Agreement recorded against the deed for the property in question. The referral shall be prepared by the Environmental Code Administrator using the records associated with the violation.

10 Monitoring (i)

Official monitoring for Integrated Report assessments and impairment status is the responsibility of the State; however, the County has many on-going monitoring programs that can support the State's efforts. Anne Arundel County's WPRP has several on-going monitoring programs that target measures of water quality and ecological health. These programs are described here.

Countywide Biological Monitoring

In 2004, a Countywide Biological Monitoring and Assessment Program for Anne Arundel County, Maryland was developed to assess the biological condition of the County's streams at multiple scales (i.e., site-specific, primary sampling unit (PSU), and countywide). Under the Countywide Biological Monitoring and Assessment program, biology (i.e., benthic macroinvertebrates) and stream habitat, as well as geomorphological and *in situ* water quality parameters, are assessed at approximately 240 sites throughout the entire County over a 5-year period using a probabilistic, rotating-basin design. Round One of the County's Biological Monitoring and Assessment Program occurred between 2004 and 2008, and Round Two took place between 2009 and 2013. Round Three is scheduled to begin 2017.

The biological monitoring program's stated goals are applicable at three scales; Countywide, Watershed-wide, and Stream-specific, and include the following components.

- Status: describe the overall stream condition
- Trends: how has the overall stream condition changed over time
- Problem identification/prioritization: identify the impaired and most degraded streams
- Stressor-response relationships: identify anthropogenic stressors and their biological response
- Evaluation of environmental management activities: monitor the success of implemented programs and restoration/retrofit projects

The Baltimore Harbor watershed is made up of five PSUs; Piney Run, Stony Run, Lower Patapsco, Sawmill Creek, and Marley Creek. Ten sampling sites were sampled in each of these PSUs in each round of sampling. Methodologies follow those used by MBSS for the biological sampling (benthic macroinvertebrates only) and habitat evaluations have included both MBSS's Physical Habitat Index (PHI) and the EPA's Rapid Bioassessment Protocol (RBP) metrics. In-situ water quality measures are also collected at each site along with a geomorphic evaluation utilizing cross-sections, particle substrate analysis using pebble counts, and measures of channel slope.

In addition to collecting the parameters described above, the County may add water quality sampling at each site to the Round Three monitoring initiative. Potential parameters, which include the analysis of nutrient levels, are listed below:

- Total Nitrogen (TN)
- Ammonia (NH3)
- Ammonium (NH4)
- Nitrate (NO3)
- Nitrite (NO2)
- Total Phosphorus (TP)
- Phosphate (PO4)
- Dissolved organic carbon (DOC)
- Total organic carbon (TOC)
- Copper
- Lead
- Zinc
- Chloride

Results summarized at the PSU scale with mean BIBI and habitat ratings (PHI and RBP) are presented in Table 25.

Table 25: Countywide Biological Monitoring Results for Baltimore Harbor Watershed

PSU Name	Round	PSU Code	Year Sampled	Drainage Area (acres)	BIBI Rating	PHI Rating	RBP Rating
Piney Run	1	1	2007	4,868	P	D	PS
Piney Run	2	1	2009	4,868	P	PD	PS
Stony Run	1	2	2007	6,203	P	D	PS
Stony Run	2	2	2010	6,203	P	PD	S
Lower Patapsco	1	3	2004	4,040	P	PD	PS
Lower Patapsco	2	3	2012	4,040	P	PD	NS
Sawmill Creek	1	4	2008	11,044	VP	D	PS
Sawmill Creek	2	4	2010	11,044	P	D	PS
Marley Creek	1	5	2006	19,425	P	D	PS
Marley Creek	2	5	2009	19,425	VP	D	PS

BIBI Ratings: G = Good, F = Fair, P = Poor, VP = Very Poor

PHI Ratings: MD = Minimally Degraded, PD = Partially Degraded, D = Degraded, SD = Severely Degraded

RBP Ratings: C = Comparable, S = Supporting, PS = Partially Supporting, NS = Non-Supporting

Restoration Monitoring

To evaluate management activities, the County uses assessment methods similar to the Countywide program (biological monitoring, water chemistry sampling, physical habitat, geomorphic evaluation) to assess baseline and post-restoration conditions for select stream, wetland and stormwater restoration and retrofit sites. In addition, these techniques are utilized to meet several NPDES MS4 permit monitoring requirements, particularly related to Assessment of Controls and Watershed Restoration Assessment.

