PATUXENT RIVER WATERSHED

POLYCHLORINATED BIPHENYLS TMDL RESTORATION PLAN

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PREPARED FOR

Anne Arundel County, Maryland
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Watershed Protection and Restoration Program
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List of Acronyms

AAWSA	Anne Arundel Watershed Stewards Academy
BMP	Best Management Practice
CAST	Chesapeake Assessment Scenario Tool
CBP	Chesapeake Bay Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHS	Controlled Hazardous Substances
CIP	Capital Improvement Program
COMAR	Code of Maryland Regulations
CWA	Clean Water Act
CWP	Center for Watershed Protection
DNREC	Delaware Department of Natural Resources and Environmental Control
DPW	Department of Public Works
EOS	Edge of Stream
EOT	Edge of Tide
FAP	Financial Assurance Plan
GIS	Geographic Information System
HLI	Historic Landfill Initiative
ICIS	Integrated Compliance Information System
LA	Load Allocation
LMA	Land and Materials Administration
LRP	Land Restoration Program
LULC	Land use / Land cover
MDE	Maryland Department of the Environment
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
NRC	National Response Center
NSA	National Security Agency
PAXTF	Patuxent Tidal Fresh Watershed
PCB	Polychlorinated biphenyl
PCS	Permit Compliance System
QAPP	Quality Assurance Project Plan
SHA	State Highway Administration
SIC	Standard Industrial Classification
SPMD	Semi Permeable Membrane Devices
SPSC	Step Pool Storm Conveyance
SW-WLA	Stormwater Waste Load Allocation
TMDL	Total Maximum Daily Load
tPCB	Total Polychlorinated biphenyl
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
TSS	Total suspended solids

UMBC	University of Maryland Baltimore County
UMCES	University of Maryland Center for Environmental Science
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VADEQ	Virginia Department of Environmental Quality
VCP	Voluntary Cleanup Program
WIP	Watershed Implementation Plan
WLA	Waste Load Allocation
WPRP	Watershed Protection and Restoration Program
WQIP	Water Quality Improvement Projects
WWTP	Waste Water Treatment Plant

Executive Summary

This restoration plan addresses the polychlorinated biphenyl (PCB) total maximum daily load (TMDL) for the Tidal Fresh portion of the Patuxent River (PAXTF) watershed under the responsibility of Anne Arundel County. The TMDL was approved by the Environmental Protection Agency (EPA) on September 19, 2017. PCBs are a group of manmade chemicals first developed in the 1920's that have an extremely high boiling point, flame resistance, and chemical stability. They were used in manufacturing and commercial applications through 1979. Manufacturing and importation of PCBs was banned in 1979 by the EPA based on evidence of toxicity to humans and wildlife, concerns about their environmental persistence and ability to bioaccumulate.

Sediment exported from a watershed is a dominant source of PCBs, particularly sediment conveyed through storm drains from urban areas. Given the understanding that PCBs are generally bound to sediment and that removal of contaminated sediment and reduction of sediment loading can be effective method of reducing the PCB loads, the modeling approach focuses on BMPs that trap and retain sediment. The basis of the modeling is total suspended solids (TSS) loading and reduction calculations based on modeling in the Chesapeake Assessment Scenario Tool (CAST), which is an on-line interface of the final Chesapeake Bay Program's Partnerships Phase 6 model. Sediment modeling in CAST is coupled with PCB sediment concentration factors to translate the sediment load and reductions to PCB loads and reductions.

The PCB load from Anne Arundel County's municipal separate storm sewer system (MS4) area is published as 100.4 g/yr for the TMDL baseline year of 2014 (MDE, 2017). The TMDL requires a 99.9% reduction in PCB load. The County's disaggregated and calibrated baseline load is estimated to be 25.41 g/yr, requiring a reduction of 25.39 g/yr.

The MS4 permit calls for an iterative and adaptive plan for implementation. This plan relies heavily on an initial monitoring phase to determine locations of specific contamination. Therefore, the plan does not currently recommend a suite of specific best management practices (BMPs) or targeted locations. Results of the monitoring will determine where remediation efforts occur and what type of controls are ultimately implemented.

An analysis was conducted to identify potential sources and any known areas of contamination. The data compilation and analysis identified 30 potentially contaminated sites, including records in the Federal PCB Activities Database and National Response Center Database, as well as a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site and known contamination at a site under Maryland Department of the Environment's (MDE) Land Restoration Program (LRP). A sampling strategy was developed to identify and characterize source areas and active sources of PCBs in the watershed. Proposed monitoring consists of using passive samplers installed directly in the stream, which adsorb PCBS in the source water over a period of several weeks. Three phases of monitoring are proposed, initially targeting the monitoring around known sources of PCBs, followed by a bifurcated trackback sampling approach to narrow the source areas to small, confined drainage areas, then confirmation sampling on smaller tributaries, depositional areas, and/or upland sites with high potential for PCB contamination. Once identified, contaminated sites will be prioritized for remediation.

Implementation of the plan will initiate PCB load reductions and demonstrate progress towards the goal. The plan will be reviewed and potentially revised annually based on monitoring results, implementation levels, and load reduction progress.

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 Patuxent River Mesohaline, Oligohaline, and Tidal Fresh watershed segments (Figure 1), have several impaired waters listings in Maryland's Draft 2018 Integrated Report of Surface Water Quality [303(d) list and 305(b) Report; MDE, 2018] including impairments due to sediment, bacteria and polychlorinated biphenyls (PCB). The TMDLs for these pollutants apply variously to several central and southern Maryland jurisdictions including Anne Arundel, Calvert, Charles, Frederick, Howard, Montgomery, Prince George's, and St. Mary's Counties. This plan will specifically address the Patuxent River watershed PCB TMDL approved by the EPA on September 19, 2017 (MDE, 2017) under the responsibility of Anne Arundel County, which is in the freshwater portion of the Patuxent River and termed the Patuxent River Tidal Fresh (PAXTF) by MDE. All other listed TMDL pollutants and jurisdictions are not addressed in this plan.

PCBs are compounds used from 1929 through 1979 in manufacturing and industrial processes. Rising concerns about the toxicity, human health effects, and persistent nature of PCBs in the environment led to a federal ban on the sale and production of PCBs in 1979. The PCB load from Anne Arundel County's municipal separate storm sewer system (MS4) area is published as 100.4 g/yr for the TMDL baseline year of 2014 (MDE, 2017). The TMDL requires a 99.9% reduction in PCB load. The County's disaggregated and calibrated baseline load is estimated to be 25.41 g/yr.

Responsibility for the Patuxent River watershed PCB 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 non-point sources in this case include Non-regulated Watershed Runoff, Atmospheric Deposition, and Contaminated sites. The WLA consists of loads attributable to regulated process water or wastewater treatment, as well as 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 NPDES regulated stormwater load and load reduction are the focus of this planning effort.

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 and subsequent 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 make progress towards the stormwater WLA (SW-WLA).

The MS4 permit calls for an iterative and adaptive plan for implementation. The County's plan relies heavily on an initial monitoring phase to determine locations of specific contamination. Therefore, the plan does not currently recommend a suite of specific best management practices (BMPs) or targeted locations. Results of the monitoring will determine where remediation efforts occur and what type of controls are ultimately implemented. It is anticipated and generally understood that a 99.9% reduction in PCB loading may not be feasible given the current limited understanding of PCB sources, the ubiquitous presence of PCBs in watershed soils, and the limitations of stormwater systems to control PCB loading. Implementation of the plan will initiate PCB load reductions and demonstrate progress towards the goal. The plan will be reviewed and potentially revised annually based on monitoring results and implementation and load reduction progress.

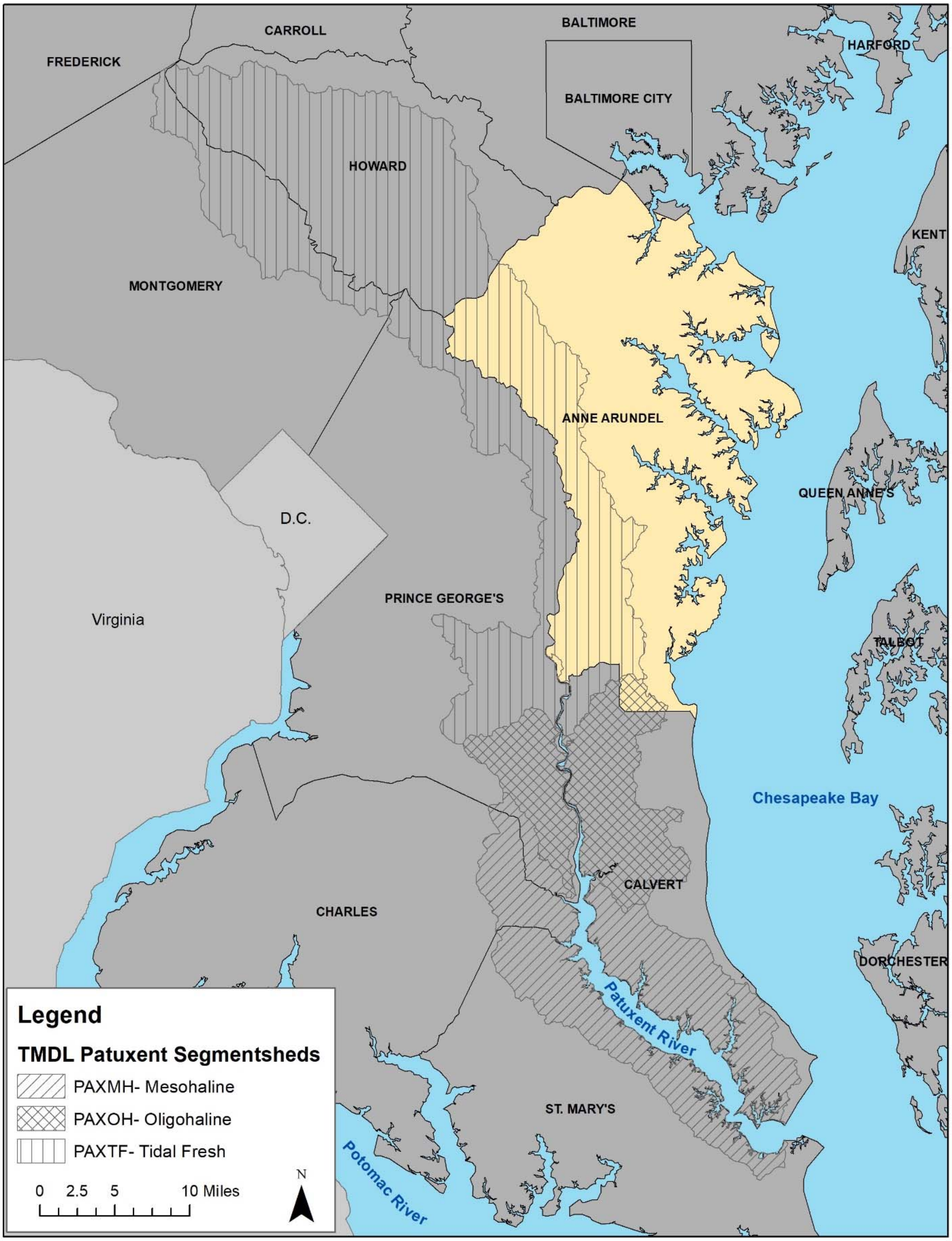

Figure 1: Patuxent River Mesohaline, Oligohaline, and Tidal Fresh Map

1.2 Baseline Load, TMDL, and Required Reduction

The PCB TMDL for the PAXTF watershed sets forth SW-WLAs for Anne Arundel, Frederick, Howard, Montgomery, and Prince George's County. This restoration plan addresses loads allocated to Anne Arundel County NPDES regulated stormwater point source PCBs for the PAXTF segment. The watershed boundary of the PAXTF within Anne Arundel County is shown in Figure 2 and includes approximately 120 square miles of land area.

1.2.1 Modeling Approach

A literature review of PCB sources and treatment showed that sediment exported from a watershed is a dominant source of PCBs, particularly sediment conveyed through storm drains from urban areas. For example, The Chesapeake Bay Toxic Contaminants Policy and Prevention Outcome (CBP, 2015) concluded that stormwater was a significant pathway for both particulate and dissolved PCBs. Land use was also a factor.

While PCBs can exist in stormwater in both dissolved and particulate forms, they are generally insoluble in water. Lighter compounds may dissolve and subsequently volatize to the air and heavier compounds bind to sediment. Schueler and Youngk (2015) discussed research indicating that a large portion of the PCB load was attached to sediment, including a sampling study in the Susquehanna River basin that showed 75 percent of PCB loads were associated with particulates. The Chesapeake Bay Program (CBP, 2015) concluded that contaminated soils were a predominant source of PCBs in stormwater. Both these reports and others (Gilbreath et al., 2012) found that older industrial areas tended to have a higher concentration of PCBs in runoff and in sediments.

Given the understanding that PCBs are generally bound to sediment and that removal of contaminated sediment and reduction of sediment loading can be effective method of reducing the PCB loads, the modeling approach focuses on BMPs that trap and retain sediment. The basis of the modeling is total suspended solids (TSS) loading and reduction calculations based on modeling in the Chesapeake Assessment Scenario Tool (CAST), which is an on-line interface of the final Chesapeake Bay Program's Partnerships Phase 6 model. Sediment modeling in CAST is coupled with PCB sediment concentration factors to translate the sediment load and reductions to PCB loads and reductions.

1.2.2 PCB Concentration

PCB loads are related to sediment by a concentration factor, which describes the mass of PCB associated with sediment. Table 4 of the Patuxent River TMDL provides a concentration of 3.3 ng/L in PAXTF sediments, based on two samples, of 0.4 and 6.2 ng/L. While this is a small sample size, with extreme variations, Table G-1 shows sediment concentrations from 13 segments of the watershed that have an average of 3.7 ng/g, sufficiently close to the PAXTF results to use 3.3 ng/g as the concentration factor for modeling.

1.2.3 Baseline Loads

In Table 18 of the TMDL, the portion of the baseline load for all regulated stormwater in Anne Arundel County in PAXTF is shown as 100.4 g/yr with 99.9% reduction and a SW-WLA of 0.1 g/yr. The baseline year is 2014. The TMDL states that the loading for NPDES regulated stormwater is an aggregate of loadings from areas covered under the following permits: Phase I and II jurisdictional MS4 permits, State Highway Administration's (SHA) Phase I MS4 permit, industrial facilities permitted for stormwater discharges, and MDE general permit to construction sites. In order to determine the baseline load and reduction requirement specific to Anne Arundel County, the aggregate baseline load of 100.4 g/yr needs to be disaggregated. Additionally, the load needs to be translated or calibrated to the model being used in the plan, CAST. Determining the baseline sediment load and associated PCB load using CAST performs both the model translation and disaggregation process simultaneously since the jurisdiction and load sources in CAST were selected to exclude state and federal lands, and regulated construction.

The Phase 6 Bay model includes the 'stream bed and banks' as a unique load source to account for loads generated within the watershed stream systems. The load source is equivalent to all of the streams in the watershed including those in non-developed land uses, including agricultural areas. To calculate the amount of baseline stream bed and bank load allocated to the urban stormwater sector MS4, the load was disaggregated from the total based on the land use proportion of MS4 load sources in CAST within the PAXTF watershed. The proportion of MS4 area to the total area is 20.9% as of 2014, the baseline year, therefore 20.9% of the stream bed and bank load were included in the County's SW-WLA baseline.

Using the procedure described above, the sediment load for PAXTF was calculated using CAST for the land uses under County's MS4 jurisdiction, using MDE 2014 Progress BMPs. The resulting baseline TSS load is shown in Table 1.

Table 1: TSS Baseline Loads from CAST

Load Source	Amount	Baseline TSS Load EOS (lbs/yr)
MS4 Buildings and Other (ac)	3,430.58	3,538,410.10
MS4 Roads (ac)	966.74	983,872.67
MS4 Tree Canopy over Impervious (ac)	1,482.78	1,668,533.16
MS4 Tree Canopy over Turf Grass (ac)	1,678.35	433,279.99
MS4 Turf Grass (ac)	8,127.05	3,635,023.15
Stream Bed and Bank (miles)*	24.43	6,717,426.20
Total (ac)	**15,685.50**	**16,976,545.26**

*Stream Bed and Bank miles and load were disaggregated from the total based on land use proportion of MS4 load sources in CAST

Using the procedure described above, the baseline load modeled in CAST is converted to a PCB load as shown in Table 2. TSS loads in lbs/yr are converted to g/yr. The PCB sediment concentration is then applied and converted from ng/yr to g/yr.

Table 2: PCB Baseline Load Calculation

TMDL Segment	Baseline TSS Load EOS (lbs/yr)	Baseline TSS Load EOS (g/yr)	Average Sediment tPCB Concentration (ng/g)	Baseline Load PCB ng/yr	Baseline Load PCB g/yr
PAXTF	16,976,545	7.70E+09	3.30E+00	2.54E+10	25.41

The County has determined to perform the modeling for progress and other scenarios using CAST, as described above. In order to be consistent with modeled loads, restoration results will be compared to the baseline modeled in CAST and converted to PCB loads. The approach is based on the following assumptions:

- All PCBs from regulated point sources are from NPDES regulated stormwater.
- 100% of PCBs conveyed via stormwater are adsorbed to sediment.
- PCB concentrations are uniform across the watershed in surface soils at 3.3 ng/g.

Applying the 99.9% reduction, Anne Arundel County would need to reduce the 25.41 g/yr by 25.39 g/yr as shown below in Table 3. This essentially indicates that the County would need to reduce the watershed sediment loads by 99.9%, which is not feasible. Identification and remediation of contaminated sites with soil PCB concentrations higher than 3.3 ng/g would allow for additional removals and make full implementation more feasible.