Watershed Assessment

In 2001, Anne Arundel County initiated a series of systematic and comprehensive watershed assessments and management plans for restoration and protection across the County. The plans are developed within a regulatory context that includes NPDES MS4 requirements, local TMDLs and Watershed Implementation Plans for the Chesapeake Bay TMDL, Maryland Stormwater Regulations and the Water Resources Element of the County's General Development Plan.

Biological monitoring is a component of the characterization and prioritization process within the management plans. The biological monitoring data is primarily utilized in the County's Watershed Management Tool (WMT), which is developed and maintained by the WPRP. Within this program, sampling sites are selected using a targeted approach with the goal of having at least one, and sometimes two sites located within each subwatershed planning unit in order to examine the relationships between land use and ecological conditions downstream. Monitoring components include benthic macroinvertebrate community sampling, *in situ* water chemistry measurements, and instream and riparian physical habitat condition assessments. Water quality grab sampling and detailed geomorphic assessments have been included for some watershed studies, but not as routine monitoring components.

The Watershed Assessment and Planning program's stated goals include:

- Characterize subwatersheds;
- Prioritize subwatersheds for preservation and restoration; and
- Inform stressor-response relationships for planning and modeling.

The County continues to reevaluate its monitoring programs as the state of the science progresses, as the understanding of water quality and ecological interactions are improved, and as regulatory programs are added or modified. The WPRP is currently reviewing the Countywide monitoring program to ensure that the methods used are appropriate and meaningful, and that TMDL and NPDES requirements continue to be met.

11 References

Anne Arundel County. 2009. General Development Plan. Adopted October 19, 2009; Bill No. 64-09. Annapolis, MD.

Anne Arundel County. 2010. Stormwater Management Practices and Procedures Manual. Revised November 22, 2010; updated February 1, 2012. Annapolis, MD.

Anne Arundel County. 2011. Patapsco Non-Tidal Watershed Assessment Comprehensive Summary Report. Prepared by Anne Arundel County Watershed Assessment and Planning Program, Annapolis MD

Anne Arundel County. 2012a. Anne Arundel County Government Chesapeake Bay TMDL Phase II Watershed Implementation Plan – July 2, 2012. Annapolis, MD.

Anne Arundel County. 2012b. Patapsco Tidal and Bodkin Creek Watershed Assessment Comprehensive Summary Report. Prepared by Anne Arundel County Watershed Assessment and Planning Program, Annapolis MD

Anne Arundel County, Department of Public Works. 2015. FY15 Enhanced Street Sweeping Program. Annapolis, MD.

Center for Watershed Protection (CWP). 2003. Impacts of impervious cover on aquatic ecosystems. Center for Watershed Protection, Ellicott City, Maryland. 142p.

Center for Watershed Protection (CWP). 2008. Deriving Reliable Pollutant Removal Rates for Municipal Street Sweeping and Storm Drain Cleanout Programs in the Chesapeake Bay Basin. Prepared by the Center for Watershed Protection, Ellicott City, MD. Prepared for U.S. EPA as fulfillment of the U.S. EPA Chesapeake Bay Program grant CB-973222-01.

House Bill 987. 2012. State of Maryland General Assembly. Annapolis, MD

Maryland Department of the Environment (MDE). Code of Maryland Regulations (COMAR). Continuously updated. Code of Maryland Regulations, Title 26- Department of the Environment. 26.08.02.01- Water Quality.