Table 3: Disaggregated and Calibrated Patuxent River Watershed Local TMDL SW-WLAs and Load Reductions

Local TMDL and Baseline Year	Patuxent River – Tidal Fresh 2014
Baseline Load and TMDL WLA	**PCB g/yr**
Baseline Scenario Load	25.41
Required Percent Reduction	99.9%
Required Reduction	25.39
Local TMDL WLA	0.03

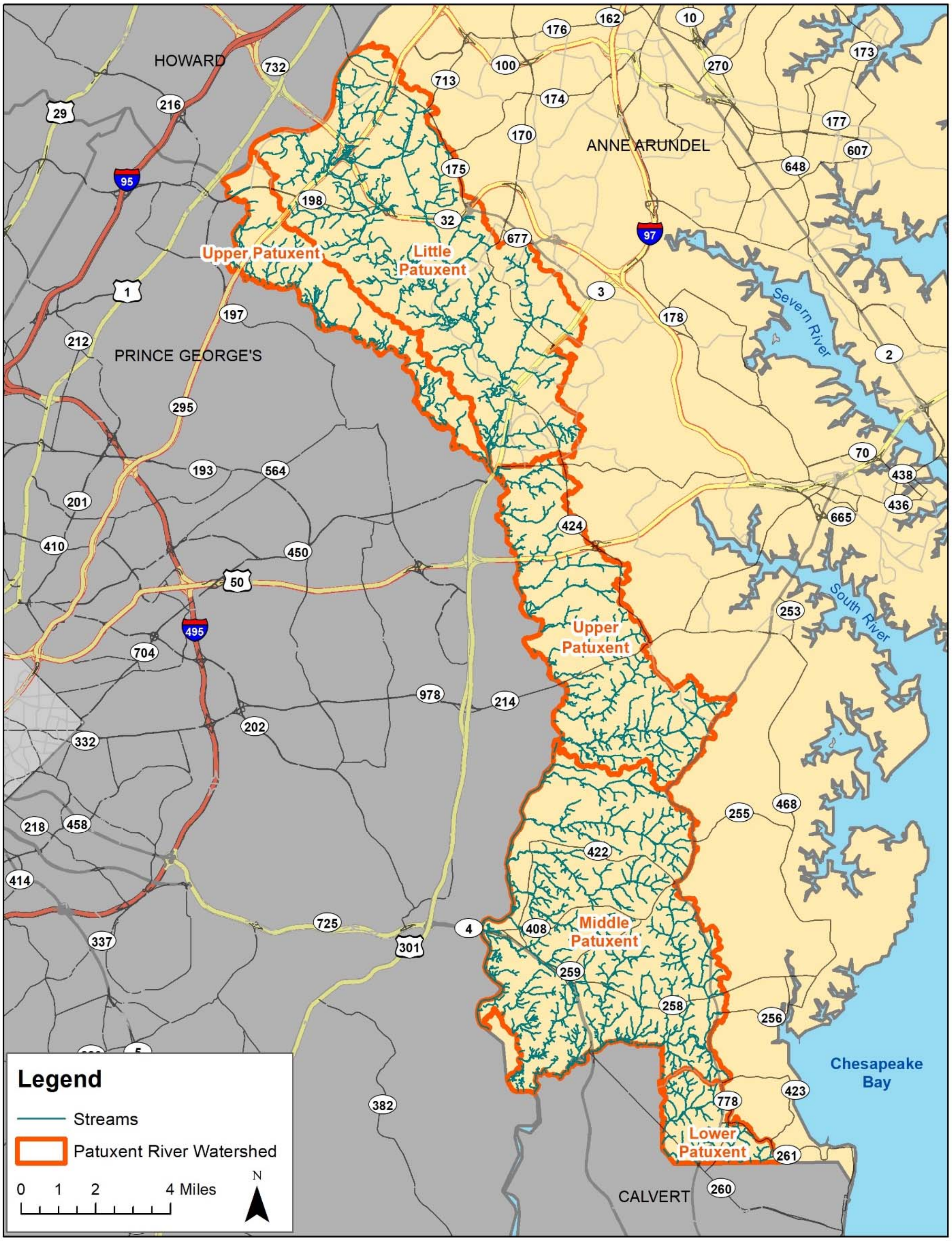

Figure 2: Patuxent River Watershed within Anne Arundel County Map

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 all 12 of its major watersheds. Comprehensive watershed assessments were completed for watershed segments that make up the PAXTF watershed with the Upper Patuxent completed in 2008 (AA Co, 2008), Little Patuxent completed in 2016 (AA Co, 2016), and the Middle Patuxent completed in 2018 (AA Co, 2018). Together these three plans cover the County's portion of Patuxent Tidal Fresh 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 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:

Patuxent River Mesohaline, Oligohaline, and Tidal Fresh Documents

- Upper Patuxent River Watershed, Overall Summary Recommendation Report, 2008
- Little Patuxent Watershed Assessment, Comprehensive Summary Report, 2016
- Herring Bay, Middle Patuxent, and Lower Patuxent Watershed Assessment, Comprehensive Summary Report, 2018
- Total Maximum Daily Loads of Polychlorinated Biphenyls in Patuxent River Mesohaline, Oligohaline and Tidal Fresh Chesapeake Bay Segments, Maryland, August 2017 (EPA Approval Date: September 19, 2017)

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)
- MDE Recommendations for Addressing the PCB SW-WLA
- 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)
- Various Chesapeake Bay Program Technical Workgroup and Expert Panel Publications related to Stormwater Retrofit, Stream Restoration, etc.

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. In addition, because the plan relies on an initial monitoring phase to identify areas of contamination, specific restoration sites and estimates of future load reductions are not known at this time, but will be added and reported as monitoring data becomes available. 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 4)

f. A schedule for implementing the management measures identified in this plan that is reasonably expeditious. (Section 6)

g. A description of interim, measurable milestones for determining whether management measures or other control actions are being implemented. (Section 7)

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 7)

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 7)

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 PAXTF watershed PCB TMDL, 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 Description

The portion of the Patuxent River watershed in Anne Arundel County consists of three 8-digit watersheds within the Patuxent River Mesohaline, Oligohaline, and Tidal Fresh Chesapeake Bay segments: Little Patuxent (02-13-11-05), Upper Patuxent (02-13-11-04), and Lower/Middle Patuxent (02-13-11-02). The watershed is located along the western border of Anne Arundel County and shares political boundaries with Howard County to the northwest, Prince George's County to the west, and Calvert County to the south.

The entire Patuxent River watershed is approximately 562,164 acres (878.4 square miles) and falls within seven counties: Howard, Montgomery, Prince George's, Charles, St. Mary's, Calvert, and Anne Arundel County (Figure 1). Within Anne Arundel County, the Patuxent River watershed is 80,084 acres (125.1 square miles) and contains 573.5 miles of streams (Table 4 and Figure 2). The watershed includes many named streams, including Cabin Branch, Davidsonville Branch, Deep Creek, Dorsey Run, Ferry Branch, Galloway Creek, Hall Creek, Little Patuxent, Lyons Creek, Stocketts Run, Rock Branch, and Wilson Owens Branch. Tributary streams flow westward to the Patuxent River, which flows south to the Chesapeake Bay. The most recent County stream layer was used, reflecting field verification work occurring between 2004 and 2017.

In addition to Anne Arundel County Phase I MS4 jurisdiction, Maryland Department of Transportation State Highway Administration, state and federal jurisdictions are also located in the Patuxent River watershed. A large section of Fort George G. Meade, a U.S. Army owned installation, is located in the central portion of the Little Patuxent watershed. The Patuxent Research Refuge North, a federal property owned and operated by the Fish and Wildlife Service of the U.S. Department of Interior, is located in the central portion of the Little Patuxent watershed and in the northern section of the Upper Patuxent watershed. The Davidsonville Transmitter Station, owned by the U.S. Army, is located in the central portion of the Upper Patuxent watershed. A portion of the Jug Bay Wetlands Sanctuary, including the Parris N. Glendening Nature Preserve, is located in the western border of the Middle Patuxent watershed.

Table 4: Watershed Drainage Area and Stream Miles

Subwatershed Name	Drainage Area (Acres)	Drainage Area (Square Miles)	Stream Length (Miles)
Little Patuxent	27,976	43.7	181.2
Upper Patuxent	22,417	35.0	148.0
Lower/Middle Patuxent	29,691	46.7	244.3
Total	**80,084**	**125.4**	**573.5**

2.2 Land Use/Land Cover

Land use analysis is an important step in identifying potential PCB sources and hot spots. Typically, PCBs are commonly associated with commercial and industrial land use types. According to the County's most recent (2014) land use/ land cover (LULC) geographic information system (GIS) dataset, only 5% of the watershed is commercial and 1% is industrial. The dominant category of land use in the Patuxent River watershed is mixed woods (39%) and residential 2-acre lots (12%). This watershed is unique in that it contains part of the Patuxent Wildlife Research Center, 12,800 acres of fields, woodlands, and wetlands, which includes several areas that were used as disposal sites for various chemical and liquid waste, as well as construction debris and household waste, from 1963 through 1986. As described in more detail in Section 3.2, this site has known PCB soil contamination. Table 5 presents the total area of each land use category. Land use distribution within the watershed is shown in Figure 3.

Table 5: 2014 Land Use / Land Cover

Land Use	Acres	Percent of Watershed
Airport	81.6	>1%
Commercial	3,792.8	5%
Forested Wetland	2,918.4	4%
Industrial	663.1	1%
Mining	681.3	1%
Open Space	5,086.6	6%
Open Wetland	1,294.3	2%
Pasture/Hay	4,219.0	5%
Residential 1/2-acre	434.5	1%
Residential 1/4-acre	2,373.8	3%
Residential 1/8-acre	3,141.3	4%
Residential 1-acre	1,093.7	1%
Residential 2-acre	9,761.1	12%
Row Crops	7,372.4	9%
Transportation	2,307.0	3%
Utility	766.8	1%
Water	880.4	1%
Woods-Coniferous	1,282.5	2%
Woods-Deciduous	672.2	1%
Woods-Mixed	31,036.3	39%
Total	**79,859.2**	**100%**

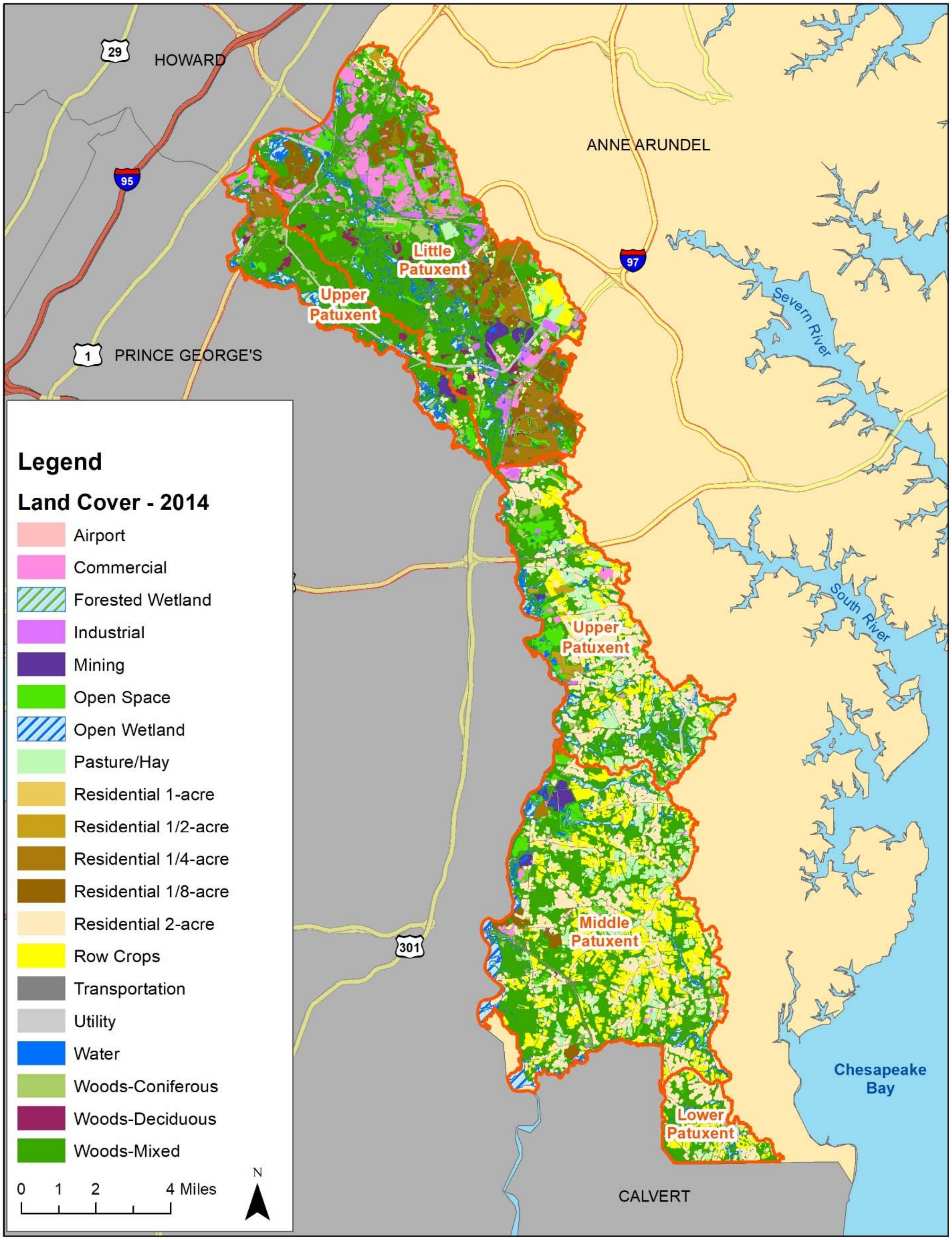

Figure 3: Land Use / Land Cover Map

2.3 Soils

The Patuxent River watershed is located within the Atlantic Coastal Plain physiographic province. Geological materials consist of unconsolidated deposits of gravel, sand, silt, and clay. The dominant soil map units within the watershed include Marr and Dodon soils (15 to 25 percent slopes), Marr and Dodon complex (2 to 15 percent slopes), and Widewater and Issue soils (0 to 2 percent slopes, frequently flooded). Majority of the watershed has slopes ranging from 0 to 5 percent. More than half of the watershed area is considered well drained (54%) or moderately well drained (14%), while 15% is considered poorly drained and 1% is considered very poorly drained. The remaining land is considered excessively or somewhat excessively drained.

Soil map units are assigned a hydrologic soil group, which describes the runoff potential of the soil. Table 6 presents the distribution of hydrologic soil group types of the watershed. More than half (51%) of the watershed is classified as Group B, or as soils having moderately low runoff potential when thoroughly wet and water transmission through the soil is unimpeded. Hydrologic soil group C accounts for 18% of the soils, while soil group D accounts for 14% of the soils in the watershed. Soils C and D have the highest runoff potential. Group A soils account for 13% of the watershed; soils in this group have high infiltration rates and low runoff potential even when thoroughly wetted. The remaining soils (3%) are assigned dual hydrologic soil groups (B/D and C/D) in high water table situations. The first letter describes the drained conditions and the second applies to the undrained condition of the soil.

The SSURGO soils data for Anne Arundel County was used for the soils data analysis (NRCS, 2018).

Table 6: Hydrologic Soil Groups and Erodibility Factors

Hydrologic Soil Group	Acres	Percent of Total
A	10,015.4	13%
B	41,174.9	51%
B/D	1,340.9	2%
C	14,209.4	18%
C/D	780.7	1%
D	11,547.7	14%
Not Applicable/Water	984.1	1%
Total	**80,053.0**	**100%**

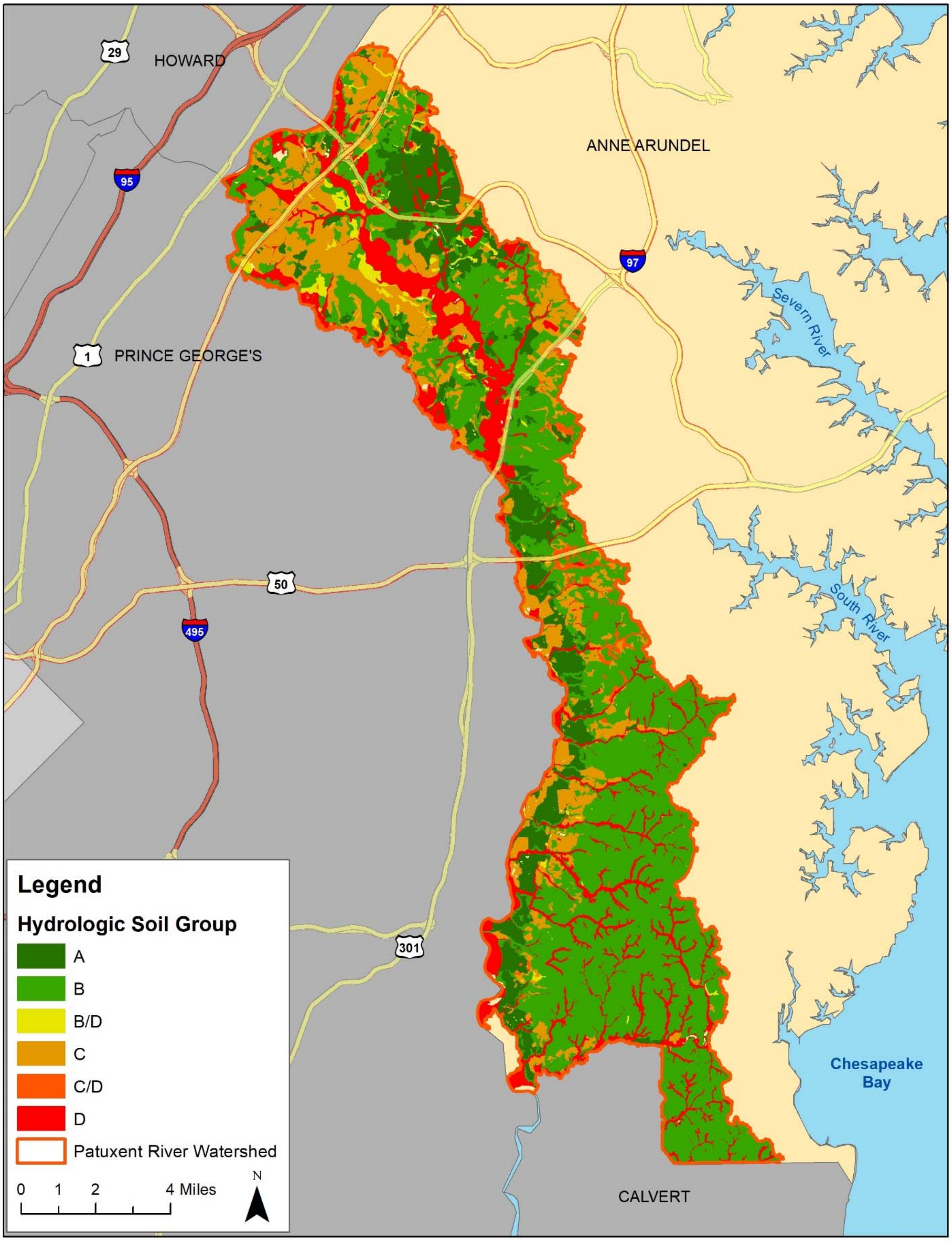

Figure 4: Hydrologic Soils Group Distribution in the Anne Arundel County Patuxent River Watershed

2.4 Impervious Surfaces

Increased impervious surfaces are commonly associated with developed land use types also associated with PCBs, such as residential, commercial, and industrial. In general, the more developed an area is, the more likely it may be to have PCB contamination, particularly is the area was developed during the PCB era, 1929-1979.

Of the three subwatersheds, Little Patuxent contains the highest proportion of impervious surfaces, at 18% of the total subwatershed area. Lower/Middle Patuxent and Upper Patuxent subwatersheds have similar impervious coverage, at 5% and 7%, respectively. Impervious surfaces make up 10% of the Patuxent watershed in Anne Arundel County. Table 7 presents the area of impervious cover by type in each subwatershed. Buildings, parking areas, and roads are the most dominant impervious cover type in all three of the subwatersheds. Anne Arundel County's 2014 impervious cover GIS layer was used for this analysis and is displayed in Figure 5.