Maryland Department of the Environment (MDE). 2006. REVISED 2015. Total Maximum Daily Loads of Nitrogen and Phosphorus for the Baltimore Harbor in Anne Arundel, Baltimore, Carroll and Howard Counties and Baltimore City, Maryland. Maryland Department of the Environment, Baltimore, MD. Prepared for Water Protection Division, U.S. Environmental Protection Agency, Region III. Philadelphia, PA.

Maryland Department of the Environment (MDE). 2013. Final Report of the Workgroup on Accounting for Growth in Maryland. Maryland Department of the Environment. August 2013. Baltimore, MD.

Maryland Department of the Environment (MDE). 2014a. Guidance for Using the Maryland Assessment Scenario Tool to Develop Stormwater Wasteload Allocation Implementation Plans for Local Nitrogen, Phosphorus, and Sediment Total Maximum Daily Loads. Maryland Department of the Environment. June 2014. Baltimore, MD.

Maryland Department of the Environment (MDE) 2014b. Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated – Guidance for National Pollutant Discharge Elimination System Stormwater Permits. Maryland Department of the Environment. August 2014. Baltimore, MD.

Maryland Department of the Environment (MDE). 2014c. General Guidance for Developing a Stormwater Wasteload Allocation (SW-WLA) Implementation Plan. Maryland Department of the Environment. October 2014. Baltimore, MD.

Maryland Department of the Environment (MDE). 2014d. Guidance for Developing Stormwater Wasteload Allocation Implementation Plans for Nutrient and Sediment Total Maximum Daily Loads. Maryland Department of the Environment. November 2014. Baltimore, MD.

Maryland Department of the Environment (MDE). 2015. Maryland's Final 2014 Integrated Report of Surface Water Quality. Maryland Department of the Environment. Baltimore, MD. Online at: http://www.mde.state.md.us/programs/Water/TMDL/Integrated303dReports/Pages/2014IR.aspx

Rosgen, D.L. 1996. Applied River Morphology (Second Edition). Wildland Hydrology. Pagosa Springs, CO.

Schueler, T.R. 1987. Controlling urban runoff: a practical manual for planning and designing urban BMPs. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T. 1994. The importance of imperviousness. Watershed Protection Techniques, 1(3), 100-111.

Simpson, T., and S. Weammert. 2009. Developing Best Management Practice Definitions and Effectiveness Estimates for Nitrogen, Phosphorus, and Sediment in the Chesapeake Bay Watershed. December 2009. University of Maryland Mid-Atlantic Water Program.

United States Environmental Protection Agency (USEPA). 2001. PLOAD Version 3.0, An ArcView Tool to Calculate Nonpoint Sources of Pollution in Watershed and Stormwater Projects. January 2001. Developed by CH2M HILL.

United States Environmental Protection Agency (USEPA). 2010. Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus and Sediment, December 29, 2010. U.S. Environmental Protection Agency in collaboration with Delaware, the District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia. Region 3 - Chesapeake Bay Program Field Office. Annapolis, MD. http://www.epa.gov/reg3wapd/tmdl/ChesapeakeBay/tmdlexec.html

Appendix A: Baltimore Harbor Watershed Project List

Status	StormID# or TBD# or Outfall #	Project #	Contract #	Contract Name	Watershed (8-digit name)	Proposed Retrofit	Drainage Area [acres]	Linear Feet	Actual/Estimated Completion Fiscal Year	Cost
Construction Complete	AA6769				Patapsco Lower N Branch	Dry Extended Detention Pond	1.53		2014	
Construction Complete	AA6954				Patapsco Lower N Branch	Dry Extended Detention Pond	13.00		2014	
Construction Complete	AA7009				Patapsco Lower N Branch	Dry Extended Detention Pond	1.96		2014	
Construction Complete	AA7910				Patapsco Lower N Branch	Wet Pond	18.39		2014	
Construction Complete	AA8953				Patapsco Lower N Branch	Infiltration	3.75		2014	
Construction Complete	AA9236				Patapsco Lower N Branch	Wet Pond	3.82		2014	
Construction Complete	AA9237				Patapsco Lower N Branch	Wet Pond	2.15		2014	
Construction Complete	AA000805				Patapsco Lower N Branch	Wet Pond	14.40		2015	
Construction Complete	AA000804				Patapsco Lower N Branch	Wet Pond	33.57		2015	
Construction Complete	AA000803				Patapsco Lower N Branch	Wet Pond	30.47		2015	
Construction Complete	AA001220				Patapsco Lower N Branch	Wet Pond	33.22		2015	
Construction Complete	AA001649				Patapsco Lower N Branch	Wet Pond	25.00		2015	
Construction Complete		Q437300	Q437368	Leeds Rd Stream Repair	Patapsco Lower N Branch	Stream Restoration		500	2015	$ 114,422.12
Construction Complete	43	B554000	B554004	Patapsco Tdl Public Ponds Ph4	Baltimore Harbor	Wet Pool	13.34		2016	$ 276,397.93
Construction Complete	411	B554000	B554004	Patapsco Tdl Public Ponds Ph4	Baltimore Harbor	Wet Pool	16.88		2016	$ 305,560.67
Construction Complete	2115	B554000	B554004	Patapsco Tdl Public Ponds Ph4	Baltimore Harbor	Wet Pool	50.19		2016	$ 304,944.04
Construction Complete	2572	B554000	B554004	Patapsco Tdl Public Pnds Ph4	Baltimore Harbor	Wet Pool	No Data		2016	$ 98,108.90
Construction Complete	486	B555600	B555605	Hospital Dr. Pond 3 Retrofit	Patapsco Lower N Branch	SPSC	6.76		2016	$ 307,334.41
Construction Complete	629	B555600	B555606	Hospital Dr. Pond 2 Retrofit	Patapsco Lower N Branch	SPSC	13.04		2016	$ 460,578.31
Under Construction	149	B555600	B555602	Patapsco Ntdl Private Ponds Ph2	Patapsco Lower N Branch	Wet Pond	47.99		2016	$ 1,225,770.00
Under Construction	4455	B555600	B555602	Patapsco Ntdl Private Pds Ph2	Patapsco Lower N Branch	Wet Pond	10.17		2016	
In Design	1220	B555700	B555703	Patapsco Ntdl Public Pds Ph3	Patapsco Lower N Branch	Wet Pond	21.46		2016	$ 192,229.68
In Design	1649	B555700	B555703	Patapsco Ntdl Public Pds Ph3	Patapsco Lower N Branch	Wet Pond	10.12		2016	
Under Construction	42	B555700	B555701	Patapsco Ntd Public Ponds Ph1	Patapsco Lower N Branch	Infiltration	3.73		2017	$ 230,628.79
Under Construction	804	B555700	B555701	Patapsco Ntdl Public Pds Ph1	Patapsco Lower N Branch	Wet Pond	58.02		2017	no PO information
Under Construction	822	B555700	B555701	Patapsco Ntdl Public Pds Ph1	Patapsco Lower N Branch	Infiltration	13.86		2017	$ 153,287.93
Under Construction	2435	B555700	B555701	Patapsco Ntdl Public Ponds Ph1	Patapsco Lower N Branch	Wet Pond	10.12		2017	$ 167,374.19
Under Construction	2444	B555700	B555701	Patapsco Ntdl Public Pds Ph1	Patapsco Lower N Branch	Wet Pond	11.89		2017	$ 314,102.27