Table 7: Patuxent River Watershed Impervious Cover

Impervious Cover Type	**Little Patuxent** Drainage Area: 27,976 acres		**Lower/Middle Patuxent** Drainage Area: 29,691 acres		**Upper Patuxent** Drainage Area: 22,417 acres	
	Acres	**Percent of Subwatershed**	**Acres**	**Percent of Subwatershed**	**Acres**	**Percent of Subwatershed**
Athletic Court	18.3	>1%	2.7	>1%	7.0	>1%
Building	1,152.0	4%	284.9	1%	314.3	1%
Deck	45.5	>1%	14.5	>1%	12.9	>1%
Driveway	301.4	1%	428.2	1%	280.3	1%
Other	101.7	>1%	6.1	>1%	42.6	>1%
Parking Area	1,441.1	5%	171.4	1%	277.8	1%
Path	60.0	>1%	13.6	>1%	15.8	>1%
Patio	69.4	>1%	20.0	>1%	26.0	>1%
Pier	0.0	>1%	0.4	>1%	0.0	>1%
Rails	40.8	>1%	0.0	>1%	8.8	>1%
Road	1,373.2	5%	453.1	2%	447.1	2%
Runway/Taxiway	31.4	>1%	0.0	>1%	3.1	>1%
Sidewalk	294.3	1%	23.1	>1%	41.0	>1%
Swimming Pool	10.1	>1%	7.4	>1%	8.8	>1%
Total	**4,939.3**	**18%**	**1,425.3**	**5%**	**1,485.4**	**7%**

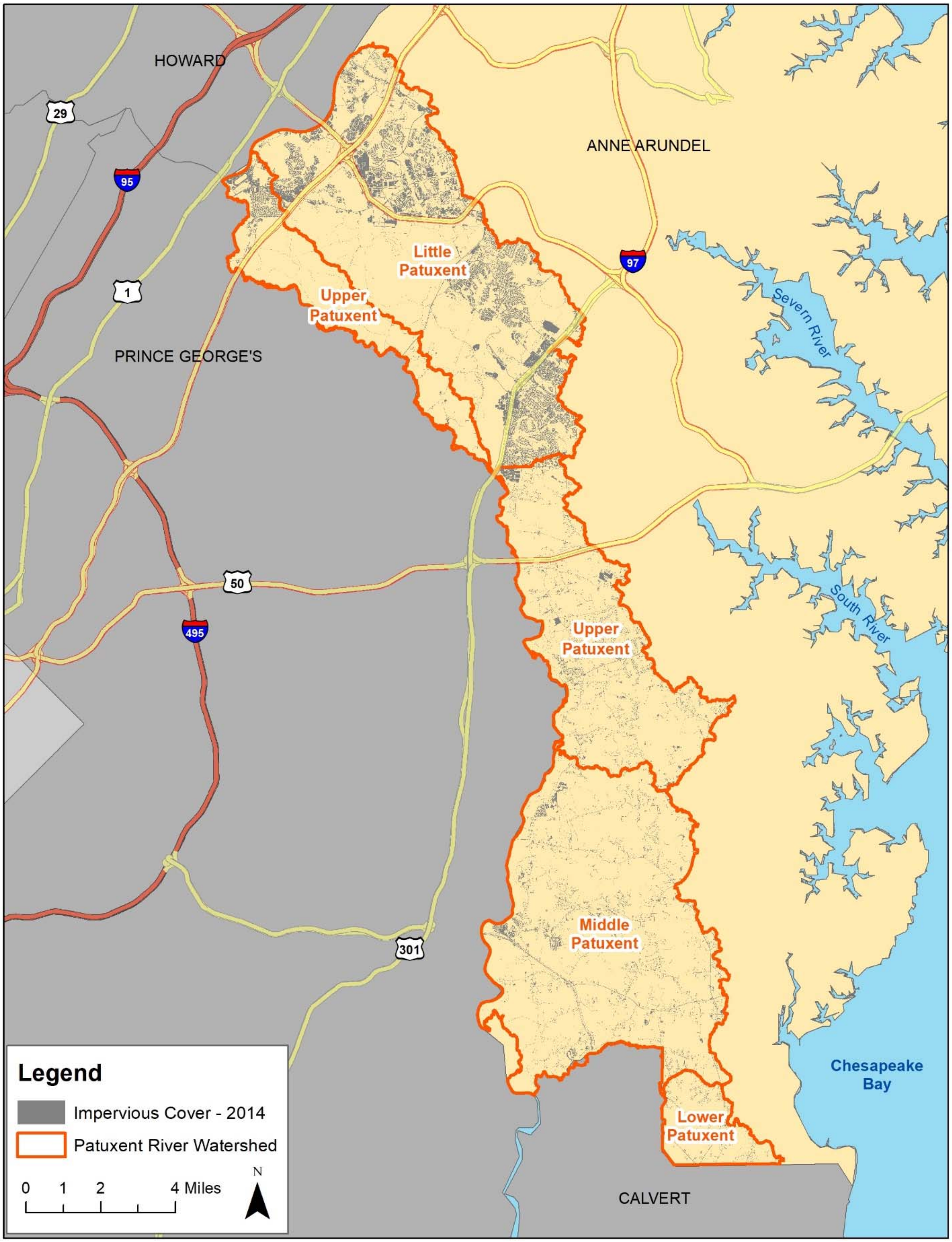

Figure 5: Patuxent River Watershed Impervious Cover Map

3 Causes and Sources of Impairment

3.1 Use Class Designations

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

The spatial extent for stream and impoundment use classes is defined in COMAR 26.08.02.08. Use Classes within the Patuxent River watershed in Anne Arundel County include Use Class I, Class I-P, and Class II. Use Class I-P stream within the study subwatersheds include the Little Patuxent River and its tributaries, including Dorsey Run and Midway Branch. The portion of the Patuxent River within the Middle Patuxent subwatershed is designated Use Class II. All other streams are designated Use Class I. There are no Use Class II-P, III, III-P, IV, or IV-P streams in the study subwatersheds.

3.2 Impairments

Waters of the Patuxent River segment of Anne Arundel County are identified on the State's draft 2018 Integrated Report of surface water quality as impaired for PCBs in fish tissue (MDE, 2018). The total PCB (tPCB) TMDL was created in 2017 to ensure that the established designated uses in the watershed are supported, specifically "fishing", "aquatic life and wildlife", and "support of estuarine and marine aquatic life and shellfish harvesting" uses. Human PCB exposure associated with the designated use "water contact reaction", including dermal contact and consumption of water, are not significant pathways for the uptake of PCBs. Rather, the human health risk associated with PCB exposure is through consumption of aquatic organisms. PCBs have been found to bioaccumlate in aquatic organisms, including fish. Bioaccumulation can occur through PCB concentrations in the water column (in dissolved and particulate form), sediments, or from consumption of other organisms containing PCBs. They can cause both acute and chronic toxic effects and have carcinogenic properties (MDE, 2017).

3.2.1 Water Quality Standards

MDE has established a tPCB fish tissue threshold of 39 ng/g or ppb (wet weight) for human consumption. Waters with tPCB fish tissue concentrations exceeding this threshold are considered impaired for PCBs in fish tissue in the State's Integrated Report. This threshold is based on 4 meals per month by a 76 kg individual (MDE, 2017).

In addition to the fish tissue threshold, Maryland has three separate water column tPCB criteria (Table 8) for human health (addresses consumption of PCB-contaminated fish), saltwater aquatic life, and freshwater aquatic life.

Table 8. tPCB Water Column Criteria

Type	Water Quality Standard Concentration (ng/L)
Human Health	0.64
Saltwater Aquatic Life	30
Freshwater Aquatic Life	14

3.3 Source Analysis

PCBs are a group of manmade chemicals first developed in the 1920's that have an extremely high boiling point, flame resistance, and chemical stability. They were used in manufacturing and commercial applications, including:

- electrical equipment such as transformers and capacitors
- hydraulic fluids, heat transfer fluids, lubricants
- plasticizers in paints, plastics, and rubber products
- pigments, dyes, and carbonless paper

Manufacturing and importation of PCBs was banned in 1979 by the U.S. EPA based on evidence of toxicity to humans and wildlife, concerns about their environmental persistence and ability to bioaccumulate. They are now listed in the top 10% of EPA's most toxic chemicals and are classified as probable human carcinogens (EPA, 2018a).

While PCBs have been banned since 1979, they do not readily break down in the environment, and remain in the air, water, and soil for long periods. Historic unregulated use of PCBs have resulted in "legacy" PCBs in the form of both hot spots and disperse contamination. PCBs have been released into the environment from inadequate hazardous waste sites, disposal of PCB-containing products in landfills not designed for hazardous waste, dumping of PCB waste, leaks or releases from electrical transformers, and burning of waste in incinerators. Additionally, products produced prior to the ban, but still in use, may contain PCBs and have the potential to contaminate land and aquatic environments through leaks, spills, improper disposal, or burning of those products (EPA, 2018a).

"New" PCBs continue to be generated and released into the environment as unintentional by-products of manufacturing certain pigments used in dyes, inks, and paints. The EPA was aware of these unintentionally produced PCBs at the time of the EPA ban in 1979, and subsequently created a rule, which allowed concentrations of up to 50 parts per million (ppm) as a result of manufacturing processes (Grossman, 2013). Newspapers, magazines, food packaging, and colored plastic bags have been found to contain PCBs. Additionally, PCBs have been found in wastewater of recycling facilities processing these materials (Grossman, 2013).

PCBs preferentially adsorb to organics and sediments and are relatively insoluble in water. As a result, hot spot contamination occurs where a PCB release occurred and slowly disperse PCBs over time with runoff or volatilization into the atmosphere. While little monitoring data exists to measure the effectiveness of PCB removal by urban BMPs, it is assumed that PCBs behave like sediment particles, and that PCB removal rates by urban BMPs are comparable to suspended sediment removal rates (Schueler and Youngk, 2015). Existing stormwater BMPs in urban areas (particularly industrial and commercial), may have been acting as a PCB trap since their installation. New stormwater retrofit practices targeted in areas with PCB presence or with historic or current industrial land use could be an effective strategy to reduce PCBs. If BMP sediments containing PCBs are removed and disposed of property, stormwater BMPs could be an effective reduction practice. However, if not removed, large storm events could cause PCBs to be flushed from the BMP to the downstream receiving stream.

PCBs are found in bottom sediments in estuarine systems and can be transported through re-suspension and diffusion in to the water column. While this can be a major source of PCBs, exchanges between sediment and water column are considered an internal load and are not considered a source in the TMDL. These load contributions are expected to decrease over time as a result of the natural attenuation of PCBs in the environment (MDE, 2017).

The transport of PCBs to the tidal segment of the Patuxent River from the Chesapeake Bay tidal influences is also a known source of PCBs. This load is also not assigned a baseline load or allocation within the TMDL since it is not considered to be a directly controllable source (MDE, 2017).

A desktop analysis was conducted to identify watershed specific potential sources and any known areas of contamination. Existing Federal, State and County records were searched to identify locations with significant potential for PCB contamination, including:

- EPA PCB Transformer Registry Database
- PCB Activities Database
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA also known as Superfund) Sites Database
- Toxic Release Inventory (TRI) Database
- MDE Land Restoration Program (LRP)
- National Response Center (NRC) Database
- MDE Historic Landfill Initiatives (HLI) Report
- Significant Wastewater Treatment Plants
- Industrial permit information using Standard Industrial Classification (SIC) codes with PCB discharge potential
- Electrical substation locations
- Military facilities
- Locations of existing Stormwater BMPs

The data compilation and analysis identified 30 potentially contaminated sites. Each potential source was classified based on its relative potential for PCB contamination. Sources with known contamination are classified as Tier 1 while those whose contamination is unknown are Tier 2 or 3. Results of the desktop source assessment are presented in Table 9.

<u>EPA PCB Transformer Registry Database</u>

The EPA requires that all transformers known to contain PCBs be registered. They maintain a database of registered transformers, which is available online to the public, and contained 26 records in Maryland, however no transformers were located within the study subwatersheds.

<u>PCB Activities Database</u>

The EPA requires that any company or person storing, transporting, or disposing of PCBs or conducting PCB research and development notify EPA and receive an identification number. This database is also available online to the public and revealed four sites within the study subwatersheds. One site, Clean Harbors Laurel, LLC, is a hazardous waste disposal company, and the other three are federal facilities: Fort Meade, National Security Agency (NSA), and Environmental Sciences Center within Fort Meade.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Sites Database

CERCLA, also known as Superfund, was a law enacted in 1980, which created a tax on the chemical and petroleum industries, which provided funding for cleaning up abandoned or uncontrolled hazardous waste sites. The act authorizes remedial response actions to reduce dangers associated with release of hazardous substances at sites listed on EPA's National Priorities List (NPL). The CERCLA database identified only one site within the study subwatersheds: Fort Gorge G. Meade. The NPL Site Narrative states that PCBs were stored and disposed of at Fort Meade and that release of PCBs to the Patuxent River has been documented (EPA, 2018b).

Toxic Release Inventory (TRI) Database

The TRI is a database of toxic chemical releases and pollution prevention activities reported by industrial and federal facilities. Facilities are required to report how much a chemical is released to the environment and/or managed through recycling, energy recovery, and treatment annually. No records related to PBCs were found in the study subwatersheds.

MDE Land Restoration Program (LRP)

The focus of the LRP is to clean up uncontrolled hazardous waste sites throughout Maryland, protecting public health and the environment by ensuring that contaminated soil, groundwater, and surface water do not pose a risk to human health and the environment. Eleven sites in the LRP database fell within the study subwatersheds, however only one had contamination records containing PCBs. This site, the Patuxent Wildlife Research Center, was further investigated in the Patuxent River PCB TMDL (MDE, 2017) and was the only potential source of PCBs identified in the document. The baseline load of total PCB (tPCB) was calculated to be 0.012 g/year.

National Response Center (NRC) Database

The NRC is an emergency call center staffed by the U.S. Coast Guard 24 hours a day that records reports of all oil or chemical release into the environment. The NRC forwards information to appropriate federal or state agencies for response. Yearly reports are available for download beginning in 1990. All available data was searched for events involving PCBs or miscellaneous transformer oil discharges, which revealed eight sites within the study subwatersheds.

MDE Historic Landfill Initiatives (HLI) Report

Prior to the 1950s, historic landfill and open burning dumps were maintained by various industries, municipalities, and/or private entities and were largely unregulated. Maryland's HLI documents these historic landfill sites; they have 456 site records and locational data on 235 sites. Four landfill sites fall within the study subwatersheds. No specific contamination risks have been identified through this initiative yet.

Wastewater Treatment Plants (WWTP)

WWTPs have recently been found to be a source of PCBs. The Back River WWTP was determined to be a point source, discharging 133.2 g/year of tPCB, in the Back River PCB TMDL (MDE, 2011). Many WWTPs are within the study subwatersheds, and while no effluent concentration data is available for PCBs, their locations will be helpful in the development of the monitoring plan. Five significant WWTP are located within the study subwatersheds, and one plant is located just north and upstream, in Howard County. Several minor WWTPs are located within the study subwatersheds, however total PCB loads from these facilities are considered insignificant (MDE, 2017).

Industrial Permits

Industrial process water facilities that have the potential to discharge PCBs were included in the Patuxent River PCB TMDL analyses. Based on guidance developed by Virginia, specific types of permitted industrial and municipal facilities with PCB discharge potential were identified based on their Standard Industrial Classification (SIC) codes (Fairfax County, 2017). No industrial process water facilities were identified within Anne Arundel County's portion of the watershed (MDE, 2017). The Permit Compliance System (PCS) and Integrated Compliance Information System (ICIS) database was searched for sites within the watershed with SIC codes associated with PCB discharge potential. This search revealed one site.

Electrical Substation Locations

While no known electrical transformers containing PCBs are registered in the EPA's database, there is the potential that electrical substations currently have electrical components that contain PCBs, as well the potential for PCB contamination in the soil or nearby water bodies from previous spills or leaks. Parcel layer data and aerial photography were used to identify four electrical substations within the study watershed.

Military Facilities

Military facilities have the potential to contain electrical transformers, circuit breakers, and other electrical equipment that contain PCBs. "Maryland Military Installations_Federal Military Installation" and "Maryland Military Installations_State Military Installation" GIS shapefiles were used to identify two federal military facilities within the study subwatersheds: Fort Meade, already identified as a potential site based on the CERCLA database, and Governor's Bridge Globecom Annex.

Table 9. Source Tracking Desktop Analysis Results

Site ID	Site Notes	Source	Tier
1	Site ID MDD980554653 Clear Harbors Laurel, LLC	Federal PCB Activities Database	Tier I
2	Site ID MDR000000984 Environmental Sciences Center	Federal PCB Activities Database	Tier I
3	Site ID MD2970590004 NSA	Federal PCB Activities Database	Tier I
4	Site ID MD9210020567 Fort Meade	Federal PCB Activities Database	Tier I
5	EPA Registry Id: 110002069813 Fort Meade	CERCLA Site	Tier I
6	CY06, chemical PCB (McCarron Ct)	National Response Center (NRC) Database	Tier II
7	CY07, Oil, Misc: Transformer (Bald Eagle Dr)	National Response Center (NRC) Database	Tier II
8	CY09, Oil, Misc: Transformer (Oak Hill Dr)	National Response Center (NRC) Database	Tier II
9	CY16, Oil, Misc: Transformer (Patuxent River Rd)	National Response Center (NRC) Database	Tier II
10	CY93, chemical PCB (Spring Green Ave)	National Response Center (NRC) Database	Tier II
11	CY94, chemical PCB (BLDG T-76)	National Response Center (NRC) Database	Tier II
12	CY94, chemical PCB (Savage Rd)	National Response Center (NRC) Database	Tier II
13	CY96, chemical PCB (Crain Highway)	National Response Center (NRC) Database	Tier II
14	Byron & Elaine Dawson Landfill Site	MDE Historic Landfill Initiatives (HLI) Report	Tier II
15	J. H. Holt Sanitary Landfill Site	MDE Historic Landfill Initiatives (HLI) Report	Tier II
16	J. H. Holt Sanitary Landfill #2 Site	MDE Historic Landfill Initiatives (HLI) Report	Tier II
17	Crofton Dump Site	MDE Historic Landfill Initiatives (HLI) Report	Tier II
18	MDL063207 Dorsey Run Advanced WWTP	Significant Wastewater Treatment Plants Shapefile	Tier II
19	MD0062596 MD City Water Reclam. Fac.	Significant Wastewater Treatment Plants Shapefile	Tier II
20	MDR000727 Piney Orchard WWTP	Significant Wastewater Treatment Plants Shapefile	Tier II
21	MD0021717 American Water Operations and Maintenance, Inc. Fort Meade WWTP	Significant Wastewater Treatment Plants Shapefile	Tier II
22	MD0021652 Patuxent Water Reclamation Fac	Significant Wastewater Treatment Plants Shapefile	Tier II
23	MDL055174 Little Patuxent Water Reclamation- Howard Co	Significant Wastewater Treatment Plants Shapefile	Tier II
24	Electrical Substation- BGE	Parcel layer/aerial photography	Tier III
25	Electrical Substation- BGE	Parcel layer/aerial photography	Tier III
26	Electrical Substation- BGE	Parcel layer/aerial photography	Tier III
27	Electrical Substation- BGE	Parcel layer/aerial photography	Tier III
28	Fort Meade	Federal Military Facility	Tier I
29	Governors Bridge Globecomm Annex	Federal Military Facility	Tier II
30	Patuxent Wildlife Research Center	MDE Land Restoration Program (LRP)	Tier I
31	Brandywine Enterprises, SIC Code 5093, Scrap and Waste Materials	EPA Permit Compliance System (PCS-ICIS)	Tier II

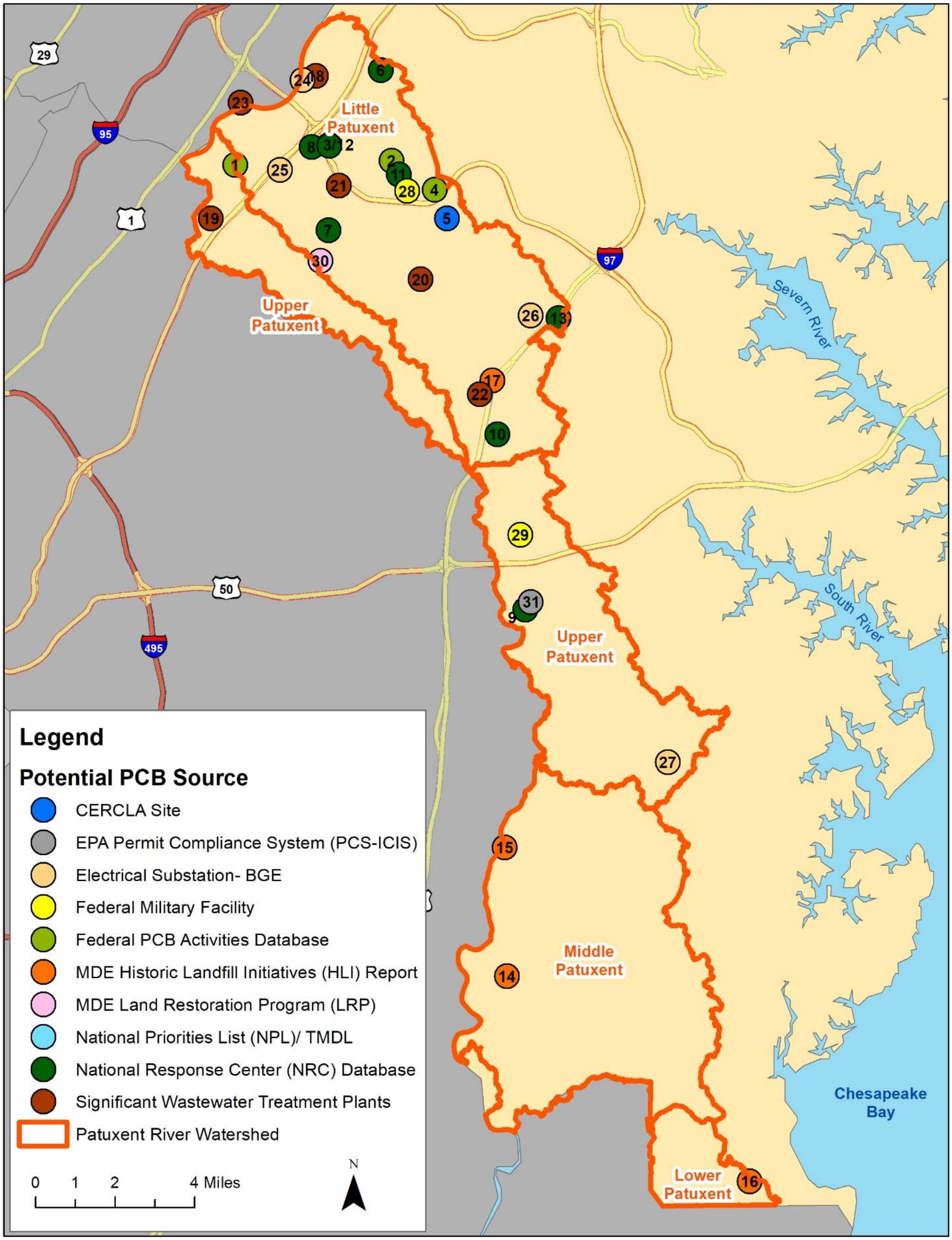

Figure 6: Potential PCB Contamination Sites Map

Stormwater BMPs

Stormwater BMPs, specifically stormwater ponds, have the potential to accumulate PCB over time and can have significant amounts of soil contamination. Contaminated stormwater ponds may be a source of PCBs to downstream waterbodies during large storm events if sediments are washed out. An analysis of the stormwater BMPs located within in the study watershed was conducted to identify the facilities with the greatest potential for PCB contamination.

The BMP types that were included in the analysis and assumed to be most likely to accumulate PCBs over time include:

- Infiltration Basin
- Infiltration Trench
- Dry Swale
- Micropool Extended Detention Pond
- Multiple Pond System
- Pocket Pond
- Extended Detention Structure, Wet
- Extended Detention Structure, Dry
- Retention Pond (Wet Pond)
- Detention Structure (Dry Pond)
- Extended Detention Wetland
- Shallow Marsh

A prioritization of the 763 BMPs with the above listed BMP types was conducted. This prioritization involved two separate analyses. First, land use data was used to determine the types of land use within the drainage area of each BMP. BMPs with drainage areas containing industrial land use are more likely to have PCB contamination and monitoring of these ponds should be prioritized. Of the 763 BMPs with priority BMP types, 686 had corresponding GIS polygon drainage areas. For the 77 BMPs without drainage area polygons, a 200-foot buffer was used to estimate the drainage area in order to capture the adjacent land use types. Older BMPs were identified as having greater potential for accumulating PCBs, therefore BMP built date was used to prioritize the older BMPs. Table 10 presents the scoring system and results of the BMP prioritization. BMP data, including BMP ID, type, built date, and prioritization Tier is presented in Appendix A.

Table 10. BMP Prioritization Scoring System and Results

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="2">Land Use in Drainage Area</th></tr>
<tr><th>Industrial</th><th>Residential and/or Commercial</th></tr>
<tr><th rowspan="2">Built Date</th><td>1981- 2000</td><td>Tier 1
19 BMPs</td><td>Tier 2
108 BMPs</td></tr>
<tr><td>2001-2018</td><td>Tier 2
21 BMPs</td><td>Tier 3
420 BMPs</td></tr>
</table>

In addition to the land use analysis and prioritization, a second analysis was conducted to identify BMPs located near previously identified potential PCB sources. Each potential PCB source site was individually reviewed to determine if any BMPs were located down gradient and within close proximity. A total of 5 BMPs were identified in this analysis and were designated as Tier 1 sites. Four of these sites were ranked Tier 2 or Tier 3 in the land use analysis.

In total, 24 BMPs were ranked Tier 1, the highest priority, and should be monitored first, as these are the oldest facilities with industrial land use present within the drainage areas. A total 127 Tier 2 sites and 418 Tier 3 sites were identified. Figure 7 displays the location of these prioritized BMPs.

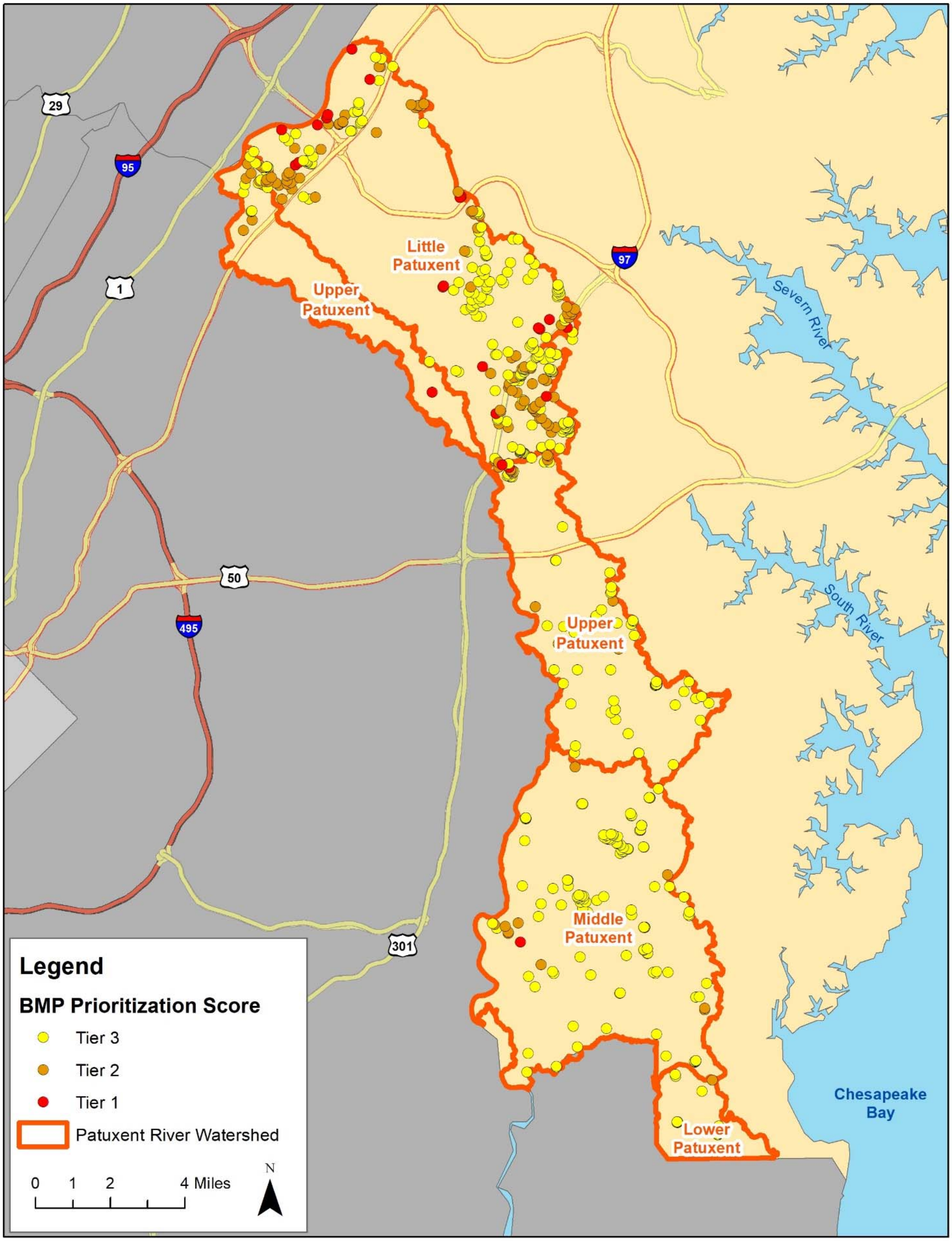

Figure 7. BMP Prioritization

4 Management Measures

This section will describe the measures to be implemented to work towards the County's PCB reduction goals for the Patuxent. Primarily they include 1) Implementation of stormwater BMP practices, restoration activities, and programs that reduce or remove sediment, and 2) Monitoring to identify with more certainty areas, or 'hot spots' of PCB contamination for remediation.

The County's strategy for addressing PCB load reductions include two major elements. The first relies on traditional stormwater management approaches that reduce sediment loading and the associated PCBs. PCBs are strongly bound to sediment and in many watersheds can be a diffuse source of pollution across the landscape (Schueler and Youngk, 2015). Anne Arundel County is already implementing stormwater management retrofits and other BMPs such as street sweeping, inlet cleaning, stream restoration, and shoreline restoration to meet NPDES permit requirements for impervious surface treatment and the Chesapeake Bay nutrient and sediment TMDL, and to meet local sediment TMDLs for the Upper Patuxent and Little Patuxent watersheds. It is understood that BMPs implemented to meet these other requirements will help to reduce PCB loading as well. The types of BMPs slated for implementation are included below in section 4.1 with descriptions of the expected pollutant load reductions in section 5.

It is anticipated that the BMPs and programs slated for implementation to meet impervious treatment goals, and local sediment TMDLs will ultimately fall short of providing full compliance with the Patuxent PCB TMDL given the 99.9% reduction. Therefore, the County will be implementing a source tracking and monitoring program to identify and prioritize subwatersheds and drainage areas with the highest PCB concentrations, and ultimately sites with PCB contamination that can be referred to state and federal agencies for remediation efforts.

4.1 Best Management Practices

Table 9 below includes a list of the typical categories of urban stormwater BMPs and restoration practices implemented by municipalities for impervious treatment and water quality benefits. The practices are listed with the associated sediment reduction values for reference. More details on the specific BMPs, levels of implementation, and modeled PCB reductions are described in section 5.

Table 11: Typical Stormwater BMPs and Restoration Practices

BMP	Sediment Reduction
Bioretention A/B soils, no underdrain	90%
Bioretention C/D soils	55%
Bioswales	80%
Dry Detention Ponds	10%
Dry Extended Detention Ponds	60%
Impervious Surface Reduction*	-
Infiltration	95%
Inlet Cleaning	420 lbs/wet ton material collected
Step Pool Stormwater Conveyance (SPSC)**	80%
Shoreline Stabilization	164 lbs/linear ft
Stream Restoration	248 lbs/linear ft
Street Sweeping	420 lbs/wet ton material collected
Urban Filtering	80%

BMP	Sediment Reduction
Vegetated Open Channels A/B soils	70%
Wet Ponds or Wetlands	60%

Sources: Chesapeake Assessment Scenario Tool (CAST) documentation
* Calculated as a land use change to a lower loading land use
**Outfall enhancement with SPSC modeled as bioswales in CAST

4.2 Monitoring Plan

4.2.1 Overview

Recent guidance prepared for the Chesapeake Bay Program Water Quality, Toxic Contaminants Workgroup (TetraTech, 2016) identifies four steps (Figure 8) for the development of PCB trackdown studies to support TMDL implementation. This guidance was developed using the results of a literature review, expert interviews, and PCB trackdown success stories.

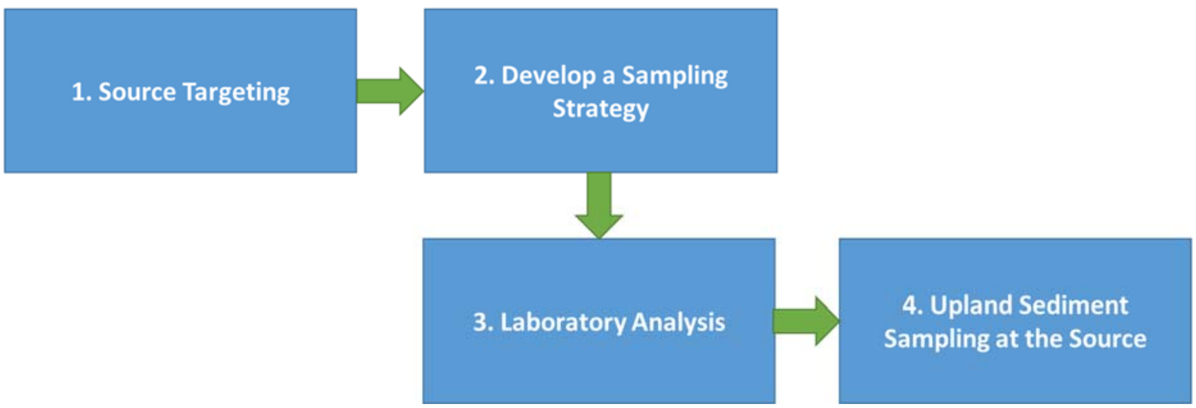

Figure 8. Four steps for the development of PCB trackdown study (Source: TetraTech, 2016)

The purpose of the monitoring plan is to lay out a sampling strategy to identify and characterize source areas and active sources of PCBs in the Patuxent River watershed in Anne Arundel County. The results of the monitoring will provide the County with information to help target and optimize the Anne Arundel County PCB TMDL Implementation Plan to achieve the required 99.9% TMDL load reduction.

The source analysis identified one known PCB contamination site, the Patuxent Wildlife Research Center, with PCB soil contamination (MDE, 2017). Soil concentration data was obtained from MDE Land Management Administration's (LMA) contaminated site survey and investigation records (MDE 2017). The location of the contaminated site is displayed in Figure 9.

Furthermore, source targeting identified numerous locations with significant *potential* for PCB contamination. Each potential source was classified based on its relative potential for PCB contamination. Sources with known contamination or presence of PCBs are classified as Tier 1 while those whose contamination is unknown are Tier 2 or 3. Tier 1 sites within the watershed include several federally owned properties such as U. S. Army Fort George G. Meade, and the National Security Agency (NSA), as well as one private company Clean Harbors Laurel, LLC that primarily operates in the hazardous waste collection and disposal business.

Ambient water quality monitoring sites to identify concentrations of PCBs in the County are limited to a single location on the Patuxent River mainstem. This location is the United States Geological Survey (USGS) stream Gauge station 01594440 located at Rt. 301, which is a short distance downstream of the confluence with the Little Patuxent River. Therefore, given the high number of potential sources in the Little Patuxent River subwatershed the recommended sampling approach is a source tracking, investigative approach starting at the lowest point in the subwatershed and working upstream to determine the presence/absence of PCBs and, if present, begin to narrow down the source to specific stream reaches or drainage areas. This bottom-up approach is similar to what was used in *Project Trackdown* (Benoit et al., 2013 and 2016) to identify sources of PCBs in tributaries to Lake Ontario; and is planned to be used by other local Maryland County Phase I MS4s to meet their implementation plan requirements.

The data generated from the monitoring effort can also be used to derive relationships between PCB concentrations, source areas, and sediment that can be modeled to quantify the NPDES-regulated stormwater loadings of PCBs. To optimize the monitoring plan, a pilot sampling strategy is recommended, using a phased approach, as described below.

4.2.2 Pilot Subwatershed

The source analysis showed that the Little Patuxent River subwatershed had the greatest concentration of sites with potential PCB contamination as well as one site with known contamination (Figure 10). Therefore, this subwatershed is recommended as the focus of the pilot monitoring effort to narrow down sources of PCBs. The Little Patuxent River subwatershed is approximately 44 mi^2 in area within Anne Arundel County, with an additional 59 mi^2 in area that drains into Anne Arundel County from neighboring Howard County. The Anne Arundel County portion of the subwatershed is composed of 17 smaller drainage areas that range in size from 0.2 to 11.9 mi^2 (Figure 3) and collectively flow into the Patuxent River mainstem.