In Design	803	B555700	B555702	Patapsco Ntdl Public Pds Ph2	Patapsco Lower N Branch	Wetland	36.10		2017	$ 480,854.85
In Design	805	B555700	B555702	Patapsco Ntdl Public Pds Ph2	Patapsco Lower N Branch	Wet Pond	13.10		2017	
In Design	817	B553400	B553402	Patapsco Tdl Otfl K040026	Baltimore Harbor	Constructed Wetland	36.91		2017	$ 541,256.81
In Design	809	B554000	B554002	Patapsco Tdl Public Pds Ph2	Baltimore Harbor	SPSC	13.85		2017	$ 653,284.28
In Design	1330	B554000	B554002	Patapsco Tdl Public Pds Ph2	Baltimore Harbor	SPSC	15.23		2017	
In Design	818	B554000	B554003	Patapsco Tdl Public Pnds Ph3	Baltimore Harbor	Biorentetion	16.22		2017	$ 452,066.81
In Design	462	B555700	B555706	Patapsco Ntdl Public Ponds Ph2	Patapsco Lower N Branch	SPSC	16.10		2017	$ 223,941.70
In Design		Q514100	Q514103	Sloop Cove	Baltimore Harbor	Stream Restoration		2000	2017	$ 1,505,743.91
In Design	299	B554000	B554005	Patapsco Tdl Public Ponds Ph5	Baltimore Harbor	Modified Level 1 wetland	11.62		2018	$ 1,108,087.84
In Design	790	B554000	B554005	Patapsco Tdl Public Ponds Ph5	Baltimore Harbor	Wet pond with high and low marsh margins	29.02		2018	
In Design	5459	B554000	B554005	Patapsco Tdl Public Ponds Ph5	Baltimore Harbor	Wet pond with marsh on margins	14.45		2017	
In Design	5459	B554000	B554005	Patapsco Tdl Public Ponds Ph5	Baltimore Harbor	Wet pond with high and low marsh margins	14.45		2018	
In Design	297	B554000	B554001	Patapsco Tdl Public Ponds Ph1	Baltimore Harbor	TBD	1.30		2018	$ 2,795,144.10
In Design	682	B554000	B554001	Patapsco Tdl Public Ponds Ph1	Baltimore Harbor	Infiltration	21.76		2018	
In Design	838	B554000	B554001	Patapsco Tdl Public Pnds Ph1	Baltimore Harbor	Infiltration	20.63		2018	
In Design	870	B554000	B554001	Patapsco Tdl Public Ponds Ph1	Baltimore Harbor	Wet Pond	30.63		2018	
In Design	871	B554000	B554001	Patapsco Tdl Public Ponds Ph1	Baltimore Harbor	Wet Pond	13.81		2018	
In Design	874	B554000	B554001	Patapsco Tdl Public Ponds Ph1	Baltimore Harbor	Infiltration	7.75		2018	
In Design	882	B554000	B554001	Patapsco Tdl Public Ponds Ph1	Baltimore Harbor	Infiltration	11.46		2018	
In Design	SWM-01	B555300	B555302	Patapsco-Untld Trib Ntdl Ph2	Patapsco Lower N Branch	Stormwater wetland; grass filter strip	124.00		2018	$ 2,996,175.00
In Design	SWM-04	B555300	B555302	Patapsco-Untld Trib Ntdl Ph2	Patapsco Lower N Branch	Infiltration trench; SPSC	3.27		2018	
In Design	SWM-05	B555300	B555302	Patapsco-Untld Trib Ntdl Ph2	Patapsco Lower N Branch	Micro-bioretention islands; permeable pavement	3.60		2018	
In Design	SWM-07	B555300	B555302	Patapsco-Untld Trib Ntdl Ph2	Patapsco Lower N Branch	Grass filters; and Bioretention basins	9.27		2018	
In Design	SWM-14	B555300	B555302	Patapsco-Untld Trib Ntdl Ph2	Patapsco Lower N Branch	Grass swale; Stormwater Wetland	195.00		2018	
In Design	97	B555600	B555601	Patapsco Ntd Private Pds Ph1	Patapsco Lower N Branch	Stream Restoration	6.57		2018	$ 422,961.85
In Design	685	B555600	B555601	Patapsco Ntdl Private Pds Ph1	Patapsco Lower N Branch	Stream Restoration	55.74		2018	
In Design	717	B555600	B555601	Patapsco Ntdl Private Pds Ph1	Patapsco Lower N Branch	Constructed Wetland	57.79		2018	
In Design	8823	B555600	B555601	Patapsco Ntdl Private Pds Ph1	Patapsco Lower N Branch	Constructed Wetland	2.87		2018	

Status	StormID# or TBD# or Outfall #	Project #	Contract #	Contract Name	Watershed (8-digit name)	Proposed Retrofit	Drainage Area [acres]	Linear Feet	Actual/Estimated Completion Fiscal Year	Cost
In Design	806	B555700	B555705	Patapsco Ntdl Public Pds Ph5	Patapsco Lower N Branch	SPSC	20.94		2018	$ 418,991.45
In Design	807	B555700	B555705	Patapsco Ntdl Public Pds Ph5	Patapsco Lower N Branch	SPSC	75.48		2018	
In Design		B553700	B553701	Sawmill Creek Ph1	Baltimore Harbor	Stream Restoration		12389	2018	$ 4,779,626.44
In Design		B555800	B555801	Bodkin Creek Strm Ph1	Baltimore Harbor	Stream Restoration		682	2018	$ 343,015.43
In Planning	SR-04	B555300	B555303	Patapsco-Untd Trib Ntd OT Ph3	Patapsco Lower N Branch	Stream Restoration	199.00		2018	$ 1,452,231.90
In Planning	SR-05	B555300	B555303	Patapsco-Untd Trib Ntd OT Ph3	Patapsco Lower N Branch	Stream Restoration	33.00		2018	
In Planning	SR-06	B555300	B555303	Patapsco-Untd Trib Ntd OT Ph3	Patapsco Lower N Branch	Stream Restoration	25.00		2018	
In Planning	SR-07	B555300	B555303	Patapsco-Untd Trib Ntd OT Ph3	Patapsco Lower N Branch	Stream Restoration	46.00		2018	
In Planning	SR-08	B555300	B555303	Patapsco-Untd Trib Ntd OT Ph3	Patapsco Lower N Branch	Stream Restoration	5.00		2018	
In Planning	SR-09	B555300	B555303	Patapsco-Untd Trib Ntd OT Ph3	Patapsco Lower N Branch	Stream Restoration	48.00		2018	
In Design		B553500	B553501	Cabin Branch Ph1	Baltimore Harbor	Stream Restoration		4700	2019	$ 4,095,734.10
In Design		B553500	B553503	Cabin Branch Ph3	Baltimore Harbor	Stream Restoration		6800	2019	$ 1,785,045.31
In Design		B553900	B553902	Pt Furnace Crk Str Rstn Ph2	Baltimore Harbor	Stream Restoration		3500	2019	$ 2,840,204.58
In Design		B553500	B553502	Cabin Branch Ph2	Baltimore Harbor	Stream Restoration		4000	2020	$ 1,360,983.75
In Design				Maritime	Patapsco Lower N Branch	Stream Restoration		14300	2020	$ 7,192,259.07
In Planning		B554800	B554801	Pt-Marley Creek Strm Rstn	Baltimore Harbor	Stream Restoration		14300	2020	$ 5,297,532.90
In Planning		B551800	B551812	Rock Creek Stream Ph1	Baltimore Harbor	Stream Restoration		12000	2020	$ 6,035,462.15