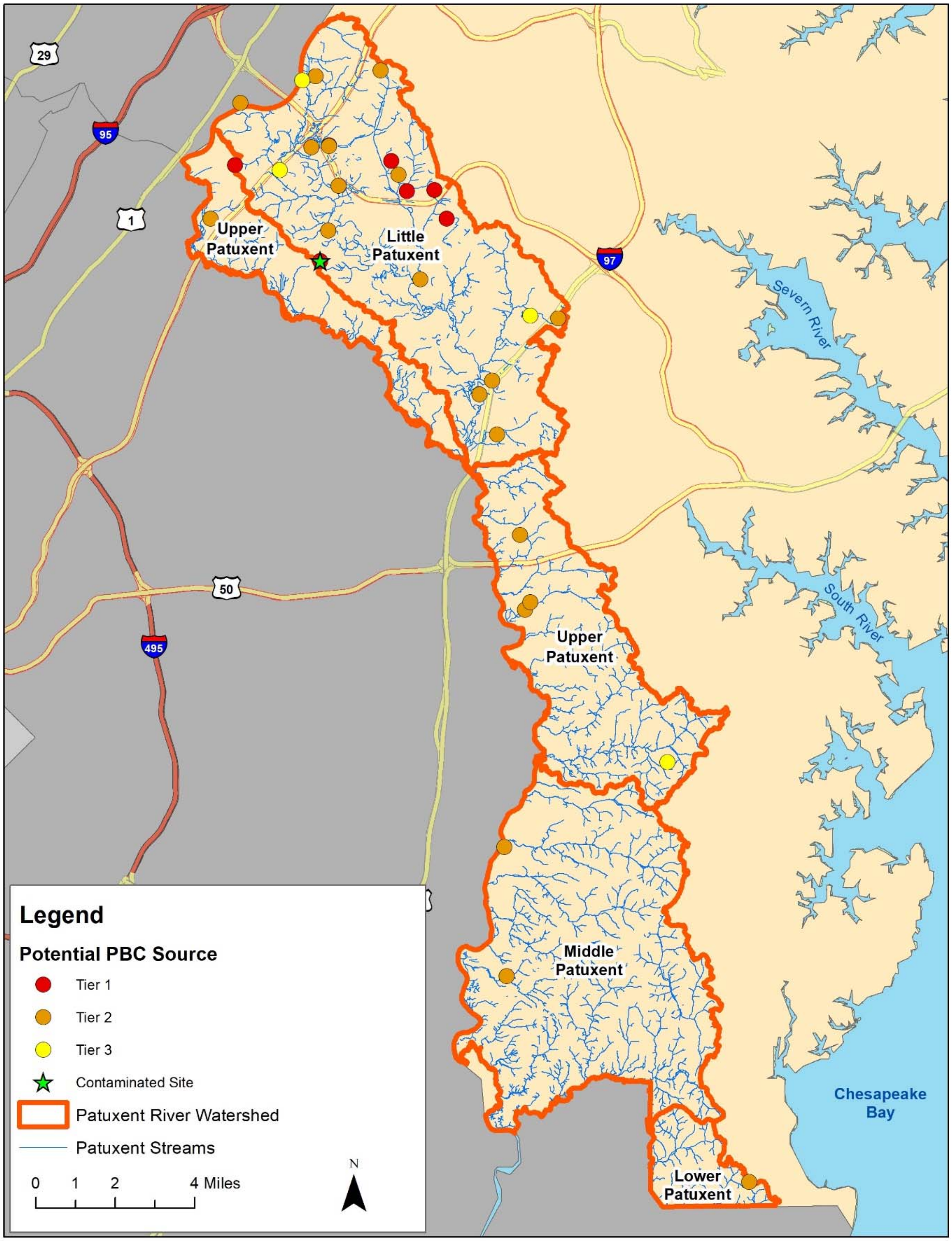

Figure 9. Tier 1, Tier 2, and Tier 3 sites ranked based on risk for PCB contamination in the Anne Arundel County Patuxent River watershed

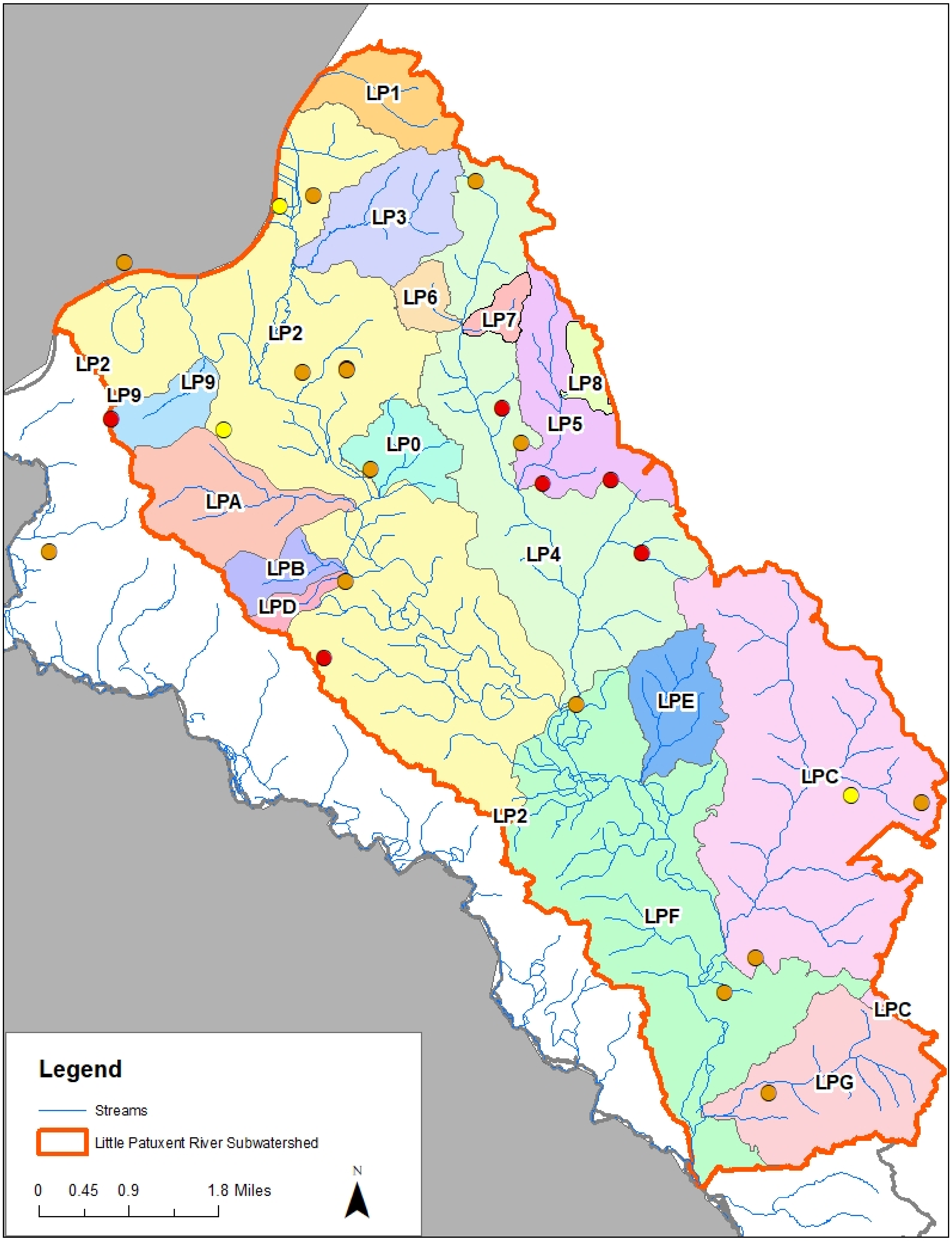

Figure 10. Little Patuxent River subwatershed drainage areas

4.2.3 Sampling Options

A review of PCB trackdown studies (TetraTech, 2016) found that much of the literature was in agreement that water and sediment are the best matrices to sample for PCB trackdown. Water samples can be collected using passive samplers, whole water samples, or grab samples. Table 12 compares some of the common and emerging sampling methods.

Table 12. Comparison of PCB Sampling Methods

Method	Pros	Cons
ISCO samplers	Collects total PCBs (dissolved and particulate) Most quantitative method Used for wet or dry sampling	High initial cost
Grab samples	Collects total PCBs (dissolved and particulate) Quicker and less expensive than ISCO samplers	More challenging to get representative samples or composites Labor intensive
Siphon samplers	Collects total PCBs (dissolved and particulate) Passive approach saves money compared to auto or grab sampling Prevents mixing and entrainment of sediment from high flows	Deployment can be difficult Cannot be readily purchased so must build
Mounted stormwater samplers	Passive approach saves money compared to auto or grab sampling Collects total PCBs (dissolved and particulate)	Deployment can be difficult
PISCES (passive in situ continuous extraction samplers)	Integrates results over an extended sampling period (7+ days) Passive approach saves money compared to auto or grab sampling	Deployment can be difficult Only captures dissolved PCBs Less reproducible than grab samples Sampling medium is toxic/requires careful disposal
SPMD (semi permeable membrane devices)	Integrates results over an extended sampling period (7+ days) Passive approach saves money compared to auto or grab sampling Sampling medium not toxic	Deployment can be difficult Only captures dissolved PCBs
POCIS (polar organic chemical integrated sampler)	Integrates results over an extended sampling period (7+ days) Passive approach saves money compared to auto or grab sampling	Deployment can be difficult Typically used for water-soluble chemicals
ELISA (enzyme-linked immunosorbent assays)	Quick and inexpensive method to sample sediment Can be applied in the field or lab	

The most common type of sampler used in the reviewed literature (TetraTech, 2016) were passive samplers because they provide time-integrated sampling over several days or weeks. The most commonly used sampler was PISCES. Sediment sampling using ELISA was found to provide a quick and inexpensive tool for upland sampling once a source has been identified (Belton et al., 2008). Sediment sampling is generally more useful when investigating smaller areas, keeping in mind that the results don't necessarily characterize local conditions since the source of the sediment may be far upstream (TetraTech, 2016).

4.2.4 Laboratory Analysis Options

There are three EPA-approved lab analysis methods for PCBs, which vary in their detection limits, specificity, and cost (Table 13). A modified EPA 1668 'Trackback' method, referred to as 1668TB, has been developed by Pace Analytical Services and used successfully by the Delaware River Basin Commission for source trackback, although it is not technically an EPA-approved method. The 1668TB method is a screening method based on EPA 1668 that reports homologue groups only, but costs significantly less than method 1668C at around $400 per sample while providing similar detection limits.

Table 13. PCB Analysis Methods

Method	Detector	Detection Limits	Cost per Sample	Notes
EPA 1668C	High resolution gas chromatograph/ high resolution mass spectrometer	0.3- 0.8 ppt (0.3-0.8 ng/L)	$750- $1,000	Highest resolution and highest cost method; identifies presence and concentration of all 209 congeners; does not rely on fingerprinting to the aroclor*; method is not biased by weathering; requires specialized equipment and highly trained operator
EPA 680	Gas chromatograph/ mass spectrometer	0.1- 0.5 ppb (100-500 ng/L)	$475	Detects presence of homologs or 10 "families" of congeners; reporting total concentration for homolog groups; detects the presence of PCBs not in the form of aroclors and aroclors that are weatherized or were not detected by 8082.
EPA 8082	Gas chromatograph/ electron capture detector	0.1 – 0.5 ppb (100-500 ng/L)	$85	Low resolution method; reports concentrations for each aroclor; may underreport PCBs
Modified Method				
EPA 1668TB	High resolution gas chromatograph/ low resolution mass spectrometer	0.3- 0.8 ppt (0.3-0.8 ng/L)	$400	Detects presence of homologs or 10 "families" of congeners; reporting total concentration for homolog groups;

** An aroclor is a mixture of PCB congeners*

The detection limits and approximate cost in Table 13 are primarily from the Delaware Department of Natural Resources and Environmental Control (DNREC, 2014). However, detection limits often vary by lab, as do costs, and some labs have developed modified versions of these methods. For example, Botts et al. (2007) used a variation of EPA Method 1668 with low resolution mass spectrometer in lieu of more expensive high resolution. This method provided sufficient resolution and confirmation of detected congeners at a relatively affordable price (Botts et al., 2007). In Maryland, both the University of Maryland Center for Environmental Science (UMCES) and University of Maryland Baltimore County (UMBC) offer a modified version of EPA 8082 that identifies individual congeners. Table 14 presents costs and detection limits specific to two local labs (CWP, 2018).

Table 14. Local Lab Analysis Options

Lab	Method	Detection Limit	Cost
UMCES Chesapeake Biological Lab	Modified version of EPA 8082; can identify upwards of 120 congeners	0.001-0.01 ng/L	$1,117/sample
ALS Environmental	EPA 1668; can identify all 209 congeners	0.109-0.193 ng/L	$950/sample

Of the studies reviewed by TetraTech (2016), USEPA Method 1668 was the most common methodology for analyzing PCB congeners and is the recommended analysis method in almost all of the reviewed studies. Benoit et al. (2016) note that the method chosen should have detection limits that are suitable for distinguishing background concentrations from potential sources. In that study, background concentrations typical of urban environments were determined to be < 10 ng/L. MDE and the Virginia Department of Environmental Quality (VADEQ) recommend the use of USEPA Method 1668 or a similar method that provides congener specific results and low detection levels necessary to identify the low PCB concentrations associated with a diffuse source (Tetra Tech, 2014). DNREC also requires this method for PCB analysis for all samples associated with the investigations of sites that are adjacent to receiving waters of Clean Water Act 303-d listed waterways for PCBs (DNREC, 2014). The ability to identify a specific congener can also aid in identifying a source because congeners can be specific to a particular use or industry.

4.2.5 Recommendations

The County is proposing PCB monitoring that will be conducted in three phases as described below with details on the selection of sites, the field sampling method to be used, and the analytical methods. In general the three phases are:

- Initial Phase (Phase 1) – Initiate subwatershed scale survey, sample core stations
- Trackback Phase (Phase 2) – Perform positive subwatershed bifurcated trackback
- Confirmation Phase (Phase 3) - Confirm contamination sources

4.2.5.1 Initial Phase (Phase 1)

The Initial Phase of the monitoring plan is based upon the following known facts about PCBs in the Patuxent River basin.

1. MDE's monitoring to support TMDL development included one station in subwatershed segment SW-15, which includes Anne Arundel County. This station is USGS stream Gauge station 01594440 located at Rt. 301 in Anne Arundel County.
2. This monitoring station detected PCB concentrations which averaged 3.75 ng/l, almost four times higher than the 14 other non-tidal stations that were sampled.
3. The monitoring occurred during four storm events which covered the full range of the flow duration curve for this station; however, only four samples were collected.
4. MDE's monitoring found elevated levels of PCBs in tidal sediments, suggesting sediment transport to be a likely source.

Based on these facts, the recommended strategy is to identify the lowest points in each drainage area that contain a potential PCB source (Figure 11). These locations would serve as the 'core' sampling stations that help identify subwatersheds with positive PCB results. However, it should be noted that these locations are subject to change and may require slight shifts in location due to landowner access constraints. Since Fort Meade is Federal Government property and beyond the jurisdiction of the County, sampling will occur just downstream of the military base, with sampling locations serving as 'input' stations to help identify where there may be PCB inputs to the County. Additional 'input' sampling locations are proposed on the Little Patuxent River mainstem and Dorsey Run where they enter the County. These stations will provide information on PCB levels entering the Patuxent River watershed from neighboring Howard County. If PCBs are identified as entering the County from either of these 'input' stations, the information will be provided to the corresponding entity since continued trackback will not be conducted beyond the County's jurisdiction.

Monitoring should occur with the objective of identifying the presence or absence and relative magnitude of PCB concentrations. To reduce manpower costs, integrated SPMD (semi permeable membrane devices) passive samplers are recommended. SPMD passive samplers (Figure 12) are installed directly in the stream and continuously interact with the surface water to adsorb PCBs in the source water over a period of several weeks. This type of sampling provides a comprehensive, reliable way to collect samples over an extended period of time and require only two visits, one for installation and one for recovery, minimizing the need to target and capture unpredictable storm events. While the devices are not commercially available for purchase, SiREM offers services to provide stock samplers for use or custom design samplers for specific applications.

Following MDE's review and approval of the County's monitoring plan, the County intends to develop a Quality Assurance Project Plan (QAPP) for the PCB sampling included in the recommendations below. The QAPP will include details of training, field sampling, sample chain of custody, laboratory methods, and reporting elements. The QAPP will specify the required quality control check and documentation elements to be followed so that method and data quality objectives can be met.

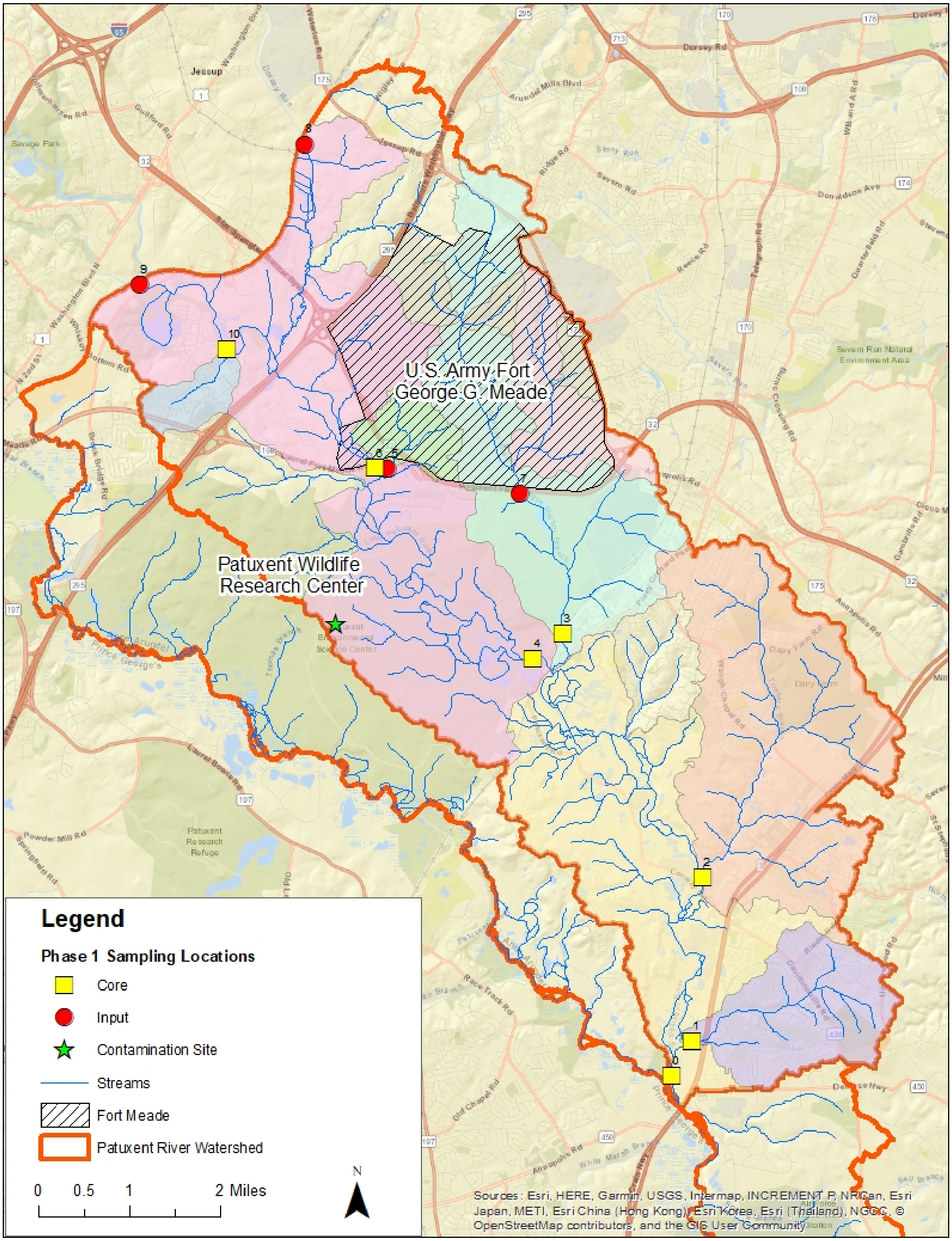

Figure 11. ***Sampling locations for Initial Phase***

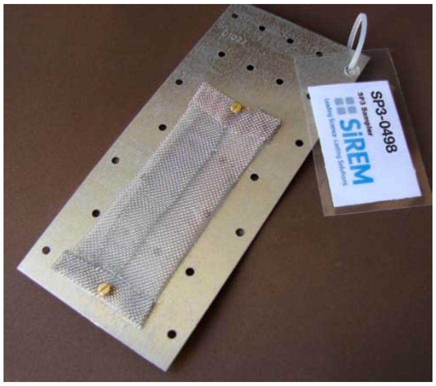

Figure 12. ***Passive sampler device for surface water (Source; SiREM)***

Passive sampling will occur for a minimum of four (4) weeks at each location. If the monitoring indicates a detectable concentration of PCBs at any of the core stations, new sampling stations will be identified in the upstream tributary below major confluences of smaller watersheds. These will be sampled as part of Phase 2 using the same methods as in Phase 1. Once PCBs are detected at any of the core stations, no further samples will be taken there. If two or more of the core stations have detectable PCB concentrations in the Phase 1 sampling, the relative magnitude of the concentration and estimated flow can be used to prioritize subsequent sampling for Phase 2. If no PCBs are detected at a core monitoring station, no further sampling is needed within the upstream drainage area. If PCBs are not present at any of the initial sites, the same approach may be repeated on tributaries without potential PCB sources. However, it is unlikely that none of the initial sites will have PCBs given the use of the most robust analysis method and given the known and potential PCB sources in this watershed.

A low-level detection method is recommended given the need to identify presence or absence of PCBs with confidence, and that current research/desktop analysis has not identified any 'smoking gun' for PCB contamination at high levels in the Anne Arundel County Patuxent River watershed. The EPA method 1668 (or a modified version of another method with detection levels comparable to 1668) is the recommended method for this monitoring approach in order to capture the range of concentrations measured at the USGS station at Route 301 (50 – 12,700 ng/L). Furthermore, MDE currently recommends EPA method 1668 for analysis of total PCBs for addressing the PCB Stormwater-Waste Load Allocations. Therefore, EPA 1668 is recommended for analysis of PCB samples in the Anne Arundel County Patuxent River watershed.

4.2.5.2 Trackback Phase (Phase 2)

For sites where PCBs are present, the Trackback Phase involves a bifurcated trackback sampling approach to narrow down the source areas to smaller, confined drainage areas. This approach reduces cost by first sampling on the mainstem about halfway up the drainage area below a major confluence using the same methods as in Phase 1. Depending on the sampling results, there are a number of decision points. If PCBs are absent, then an additional sampling location can be identified below a major confluence between the initial Phase 1 location and the Phase 2 location. If PCBs are present, another upstream sampling location can be identified to continue narrowing in on the source area. The sampling sites chosen should represent fairly large drainage areas. For each Phase 1 station with detectable PCBs, up to 10 new upstream locations will be sampled as part of Phase 2, although the number of stations needed may be smaller depending on the number of hits, the size of the drainage area, and layout of the stream network. If results are needed more quickly, additional sites can be sampled at once, at major confluences within the drainage area. However, this will increase the monitoring cost. Figure 14 provides an example of an iterative Phase 2 sampling approach for a Phase 1 station with confirmed PCB presence.

As with the Initial Phase, passive sampling with integrated SPMD samplers is recommended across all sites in the Trackback Phase. The SPMD passive samplers will be deployed directly in the stream over a period of several weeks to collect time-integrated samples. After 4 – 6 weeks in the stream, samplers will be collected and shipped to the laboratory for processing and analysis using method EPA 1668.

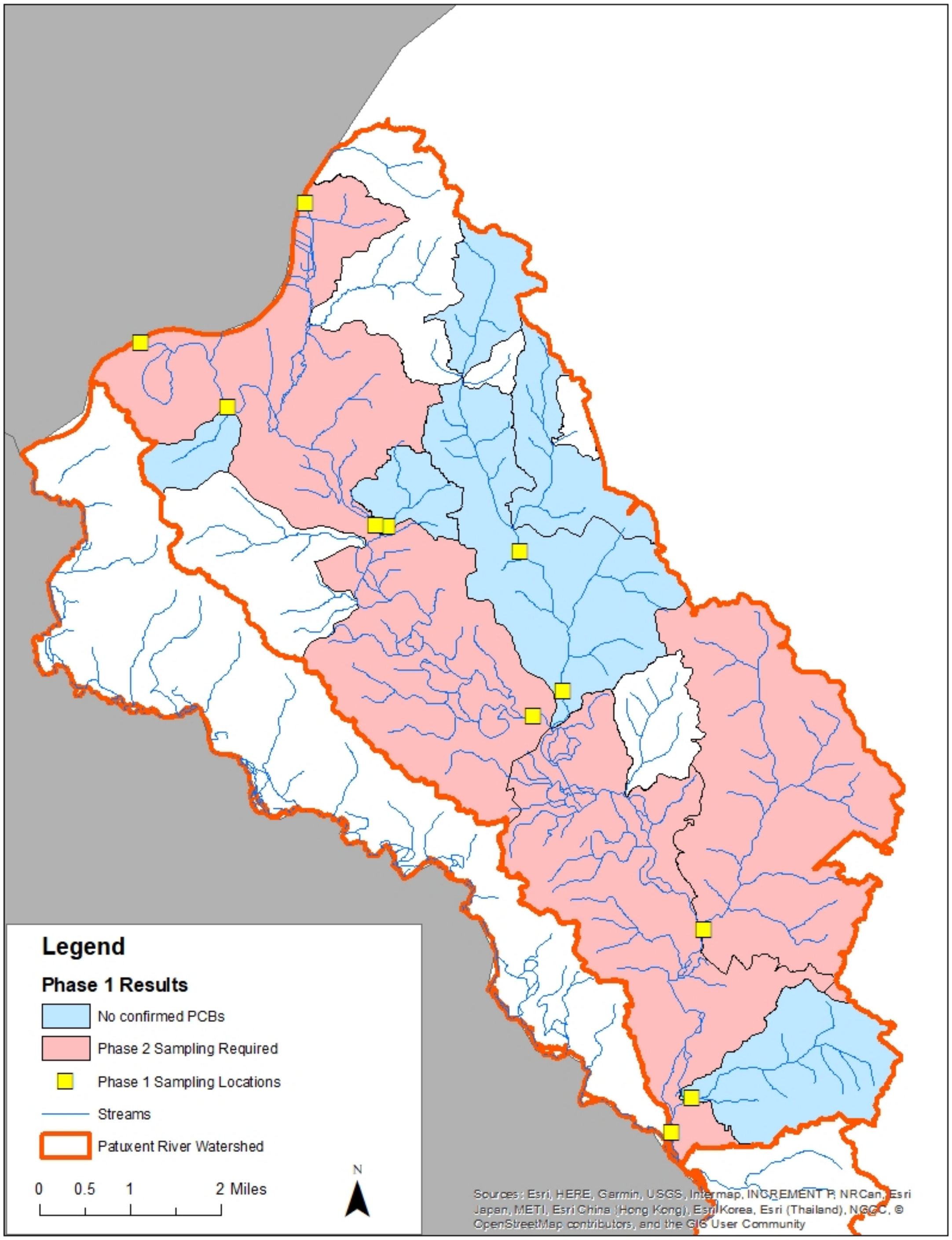

Figure 13. ***Example results of Initial Phase sampling***

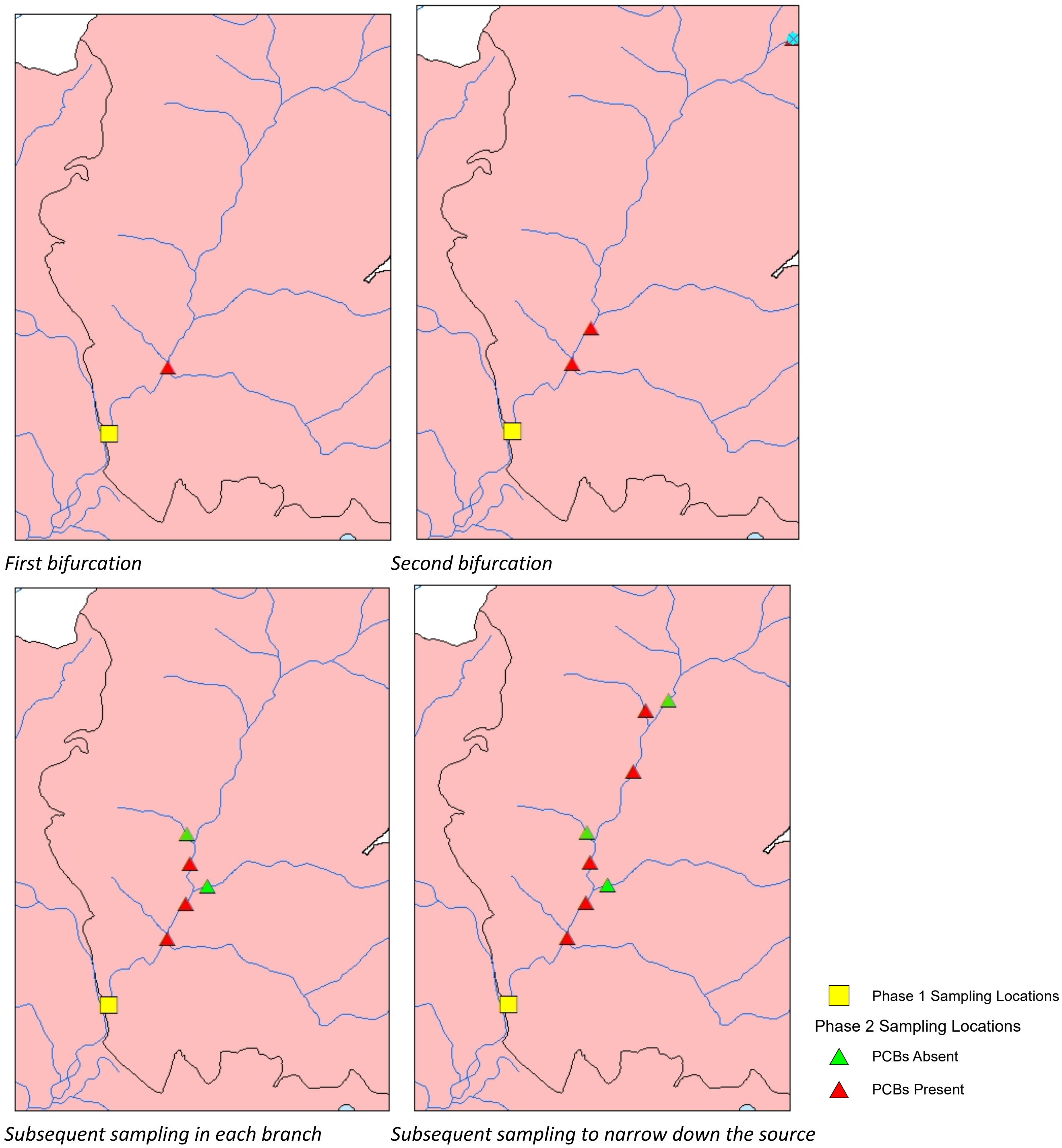

Figure 14. Trackback Phase sampling approach for drainage area with PCBs present

4.2.5.3 Confirmation Phase

The objective of Confirmation Phase monitoring is to identify specific sources of PCBs and quantify the level or amount of contamination. The exact sampling locations and methods will depend on the Trackback Phase results, but may include additional stream sampling on smaller tributaries, sampling at depositional areas in the stream that may be active PCB-contaminated sediment sources, upland sediment sampling at or below sites with high potential for PCB contamination (e.g., in street soils in front of suspected facilities), or sampling at or below stormwater outfalls. This phase will help to locate the original source by matching PCB types located in hotspots in the watershed to PCB types found in the sediment at the potential upland sources. Belton et al (2008) provides an example of using ELISA to sample sediment at potential sources and confirm that the PCBs at the sites matched the PCBs identified in the tributaries and point source outfalls discharging to the impaired waterbody. Benoit et al. (2016) provides a methodology for sampling depositional sediments in streams as an additional line of evidence for PCB trackdown studies.

4.3 Remediation

Sites identified through monitoring to have contamination at levels above background will be prioritized for cleanup. If a current active source is identified, it will be controlled and contaminated material remediated. Sites on County property will be the responsibility of the County to address cleanup, working with EPA and MDE on proper methods. For contamination on private property, the County will discuss with EPA and MDE an appropriate course of action and identify the party responsible for remediating the contamination.

MDE offered guidance to MS4 on the site remediation process through a presentation related to Montgomery County's PCB TMDL (MDE 2014e). The contamination source is first reported to EPA. The remediation standard under the Toxic Substances Control Act (TSCA) is 1 ppm. EPA will review the contamination levels, site conditions, and potential exposure pathways before making an action decision. If EPA determines no action on their part, the County will coordinate with MDE's Land and Materials Administration (LMA) to determine the appropriate action. At the state and local level there are currently no regulations in place to force a land owner to remediate. Two programs can be used for voluntary cleanup including the Voluntary Cleanup Program (VCP) and the Controlled Hazardous Substances (CHS) program.

The remediation method will be specific to the site and the potential exposure pathways. Contaminated sediments and soils can be capped or trapped in-situ to eliminate or reduce volatilization, erosion, or re-suspension. Areas with higher risk of exposure may be dredged or excavated to remove the contaminated sediments. Methods of disposal will depend on the concentration of PCBs. If the PCB concentration of the material removed is less than 50 ppm, in most cases the material may be disposed of in a municipal landfill or equivalent. Under the TSCA, if the PCB concentration of the material removed is 50 ppm or greater, the requirements for disposal vary by the type of material and concentration and may include:

- Incineration in a TSCA-approved facility
- Disposal in a TSCA-approved chemical waste landfill
- Disposal by an EPA-approved alternative method

Researchers are developing new methods for remediation that have promise for trapping or removing PCB laden sediment. These techniques include PCB-degrading bacteria or fungi to break down the PCB, or activated carbon to bind the PCB reduce the bioavailability of toxic material in the sediment. These methods appear to have more applicability in downstream receiving waters and tidal estuary systems. Their use could be a combined effort of the jurisdictions responsible for addressing the TMDL.

Anne Arundel County is currently pursuing a pilot investigation of in-situ treatment of PCB contaminated sediment in a stormwater detention pond using activated charcoal amendment. This investigation, located in the Severn River watershed, will provide information that will be used to inform decisions on how to remediate PCB contamination within the Patuxent watershed.

5 Expected Load Reductions

This section of the report includes a summary of the modeling approach and baseline load modeling (details are in section 1.2), and provides a discussion of the expected load reductions with implementation of the plan. Load reductions associated with currently planned stormwater BMPs are included, however the results of the source tracking and monitoring plan will determine the number and extent of contaminated sites for remediation. Load reductions for those potential sites are unknown and not currently estimated.

5.1 Modeling Approach

Section 1.2.1 describes in detail the connection between PCB and sediment and the selection of the modeling methods used in this planning effort, specifically for the baseline model, which translates and disaggregates the PCB load specific to Anne Arundel County's MS4 stormwater sector. The baseline modeling is completed in CAST, which provides the sediment (TSS) load as of the baseline year, 2014. The PCB sediment concentration of 3.3 ng/l referenced in the TMDL is used to relate the TSS load to a PCB load.

The modeling approach for determining current progress reductions through the end of FY2018 and for currently planned BMPs is consistent with the baseline model, using CAST and the PCB sediment concentration factor. CAST calculates pollutant loads and reductions calibrated to the Chesapeake Bay Program Partnership Watershed Model (CBP WM Phase 6).

CAST estimates of load reductions for point and nonpoint sources including agriculture, urban, forest, and septic loading. Each BMP provides a reduction for nitrogen, phosphorus, and sediment, along with other pollutants. Load reductions are not tied to any single BMP, but rather to a suite of BMPs working in concert to treat the loads. CAST calculates 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 CAST. Sediment reduction credit for vacuum-assisted street sweeping and inlet cleaning is calculated following methods described in MDE (2014a) based on the mass of material removed.

CAST provides loads at two different scales: edge of a small stream (EOS) and delivered to the tidal portion of the Chesapeake Bay (EOT). 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.

5.2 Baseline Loads and Required Reduction

Baseline levels (i.e., land use loads with baseline BMPs) from 2014 conditions in the PAXTF watershed were calculated using the MDE 2014 Progress BMPs in CAST. Results of the baseline load modeling are presented in Table 15 with the resulting disaggregated and translated 2014 baseline PCB load (25.41 g/yr) the reduction percent (99.9%) and the required reduction (25.39 g/yr). Details of the baseline modeling can be found in section 1.2.

Table 15. Baseline Load and Required Reduction

Local TMDL and Baseline Year	Patuxent River – Tidal Fresh 2014
Baseline Load and TMDL WLA	**PCB g/yr**
Baseline Scenario Load	25.41
Required Percent Reduction	99.9%
Required Reduction	25.39
Local TMDL WLA	0.03

5.3 Progress Implementation and Load Reductions

Anne Arundel County maintains an extensive geodatabase of stormwater urban BMP facilities, restoration practices, and water quality improvement projects. Current progress BMP implementation from the 2014 baseline year through FY2018 in the PAXTF watershed is shown in Table 16. Approximately 148 acres of County Phase I MS4 land has been treated by stormwater BMPs (SPSC and wet ponds/wetlands) through FY2018 in addition to 1,161 linear feet of stream restoration and the implementation of other inlet cleaning and street sweeping practices.

Table 16: BMP Implementation Baseline through FY2018

BMP	Unit	2014 Baseline	2014 – 2018 Restoration	2014-2018 Restoration Cost
Inlet Cleaning*	lbs removed	0.0	3,797	$29,887.21
SPSC	acre	0.0	7.91	$830,487.43
Stream Restoration	linear feet	0.0	1,161.0	$336,490.00**
Street Sweeping*	lbs removed	0.0	3,797	$29,887.21
Wet Ponds or Wetlands	acre	0.0	139.7	$1,785,069.00

Source: Anne Arundel County NPDES geodatabase
*Street Sweeping and Inlet Cleaning are annual practices. Pounds of material removed and cost reported here is the yearly average of FY17 and FY18 for inlet cleaning and the yearly average of FY16, FY17, and FY18 for street sweeping.
**Cost for Navy Dairy Farm stream restoration (1,011 linear feet) not included, as this project was not funded by the County.

The load reductions associated with the progress implementation from baseline through FY2018 are provided in Table 17. Results indicate that the total load reduced thus far is equivalent to 0.8% as compared to the goal of 99.9%.

Table 17: FY2018 Progress Reductions Achieved

Local TMDL and Baseline Year	Patuxent River – Tidal Fresh 2014
FY18 Progress Results	**PCB g/yr**
FY18 Progress Load	24.7
Restoration Reduction (from baseline to 2018)	0.7
Restoration Reduction Percent	2.8%
Reduction Percent Remaining	97.1%

5.4 Planned Implementation

Anne Arundel County has projects planned for the Patuxent watershed due to existing planning efforts for compliance with impervious surface treatment goals and for meeting requirements of local TMDLs. The level of implementation currently planned for and included on the County's NPDES geodatabase is summarized in Table 18.Table 18: Restoration BMP Implementation - Planned Implementation for Patuxent River The primary project types proposed are SPSC and stream restoration. Inlet cleaning and street sweeping programs are anticipated to continue at the level observed in FY2018. Because the County is not relying on stormwater BMPs and traditional restoration projects to meet the PCB TMDL goal, an additional suite of stormwater projects and programs are not proposed.