Appendix B: Public Comment Period Documentation

Addendum

Public Comments

The *Baltimore Harbor Watershed Nutrient TMDL Restoration Plan, Anne Arundel County, Maryland* was posted on the County's web page and advertised for public comment in the *Maryland Gazette* and *The Capital* newspapers from September 28, 2016 through October 28, 2016. A copy of the Public Comment Notice and the Capital newspaper advertisement are provided on the following pages.

No public comments were received.

Notice of Public Comment on TMDL Restoration Plans
Anne Arundel County Department of Public Works
Watershed Protection and Restoration Program

General information
Public comment period begins: September 28, 2016
Public comment period ends: 4:30 p.m. on October 28, 2016

WPRP contact person:
Ginger Ellis, Planning Administrator
2662 Riva Road, MS#7409
Annapolis, MD 21401
Fax: 410-222-0759
E-mail: pwelli16@aacounty.org

The Anne Arundel County Department of Public Works (DPW) Watershed Protection and Restoration Program (WPRP) has developed restoration plans to address local water quality impairments for watersheds with an approved Total Maximum Daily Load (TMDL) issued by the Maryland Department of the Environment (MDE) and approved by the U.S. Environmental Protection Agency (EPA). As defined by EPA, a TMDL sets a maximum load of a specific pollutant or stressor that a water body can assimilate and still meet water quality standards for its designated use.

Per the requirements of its National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit (11-DP- 3316, MD0068306), Anne Arundel County has developed the following restoration plans to address specific TMDL's as required:

- **"Baltimore Harbor Watershed Nutrient TMDL Restoration Plan"**
- **"Little Patuxent River Sediment TMDL Restoration Plan"**
- **"Patapsco River Lower North Branch Sediment TMDL Restoration Plan"**
- **"Upper Patuxent River Sediment TMDL Restoration Plan"**

WPRP invites comments from the public on the above proposed TMDL restoration plans. The draft TMDL restoration plans are available for review on the Anne Arundel County Watershed Protection and Restoration Program's website at http://www.aarivers.org and can be inspected at the physical address listed above.

Only written comments will be accepted, no phone calls please. The public comment period will end at 4:30 p.m. on October 28, 2016. Written comments should include: title of TMDL restoration plan, name, address, and telephone number of the person submitting the comments and should be mailed to WPRP Attn: Ginger Ellis, Planning Administrator, 2662 Riva Road, MS#7409, Annapolis, MD 21401, faxed to WPRP Attn: Ginger Ellis at 410-222-7059, or e-mailed to pwelli16@aacounty.org.

LEGAL NOTICES

Notice of Public Comment on TMDL Restoration Plans Anne Arundel County Department of Public Works Watershed Protection and Restoration Program

General information
Public comment period begins: September 28, 2016
Public comment period ends: 4:30 p.m. on October 28, 2016

WPRP contact person:
Ginger Ellis, Planning Administrator
2662 Riva Road, MS#7409
Annapolis, MD 21401
Fax: 410-222-0759
E-mail: pwelli16@aacounty.org

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4484883
CAP/MD 40/018 September 28

NOTICE OF HEARINGS
REZONINGS, CRITICAL AREA RECLASSIFICATIONS OR DECLASSIFICATIONS, SPECIAL EXCEPTIONS, VARIANCES AND ADMINISTRATIVE
ANNE ARUNDEL COUNTY, MARYLAND

The following cases will be heard before the BOARD OF APPEALS in the Council Chambers, Arundel Center, 44 Calvert Street, Annapolis, Maryland. *Individuals who need special accommodation should call 410-222-1119 (TTY 410-222-4355) at least seven working days before a hearing.*

Wednesday, October 5, 2016 at 3:30 p.m., BA 11-16A (1978-0016-N) Michael A. Spiegel and Karen J. Leva (CD 5) an appeal of the denial of a change in use request for a current nonconforming use allowing commercial waterman activities on property known as 725 Red Cedar Rd., Annapolis.