Table 18: Restoration BMP Implementation - Planned Implementation for Patuxent River

BMP	Units	Planned Restoration	Planned Restoration Cost
Inlet Cleaning*	lbs removed	3,797	$29,887.21
SPSC	acre	221.23	$6,652,131.00
Stream Restoration	linear feet	4,419.00	$4,423,020.00
Street Sweeping*	lbs removed	3,797	$29,887.21

*Street Sweeping and Inlet Cleaning are annual practices. Pounds of material removed and cost reported here is the yearly average of FY17 and FY18 for inlet cleaning and the yearly average of FY16, FY17, and FY18 for street sweeping. A similar rate of future implementation is anticipated.

Pollutant load reductions associated with the planned projects are summarized in Table 19. With completion of the planned projects, the total progress is estimated to be at 3.4% compared against the goal of 99.9%.

Table 19: Planned PCB Reductions

Local TMDL and Baseline Year	Patuxent River – Tidal Fresh
	2014
Planned Results	**PCB g/yr**
Planned Load	22.6
Restoration Reduction (from baseline)	2.8
Restoration Reduction Percent	11.1%
Reduction Percent Remaining	88.8%

6 Implementation

6.1 Schedule

Because much of the County's plan depends on results of the recommended monitoring program, and because traditional stormwater BMPs have relatively little impact on PCB loading, Anne Arundel County is not currently presenting a defined end date for meeting the County's PCB TMDL SW-WLA for the regulated point source stormwater sector. In addition, the schedule will need to be flexible to allow for an adaptive and iterative approach.

The County will continue to implement projects and programs focused on impervious surface reduction and treatment as required by the County's MS4 NPDES permit. The County's focus related to the permit has been meeting the 20% goal by February of 2019. It is expected that impervious surface treatment in some form will continue into the County's next permit and that projects and programs that reduce sediment loading and PCBs will continue. TMDL plans are in place for sediment (TSS) TMDLs in the Upper Patuxent and Little Patuxent watersheds with proposed completion dates of 2025 for both. In addition the E. coli bacteria plan in the Upper Patuxent has a proposed completion date of 2025. To meet these goals the County will be implanting restoration practices up through the proposed completion dates. The County will continue to track PCB load reductions that result from these impervious surface treatment and TMDL efforts.

The projects and programs identified in section 5.4 in Table 18 are all scheduled for completion before the end of FY2022.

Anne Arundel County plans to initiate Phase 1 PCB sampling at the 11 stations described in section 4.2 in FY2020. It is anticipated that results will be received and Phase 2 Trackback sampling can be started in the latter part of FY2020. Trackback sampling will continue through FY2021 and areas will be identified for potential Confirmation Phase sampling which may begin in FY2022.

6.2 Cost

Cost estimates are provided here for PCB sampling and analysis as part of the monitoring and trackback strategy. It is important to note that costs for supplemental tasks such as property owner notifications and reporting are not included.

The preliminary estimated cost for Initial Phase sampling is of $25,000. This includes collection and analysis of integrated passive samples at the 7 'core' and 4 'input' stations (11 total stations) as well as 3 blanks for a total of 14 samples:

- Cost of samplers: $1,400 ($100 per sampler device)
- Labor and direct costs (mileage and miscellaneous equipment) for sampler installation and retrieval: $5,400. This assumes the County uses a contractor for labor.
- Lab analysis: $18,200 using EPA 1668 method and SiREM lab
- The labor costs (sample collection and analysis) translate to roughly $2,270 per site.

The cost for Trackback Phase depends on the number of "hits", but the preliminary estimated cost is $119,700. This includes collection and analysis of 73 samples (assumes all 7 'core' stations have hits for PCBs and that samplers are installed at 10 new sites in each drainage area, plus 3 blanks):

- Cost of samplers: $7,300 ($100 per sampler device)
- Labor and direct costs (mileage and miscellaneous equipment) for sample collection: $17,500
- Lab analysis: $94,900 using EPA 1668 method and SiREM lab
- The labor costs (sample collection and analysis) translate to roughly $1,710 per site.

Costs for Confirmation Phase sampling are not yet determined and will be based in the needs of the specific sites identified for contamination confirmation.

6.3 Technical and Financial Resources

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, water quality monitoring, BMP planning, and TMDL plan 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, 2014c).

Anne Arundel County DPW contracts with consultants through several contract vehicles including open-end task based assignments and full delivery contracts, 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.

Technical assistance to implement the proposed monitoring program will also be necessary. The County's contract consultants will seek assistance when needed from local experts in PCB sampling at UMBC to ensure that the sampling methods detailed in the QAPP and used in all phases if the monitoring are correct and complete.

Financial Needs

Typically, the financial needs to implement a TMDL plan are fairly well understood and detailed in the planning documents. In this case, the plan is developed to be adaptive to the results of the monitoring program. The load reduced by traditional stormwater BMPs and programs, while quantified, are not expected to be the primary means by which the PCB loads are reduced. Because of these factors, a total cost to meet the TMDL is not derived.

The estimated cost of the monitoring program is detailed in section 6.2 above, totaling approximately $144,700. It is expected that the monitoring will be conducted out of the County's open-end consulting contracts and funded with operational money. Grant money for all of portions of the monitoring work may be investigated.

7 Evaluation Criteria

Progress will be measured through three approaches: tracking implementation of management measures, estimating load reductions through modeling, and tracking overall program success through monitoring. These elements are described below.

7.1 Adaptive Management Approach

Adaptive management is a critical component of making progress towards the PCB TMDL goals. Results of the Phase 1 and Phase 2 monitoring will be critical components to identifying sources of PCBs and targeting restoration and remediation strategies where high concentrations of PCBs exist. The County will also use results of the monitoring to refine the PCB load modeling. More data from sites across the watershed will provide a more accurate model result. The County will provide future updates to its approach to MDE directly or in NPDES annual reports.

7.2 Tracking Implementation of Management Measures

As stated previously, the County's BMP implementation is only expected to have a minor impact on PCB reductions, but those practices will be documented and tracked. 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 and NPDES MS4 geodatabase 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. The County is also capturing and tracking projects through the AAWSA. Watershed stewards can enter their own data and implementation projects through the WPRP website (www.aarivers.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 County will also track remediation of any discovered contaminated sites. The County will communicate with MDE or EPA depending on the agency operating the clean-up to stay abreast of the clean-up progress and details of the levels of contaminated material and PCBs removed.

Two-Year Milestone Reporting

As a part of the federal Chesapeake Bay Accountability Framework, 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 were previously 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 2018-2019 is from January 1, 2018 through December 31, 2019. Following the development of MDE's NPDES MS4 geodatabase as a reporting vehicle for BMP Implementation, 2-Year BMP Implementation milestone reports are no longer required to be submitted.

Annual NPDES Reporting

As a requirement of the NPDES permit, the County must submit on or before the anniversary date of the current permit a progress report demonstrating 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 SW-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. 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

Elements of the database, following MDE's, current schema (version 1.2, May 2017) include feature classes and associated tables that store and report to MDE the County's restoration projects. MDE and the Bay Program use the data for larger scale Bay modeling and TMDL compliance tracking. The relevant database features include:

- AltBMPLine - stream restoration, shoreline restoration, outfalls
- AltBMPPoint – septic system practices (pump-out, upgrades, connections)
- AltBMPPoly – tree planting, street sweeping, inlet cleaning, impervious removal
- RestBMP – stormwater BMPs (SPSC, bioretention, wet ponds etc.)

Annual Assessment Report

Anne Arundel County produces an annual progress assessment report for each County TMDL that has a completed and final plan in place. The reports include implementation and load reduction summaries for the projects and programs completed in the current reporting year, and also compiled for the full restoration period from the baseline through the current reporting year. Comparisons are made to the planned levels to determine if the County is on track. Costs of program implementation are reported. The annual progress assessment reports are submitted to MDE with the County's annual NPDES report in February of each year.

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 and is another mechanism of reporting to MDE. 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 an updated version will be submitted in February of 2019.

7.3 Estimating Load Reductions

The County performs modeling annually to evaluate load reductions and progress towards meeting SW-WLA goals. The load reductions are reported in the County's 'Annual Assessment Reports' as described above and in the County's NPDES annual report. Modeled baseline and current loads are reported in the NPDES geodatabase following MDE's schema in the 'LocalStormwaterWatershedAssessment' table. The progress assessments contribute to constant re-evaluation of management plans, and adapting responses accordingly as technologies and efficiencies change, programs mature, credit trading is enacted, and regulations are put in place. It is expected that County will model load reductions for the PAXTF using CAST to maintain consistency with the model framework used to develop the plan and initial progress loads.

7.4 Monitoring

Monitoring levels of PCB concentrations in surface water, groundwater, and soils may be necessary to provide information on long-term progress and success of remediation efforts. Currently however, a long-term monitoring program to be implemented by the County is not developed or funded. Development of such a monitoring program is dependent on the results of the monitoring plan described in section 4.2 implemented to identify sources in the watershed, and will depend on a number of other factors. These include the number and extent of identified contaminated sites, the type of property ownership, the remediation strategy applied to each, and the level of involvement from state and federal agencies at each site.

It is anticipated that drainages with high levels of PCB that lead to upstream clean-up efforts would be resampled periodically to determine post-remediation PCB levels and if state water quality standards are being met. It is expected that MDE will have some level of responsibility for long-term monitoring for the routine update of Maryland's list of impaired waters. The County will coordinate with MDE on the appropriate level of monitoring.

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Appendix A: BMP Prioritization Results

Record Key	BMP Type	Built Date	Notes	Tier
169_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	9/9/1986		1
655_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	6/12/1989		1
544_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	7/25/1990		1
456_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	10/9/1990		1
456_2	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	10/9/1990		1
667_1	S: PWED-Extended Detention Structure, Wet	1/15/1991		1
889_1	S: ITRN-Infiltration Trench	3/28/1991		1
337_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	2/19/1992		1
231_1	S: PWET-Retention Pond (Wet Pond)	1/4/1993		1
273_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	2/15/1993		1
834_2	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	7/27/1993		1
1140_2	S: PWED-Extended Detention Structure, Wet	8/23/1996		1
2592_2	S: PWED-Extended Detention Structure, Wet	9/10/1996		1
1451_1	S: PWED-Extended Detention Structure, Wet	11/15/1996		1
2519_1	S: PWET-Retention Pond (Wet Pond)	9/2/1997		1
2756_1	S: PWED-Extended Detention Structure, Wet	6/3/1998		1
2502_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	6/7/1999		1
3205_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	4/27/2000		1
5768_1	S: PWET-Retention Pond (Wet Pond)	5/12/2011	near other PCB source	1
8505_10	S: ITRN-Infiltration Trench	10/30/2014	near other	1
8505_16	S: ITRN-Infiltration Trench	10/30/2014	Buffer DA, near other PCB source	1
7068_1	S: WEDW-ED Wetland	12/22/2014	near other PCB source	1
2893_1	S: ITRN-Infiltration Trench		near other PCB source	1
634_1	S: IBAS-Infiltration Basin			1
194_2	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	5/13/1983		2
194_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	5/13/1983		2
120_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	11/8/1983		2
234_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	8/7/1985		2
228_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	9/11/1985		2
364_1	S: IBAS-Infiltration Basin	6/13/1988		2
537_1	S: ITRN-Infiltration Trench	11/16/1988	Buffer DA	2
537_2	S: ITRN-Infiltration Trench	11/16/1988	Buffer DA	2
358_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	12/6/1988		2
622_1	S: ITRN-Infiltration Trench	2/8/1989		2
522_1	S: ITRN-Infiltration Trench	8/7/1989		2
668_2	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	1/10/1990		2
668_1	S: ITRN-Infiltration Trench	1/10/1990		2
968_1	S: ITRN-Infiltration Trench	2/16/1990		2
402_1	S: IBAS-Infiltration Basin	3/7/1990		2

Record Key	BMP Type	Built Date	Notes	Tier
658_1	S: IBAS-Infiltration Basin	4/10/1990		2
650_1	S: ITRN-Infiltration Trench	7/18/1990		2
650_2	S: ITRN-Infiltration Trench	7/18/1990		2
555_1	S: ITRN-Infiltration Trench	10/23/1990		2
504_1	S: ITRN-Infiltration Trench	10/26/1990		2
1035_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	4/2/1991		2
882_2	S: ITRN-Infiltration Trench	5/2/1991		2
882_1	S: ITRN-Infiltration Trench	5/2/1991		2
615_2	S: ITRN-Infiltration Trench	6/5/1991		2
615_1	S: ITRN-Infiltration Trench	6/5/1991		2
305_1	S: PWED-Extended Detention Structure, Wet	6/26/1991		2
727_1	S: ITRN-Infiltration Trench	9/10/1991		2
739_2	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	10/12/1991		2
739_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	10/12/1991		2
1133_2	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	11/7/1991		2
1133_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	11/7/1991		2
189_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	11/21/1991		2
623_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	12/16/1991		2
917_1	S: ITRN-Infiltration Trench	1/5/1992		2
917_2	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	1/5/1992		2
922_1	S: ITRN-Infiltration Trench	6/21/1992		2
197_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	7/6/1992		2
1212_1	S: ITRN-Infiltration Trench	9/4/1992		2
84_2	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	9/9/1992		2
84_1	S: PWET-Retention Pond (Wet Pond)	9/9/1992		2
1051_1	S: PWET-Retention Pond (Wet Pond)	10/3/1992		2
1303_2	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	3/23/1993		2
144_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	7/1/1993		2
1111_1	S: ITRN-Infiltration Trench	7/13/1993		2
834_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	7/27/1993		2
856_1	S: PWED-Extended Detention Structure, Wet	8/13/1993		2
830_1	S: PWED-Extended Detention Structure, Wet	12/14/1993		2
962_2	S: ITRN-Infiltration Trench	12/30/1993		2
962_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	12/30/1993		2
1576_1	S: ITRN-Infiltration Trench	7/26/1994		2
959_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	9/20/1994		2
8909_2	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	9/29/1994		2
8909_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	9/29/1994		2
1504_1	S: ITRN-Infiltration Trench	12/23/1994		2

Record Key	BMP Type	Built Date	Notes	Tier
1888_1	S: ITRN-Infiltration Trench	2/8/1995		2
1892_1	S: ITRN-Infiltration Trench	6/7/1995		2
1779_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	6/13/1995		2
1047_1	S: PWET-Retention Pond (Wet Pond)	6/20/1995		2
523_1	S: ITRN-Infiltration Trench	9/20/1995		2
1966_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	10/5/1995		2
672_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	11/21/1995		2
1677_3	S: ITRN-Infiltration Trench	2/14/1996		2
1677_2	S: ITRN-Infiltration Trench	2/14/1996		2
1677_1	S: ITRN-Infiltration Trench	2/14/1996		2
2427_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	3/1/1996		2
1140_1	S: PWED-Extended Detention Structure, Wet	8/23/1996		2
532_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	6/25/1997		2
532_2	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	6/25/1997		2
2108_2	S: ITRN-Infiltration Trench	8/20/1997		2
2108_3	S: ITRN-Infiltration Trench	8/20/1997		2
2682_1	S: ITRN-Infiltration Trench	8/21/1997		2
1993_5	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	9/3/1997		2
1993_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	9/3/1997		2
1297_1	S: PWET-Retention Pond (Wet Pond)	9/18/1997		2
2817_1	S: ITRN-Infiltration Trench	12/3/1997		2
2138_3	S: PWET-Retention Pond (Wet Pond)	12/24/1997		2
807_1	S: PWED-Extended Detention Structure, Wet	1/1/1998		2
2608_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	1/2/1998		2
2806_1	S: ITRN-Infiltration Trench	2/9/1998		2
1912_2	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	3/3/1998		2
125_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	5/20/1998		2
2626_1	S: ITRN-Infiltration Trench	7/22/1998		2
3171_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	8/5/1998		2
2793_1	S: ITRN-Infiltration Trench	8/8/1998		2
2961_1	S: ITRN-Infiltration Trench	9/25/1998		2
1400_1	S: PWET-Retention Pond (Wet Pond)	1/27/1999		2
1640_1	S: PWED-Extended Detention Structure, Wet	3/8/1999		2
2291_1	S: IBAS-Infiltration Basin	3/16/1999		2
2938_2	S: ITRN-Infiltration Trench	5/18/1999		2
2938_1	S: ITRN-Infiltration Trench	5/18/1999		2
3459_1	S: IBAS-Infiltration Basin	6/27/1999		2
3298_1	S: ITRN-Infiltration Trench	9/16/1999		2
3198_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	12/1/1999		2

Record Key	BMP Type	Built Date	Notes	Tier
1466_1	S: PWED-Extended Detention Structure, Wet	1/7/2000		2
3174_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	2/22/2000		2
3102_1	S: ITRN-Infiltration Trench	6/8/2000		2
3086_1	S: ITRN-Infiltration Trench	8/7/2000		2
733_1	S: ITRN-Infiltration Trench	9/12/2000		2
2132_1	S: ITRN-Infiltration Trench	10/16/2000		2
3067_2	S: ITRN-Infiltration Trench	12/28/2000		2
8923_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	10/2/2001		2
977_1	S: PWET-Retention Pond (Wet Pond)	1/2/2002		2
3716_1	S: ITRN-Infiltration Trench	7/3/2002		2
3461_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	8/25/2003		2
3809_1	S: PWED-Extended Detention Structure, Wet	9/18/2003		2
3657_1	S: PWED-Extended Detention Structure, Wet	6/15/2004		2
988_1	S: ITRN-Infiltration Trench	9/10/2004		2
4290_2	S: ITRN-Infiltration Trench	11/16/2004		2
4290_3	S: ITRN-Infiltration Trench	11/16/2004		2
4022_1	S: ITRN-Infiltration Trench	4/18/2005		2
5583_1	S: PWET-Retention Pond (Wet Pond)	4/19/2008		2
5952_1	S: PWED-Extended Detention Structure, Wet	10/26/2009		2
6924_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	2/2/2010		2
5921_8	S: ITRN-Infiltration Trench	7/26/2010	Buffer DA	2
2063_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	12/12/2011	Buffer DA	2
7077_1	S: PMPS-Multiple Pond System	9/13/2013		2
8337_5	S: PWET-Retention Pond (Wet Pond)	1/3/2014		2
3680_1	S: ITRN-Infiltration Trench	12/31/2016		2
3680_2	S: ITRN-Infiltration Trench	12/31/2016		2
3145_1	S: ITRN-Infiltration Trench			2
4500_1	S: ITRN-Infiltration Trench			2
1006_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)			2
279_1	S: ODSW-Dry Swale			2
8943_4	S: PWET-Retention Pond (Wet Pond)			2
8945_2	S: ITRN-Infiltration Trench		Buffer DA	2
2974_1	S: ITRN-Infiltration Trench			2
340_1	S: PWED-Extended Detention Structure, Wet			2
2064_4	S: ITRN-Infiltration Trench	1/2/2001		3
2064_3	S: ITRN-Infiltration Trench	1/2/2001		3
2064_2	S: ITRN-Infiltration Trench	1/2/2001		3
2064_1	S: ITRN-Infiltration Trench	1/2/2001		3
2064_10	S: ITRN-Infiltration Trench	1/2/2001		3