Tuesday, October 11, 2016 at 6:30 p.m., BA 25-16R (2016-0029-R) BA 26-16R (2016-0076-R) Brock Bridge Land Holding Company, LLC, et al. (AD 4, CD 1) an appeal of the denial of a zoning reclassification from R1-Residential to C1-Local Commercial District on properties compris-

ANNE ARUNDEL COUNTY, MARYLAND
Annapolis, Maryland
ANNOUNCEMENT
NOTICE TO BIDDERS

Specifications and Bid Proposals for providing the subject item(s) are available at the Purchasing Office, Heritage Office Complex, 2660 Riva Road, 3rd Floor, Annapolis, Maryland 21401. Bids will be received until time/date shown for bid(s) listed below, at the same location, after which they will be publicly opened and read in the **Patuxent Room**, located on the same floor. Bids received after the time set for opening will be rejected

Due by 1:30 p.m. Local Time
Tuesday, October 11, 2016
IFB No. 16-127
Trailers
Contact: Stephen Ports, 410-222-7665

Due by 1:30 p.m. Local Time
Tuesday, October 25, 2016
IFB No. 16-129
All-Terrain Utility Vehicles
Contact: Stacey Sells, 410-222-7646

Due by 1:30 p.m. Local Time
Tuesday, November 1, 2016
IFB No. 16-116
Signs, Traffic
Contact: Casandra Daniels, 410-222-7666

4484865
CAP/MD 40/016 Sept. 28

NOTICE
IN THE CIRCUIT COURT FOR
ANNE ARUNDEL COUNTY
Case No. C-02-CV-15-003505-FC

LAURA H.G. O'SULLIVAN, ET AL., Substitute Trustees
Versus
MAURICE BRISCOE, ANDREA F. BRISCOE AKA ANDREA FAYA BRISCOE, RUDY BRISCOE AKA RUDY TYRONE BRISCOE
Defendants

Notice is hereby issued this Tuesday, September 13, 2016 that the sale of the property in the proceedings mentioned, made and reported by Rachel Kiefer, Esq., Substitute Trustee(s). BE RATIFIED AND CONFIRMED, unless cause to the contrary thereof be shown on or before the 13th day of October 2016 next; Provided, a copy of this Notice be inserted in some newspaper published in Anne Arundel County, once in each of three successive weeks before the 13th day of October 2016 next.

The report states that the amount of sale of the property at 905 BEECH TREE ROAD, SEVERN, MD 21144 to be $195,822.75.

Robert P. Duckworth
Clerk
True Copy
TEST:
Robert P. Duckworth
Clerk

CAP 39/023 Sept. 21, 28 - Oct. 5 4467607

NOTICE FOR PUBLICATION
OF NAME CHANGE
IN THE CIRCUIT COURT FOR
ANNE ARUNDEL COUNTY
Civil No.
C-02-FM-16-003603

IN THE MATTER OF:
DAMAR LLEWELLYN JOHNSON
FOR CHANGE OF NAME TO:
JEREMIAH LLEWELLYN PARKER

The Petitioner Kiera D Smith has filed a Petition to change the name of a minor child, from DAMAR LLEWELLYN JOHNSON to JEREMIAH LLEWELLYN PARKER

To be published in the Capital Newspaper on 9/28/2016. The reason for this request is: A DNA test was performed and the alleged father was proven not to be the biological father and has not been involved with child since 2012.

Any person may file an objection to the Petition on or before the 13TH Day of OCTOBER, 2016 Such objection must be supported by an affidavit made on personal knowledge and served upon the Petitioner in accordance with Maryland Rule 1-321.

Robert P. Duckworth
Clerk
True Copy
TEST:
Robert P. Duckworth
Clerk
4459431

NOTICE FOR PUBLICATION
(MINOR)
IN THE CIRCUIT COURT FOR
ANNE ARUNDEL COUNTY
CIVIL NO. C-02-FM-16-003604-NC

IN THE MATTER OF:
Christopher Stanley Okosun, Jr.
FOR CHANGE OF NAME TO:
Christopher Sam Junior Onwuka