Record Key	BMP Type	Built Date	Notes	Tier
2064_11	S: ITRN-Infiltration Trench	1/2/2001		3
2064_9	S: ITRN-Infiltration Trench	1/2/2001		3
2064_8	S: ITRN-Infiltration Trench	1/2/2001		3
2064_7	S: ITRN-Infiltration Trench	1/2/2001		3
2064_6	S: ITRN-Infiltration Trench	1/2/2001		3
2064_5	S: ITRN-Infiltration Trench	1/2/2001		3
3439_1	S: ITRN-Infiltration Trench	1/8/2001		3
3529_1	S: ITRN-Infiltration Trench	1/11/2001		3
3405_1	S: ITRN-Infiltration Trench	2/1/2001		3
2701_2	S: ITRN-Infiltration Trench	4/4/2001		3
2701_1	S: ITRN-Infiltration Trench	4/4/2001		3
3800_1	S: PWED-Extended Detention Structure, Wet	5/31/2001		3
3800_2	S: PWED-Extended Detention Structure, Wet	5/31/2001		3
4389_1	S: ITRN-Infiltration Trench	6/4/2001		3
1748_1	S: PWET-Retention Pond (Wet Pond)	6/13/2001		3
1748_2	S: PWET-Retention Pond (Wet Pond)	6/13/2001		3
2856_8	S: ITRN-Infiltration Trench	7/6/2001		3
2856_7	S: ITRN-Infiltration Trench	7/6/2001		3
2856_3	S: ITRN-Infiltration Trench	7/6/2001		3
2856_4	S: ITRN-Infiltration Trench	7/6/2001		3
2856_5	S: ITRN-Infiltration Trench	7/6/2001		3
2856_6	S: ITRN-Infiltration Trench	7/6/2001		3
2856_1	S: ITRN-Infiltration Trench	7/6/2001		3
2856_2	S: ITRN-Infiltration Trench	7/6/2001		3
1346_1	S: PWET-Retention Pond (Wet Pond)	7/6/2001		3
3820_1	S: ITRN-Infiltration Trench	7/26/2001		3
3462_1	S: WSHW-Shallow Marsh	7/30/2001		3
3140_1	S: ITRN-Infiltration Trench	8/9/2001		3
3507_1	S: ITRN-Infiltration Trench	9/20/2001		3
3779_1	S: ITRN-Infiltration Trench	9/28/2001		3
1514_1	S: PWED-Extended Detention Structure, Wet	10/1/2001		3
473_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	10/3/2001		3
3910_1	S: ITRN-Infiltration Trench	10/8/2001		3
1472_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	10/10/2001		3
3726_1	S: PWED-Extended Detention Structure, Wet	10/29/2001		3
3182_1	S: PWET-Retention Pond (Wet Pond)	11/6/2001		3
2119_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	11/19/2001		3
3683_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	11/21/2001		3
3620_2	S: ITRN-Infiltration Trench	12/2/2001		3

Record Key	BMP Type	Built Date	Notes	Tier
3651_1	S: ITRN-Infiltration Trench	1/2/2002		3
3798_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	1/24/2002		3
3969_1	S: ITRN-Infiltration Trench	1/28/2002		3
3764_1	S: ITRN-Infiltration Trench	2/20/2002		3
3857_1	S: PWED-Extended Detention Structure, Wet	3/6/2002		3
2312_2	S: ITRN-Infiltration Trench	3/12/2002		3
2312_1	S: ITRN-Infiltration Trench	3/12/2002		3
2784_1	S: ITRN-Infiltration Trench	3/12/2002		3
3964_1	S: ITRN-Infiltration Trench	3/28/2002		3
4108_1	S: ITRN-Infiltration Trench	4/11/2002		3
3066_1	S: PWED-Extended Detention Structure, Wet	5/21/2002		3
4072_2	S: ITRN-Infiltration Trench	6/4/2002		3
4072_1	S: ITRN-Infiltration Trench	6/4/2002		3
4078_1	S: ITRN-Infiltration Trench	6/12/2002		3
3288_1	S: ITRN-Infiltration Trench	7/19/2002		3
3923_1	S: ITRN-Infiltration Trench	7/22/2002		3
3898_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	8/29/2002		3
3940_1	S: ITRN-Infiltration Trench	9/3/2002		3
3450_1	S: PWED-Extended Detention Structure, Wet	10/10/2002		3
4172_1	S: ITRN-Infiltration Trench	10/22/2002		3
4197_1	S: ITRN-Infiltration Trench	11/8/2002		3
4024_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	11/14/2002		3
4110_1	S: ITRN-Infiltration Trench	11/15/2002		3
1433_1	S: ITRN-Infiltration Trench	12/1/2002		3
4286_1	S: ITRN-Infiltration Trench	12/2/2002		3
3935_1	S: ITRN-Infiltration Trench	1/9/2003		3
3671_1	S: ITRN-Infiltration Trench	1/23/2003		3
3671_2	S: ITRN-Infiltration Trench	1/23/2003		3
3635_1	S: ITRN-Infiltration Trench	1/30/2003		3
3164_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	3/1/2003		3
3164_6	S: ITRN-Infiltration Trench	3/1/2003		3
3164_17	S: ITRN-Infiltration Trench	3/1/2003		3
3164_4	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	3/1/2003		3
3164_16	S: ITRN-Infiltration Trench	3/1/2003		3
3164_15	S: ITRN-Infiltration Trench	3/1/2003		3
3164_7	S: ITRN-Infiltration Trench	3/1/2003		3
3164_9	S: ITRN-Infiltration Trench	3/1/2003		3
3164_8	S: ITRN-Infiltration Trench	3/1/2003		3
3164_10	S: ITRN-Infiltration Trench	3/1/2003		3

Record Key	BMP Type	Built Date	Notes	Tier
3164_11	S: ITRN-Infiltration Trench	3/1/2003		3
3164_3	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	3/1/2003		3
3164_13	S: ITRN-Infiltration Trench	3/1/2003		3
3164_2	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	3/1/2003		3
3164_12	S: ITRN-Infiltration Trench	3/1/2003		3
3164_14	S: ITRN-Infiltration Trench	3/1/2003		3
3164_5	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	3/1/2003		3
2443_1	S: ITRN-Infiltration Trench	3/24/2003		3
3778_1	S: PWED-Extended Detention Structure, Wet	4/17/2003		3
4353_1	S: ITRN-Infiltration Trench	4/25/2003		3
4048_1	S: ITRN-Infiltration Trench	5/12/2003		3
3849_1	S: PWET-Retention Pond (Wet Pond)	6/20/2003		3
4461_1	S: ITRN-Infiltration Trench	9/12/2003		3
1471_1	S: ITRN-Infiltration Trench	9/28/2003		3
4080_1	S: ITRN-Infiltration Trench	9/30/2003		3
4309_2	S: ITRN-Infiltration Trench	10/21/2003		3
4309_1	S: ITRN-Infiltration Trench	10/21/2003		3
4073_1	S: PWED-Extended Detention Structure, Wet	11/11/2003		3
4149_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	11/23/2003	Buffer DA	3
4467_1	S: ITRN-Infiltration Trench	12/23/2003		3
4690_1	S: ITRN-Infiltration Trench	1/2/2004		3
2546_1	S: PWED-Extended Detention Structure, Wet	1/12/2004		3
4289_1	S: ITRN-Infiltration Trench	1/15/2004		3
4231_1	S: ODSW-Dry Swale	2/11/2004		3
4539_1	S: ITRN-Infiltration Trench	4/22/2004		3
4605_5	S: ITRN-Infiltration Trench	4/22/2004	Buffer DA	3
4663_1	S: ITRN-Infiltration Trench	5/26/2004		3
4663_2	S: ITRN-Infiltration Trench	5/26/2004		3
3815_1	S: ITRN-Infiltration Trench	6/29/2004		3
4241_1	S: ITRN-Infiltration Trench	7/2/2004		3
4241_2	S: ITRN-Infiltration Trench	7/2/2004		3
4222_1	S: ITRN-Infiltration Trench	7/10/2004	Buffer DA	3
4628_10	S: ITRN-Infiltration Trench	7/23/2004	Buffer DA	3
4628_8	S: ITRN-Infiltration Trench	7/23/2004	Buffer DA	3
4628_6	S: ITRN-Infiltration Trench	7/23/2004	Buffer DA	3
4628_4	S: ITRN-Infiltration Trench	7/23/2004	Buffer DA	3
4628_2	S: ITRN-Infiltration Trench	7/23/2004	Buffer DA	3
5113_1	S: ITRN-Infiltration Trench	8/1/2004		3
4784_1	S: ITRN-Infiltration Trench	9/9/2004		3

Record Key	BMP Type	Built Date	Notes	Tier
5060_1	S: ITRN-Infiltration Trench	9/28/2004		3
5364_3	S: PWET-Retention Pond (Wet Pond)	10/7/2004		3
5304_4	S: ITRN-Infiltration Trench	10/8/2004		3
5304_5	S: ITRN-Infiltration Trench	10/8/2004		3
5304_6	S: ITRN-Infiltration Trench	10/8/2004		3
3719_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	10/13/2004		3
4520_1	S: ITRN-Infiltration Trench	10/18/2004		3
4792_1	S: ITRN-Infiltration Trench	11/15/2004		3
4792_2	S: ITRN-Infiltration Trench	11/15/2004		3
4290_1	S: ITRN-Infiltration Trench	11/16/2004		3
3783_1	S: ITRN-Infiltration Trench	12/3/2004		3
3792_1	S: PWED-Extended Detention Structure, Wet	1/10/2005		3
3792_2	S: PWED-Extended Detention Structure, Wet	1/10/2005		3
4407_1	S: ITRN-Infiltration Trench	7/8/2005		3
4974_5	S: ITRN-Infiltration Trench	7/12/2005	Buffer DA	3
4974_4	S: ITRN-Infiltration Trench	7/12/2005	Buffer DA	3
4974_3	S: ITRN-Infiltration Trench	7/12/2005	Buffer DA	3
4974_1	S: ITRN-Infiltration Trench	7/12/2005	Buffer DA	3
4974_2	S: ITRN-Infiltration Trench	7/12/2005	Buffer DA	3
4324_3	S: ITRN-Infiltration Trench	7/18/2005		3
4324_2	S: ITRN-Infiltration Trench	7/18/2005		3
4324_1	S: ITRN-Infiltration Trench	7/18/2005		3
5511_1	S: ITRN-Infiltration Trench	8/19/2005		3
5511_2	S: ITRN-Infiltration Trench	8/19/2005		3
113_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	9/24/2005		3
2890_1	S: ITRN-Infiltration Trench	10/6/2005		3
2969_2	S: ITRN-Infiltration Trench	10/6/2005		3
2969_3	S: ITRN-Infiltration Trench	10/6/2005		3
2969_1	S: ITRN-Infiltration Trench	10/6/2005		3
2969_4	S: ITRN-Infiltration Trench	10/6/2005		3
2969_5	S: ITRN-Infiltration Trench	10/6/2005		3
4406_1	S: ITRN-Infiltration Trench	10/10/2005		3
4899_1	S: ITRN-Infiltration Trench	10/10/2005		3
4973_1	S: ITRN-Infiltration Trench	10/12/2005		3
3691_1	S: ITRN-Infiltration Trench	11/3/2005		3
5261_4	S: ITRN-Infiltration Trench	11/21/2005		3
5261_3	S: ITRN-Infiltration Trench	11/21/2005		3
5261_1	S: ITRN-Infiltration Trench	11/21/2005		3
5261_2	S: ITRN-Infiltration Trench	11/21/2005		3

Record Key	BMP Type	Built Date	Notes	Tier
5261_5	S: PWET-Retention Pond (Wet Pond)	11/21/2005		3
4323_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	11/23/2005		3
4352_1	S: ITRN-Infiltration Trench	11/23/2005		3
3926_4	S: ITRN-Infiltration Trench	11/30/2005		3
3926_2	S: PWED-Extended Detention Structure, Wet	11/30/2005		3
3926_7	S: ITRN-Infiltration Trench	11/30/2005		3
3926_1	S: PWED-Extended Detention Structure, Wet	11/30/2005		3
3926_6	S: ITRN-Infiltration Trench	11/30/2005		3
3926_5	S: ITRN-Infiltration Trench	11/30/2005		3
3926_8	S: ITRN-Infiltration Trench	11/30/2005		3
3926_9	S: ITRN-Infiltration Trench	11/30/2005		3
3926_3	S: PWED-Extended Detention Structure, Wet	11/30/2005		3
3926_10	S: ITRN-Infiltration Trench	11/30/2005		3
3926_12	S: ITRN-Infiltration Trench	11/30/2005		3
3926_11	S: ITRN-Infiltration Trench	11/30/2005		3
3926_14	S: ITRN-Infiltration Trench	11/30/2005		3
3926_13	S: ITRN-Infiltration Trench	11/30/2005		3
3822_2	S: PWED-Extended Detention Structure, Wet	12/2/2005		3
3822_1	S: PWED-Extended Detention Structure, Wet	12/2/2005		3
5239_1	S: ITRN-Infiltration Trench	2/3/2006		3
5230_1	S: ITRN-Infiltration Trench	2/24/2006	Buffer DA	3
5674_2	S: ITRN-Infiltration Trench	2/27/2006		3
5674_1	S: ITRN-Infiltration Trench	2/27/2006		3
3338_1	S: IBAS-Infiltration Basin	2/28/2006		3
5463_3	S: ITRN-Infiltration Trench	3/15/2006		3
4366_1	S: ITRN-Infiltration Trench	3/27/2006		3
4366_2	S: ITRN-Infiltration Trench	3/27/2006		3
2304_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	4/12/2006		3
3319_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	4/20/2006		3
5628_2	S: ITRN-Infiltration Trench	4/28/2006		3
1190_1	S: ITRN-Infiltration Trench	5/9/2006		3
4128_1	S: ITRN-Infiltration Trench	5/16/2006		3
5431_1	S: ITRN-Infiltration Trench	6/1/2006		3
5906_1	S: PWET-Retention Pond (Wet Pond)	6/1/2006		3
3375_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	6/6/2006		3
4413_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	6/16/2006		3
4030_1	S: PWED-Extended Detention Structure, Wet	8/9/2006		3
6140_1	S: ITRN-Infiltration Trench	8/22/2006		3
5412_2	S: ODSW-Dry Swale	9/11/2006		3

Record Key	BMP Type	Built Date	Notes	Tier
5412_4	S: ODSW-Dry Swale	9/11/2006	Buffer DA	3
5412_3	S: ODSW-Dry Swale	9/11/2006		3
5407_2	S: ITRN-Infiltration Trench	9/13/2006		3
5407_1	S: ITRN-Infiltration Trench	9/13/2006		3
3925_1	S: PWED-Extended Detention Structure, Wet	9/28/2006		3
5130_1	S: PWET-Retention Pond (Wet Pond)	10/1/2006		3
5807_10	S: ITRN-Infiltration Trench	10/12/2006	Buffer DA	3
5807_9	S: ITRN-Infiltration Trench	10/12/2006	Buffer DA	3
5807_11	S: ITRN-Infiltration Trench	10/12/2006	Buffer DA	3
5807_8	S: ITRN-Infiltration Trench	10/12/2006	Buffer DA	3
5483_1	S: ITRN-Infiltration Trench	10/24/2006		3
4859_1	S: ITRN-Infiltration Trench	11/29/2006		3
4823_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	12/28/2006		3
4823_2	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	12/28/2006		3
6252_1	S: ITRN-Infiltration Trench	1/17/2007		3
6417_1	S: ITRN-Infiltration Trench	2/12/2007		3
5855_1	S: ITRN-Infiltration Trench	2/26/2007		3
4335_1	S: PWED-Extended Detention Structure, Wet	3/9/2007		3
4335_2	S: ITRN-Infiltration Trench	3/9/2007		3
5604_1	S: ITRN-Infiltration Trench	3/20/2007		3
4695_2	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	5/11/2007		3
5013_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	5/11/2007		3
5013_2	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	5/11/2007		3
5366_4	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	6/25/2007	Buffer DA	3
4281_3	S: ITRN-Infiltration Trench	8/20/2007		3
4281_2	S: ITRN-Infiltration Trench	8/20/2007		3
4281_4	S: ITRN-Infiltration Trench	8/20/2007		3
4281_1	S: ITRN-Infiltration Trench	8/20/2007		3
6541_1	S: ITRN-Infiltration Trench	9/21/2007		3
6541_2	S: ITRN-Infiltration Trench	9/21/2007		3
6541_3	S: ITRN-Infiltration Trench	9/21/2007		3
6541_4	S: ITRN-Infiltration Trench	9/21/2007		3
6541_5	S: ITRN-Infiltration Trench	9/21/2007		3
6465_1	S: ITRN-Infiltration Trench	10/4/2007	Buffer DA	3
3838_2	S: ITRN-Infiltration Trench	10/10/2007		3
3838_1	S: ITRN-Infiltration Trench	10/10/2007		3
5972_6	S: ITRN-Infiltration Trench	10/19/2007	Buffer DA	3
5972_8	S: ITRN-Infiltration Trench	10/19/2007	Buffer DA	3
5972_10	S: ITRN-Infiltration Trench	10/19/2007	Buffer DA	3

Record Key	BMP Type	Built Date	Notes	Tier
5972_4	S: ITRN-Infiltration Trench	10/19/2007	Buffer DA	3
5972_13	S: ITRN-Infiltration Trench	10/19/2007	Buffer DA	3
5972_12	S: ITRN-Infiltration Trench	10/19/2007	Buffer DA	3
5972_2	S: ITRN-Infiltration Trench	10/19/2007	Buffer DA	3
5972_16	S: ITRN-Infiltration Trench	10/19/2007	Buffer DA	3
5972_20	S: ITRN-Infiltration Trench	10/19/2007	Buffer DA	3
5972_18	S: ITRN-Infiltration Trench	10/19/2007	Buffer DA	3
5972_14	S: ITRN-Infiltration Trench	10/19/2007	Buffer DA	3
4454_3	S: ITRN-Infiltration Trench	11/12/2007		3
4454_2	S: ITRN-Infiltration Trench	11/12/2007		3
6463_1	S: ITRN-Infiltration Trench	11/17/2007		3
6463_2	S: ODSW-Dry Swale	11/17/2007		3
6050_2	S: ITRN-Infiltration Trench	11/29/2007		3
6050_1	S: ITRN-Infiltration Trench	11/29/2007		3
7113_1	S: ITRN-Infiltration Trench	12/6/2007		3
6130_1	S: ITRN-Infiltration Trench	12/21/2007		3
6694_1	S: ITRN-Infiltration Trench	3/27/2008		3
6445_1	S: ITRN-Infiltration Trench	3/28/2008		3
4568_2	S: ITRN-Infiltration Trench	5/15/2008		3
4568_1	S: ITRN-Infiltration Trench	5/15/2008		3
1076_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	7/8/2008	Buffer DA	3
7175_1	S: ITRN-Infiltration Trench	7/10/2008		3
6810_1	S: ITRN-Infiltration Trench	8/23/2008		3
6175_1	S: ITRN-Infiltration Trench	9/1/2008		3
6055_2	S: ITRN-Infiltration Trench	9/2/2008		3
6055_1	S: ITRN-Infiltration Trench	9/2/2008		3
6827_13	S: ITRN-Infiltration Trench	9/15/2008		3
4075_1	S: PWED-Extended Detention Structure, Wet	9/24/2008		3
7073_1	S: PWED-Extended Detention Structure, Wet	10/7/2008		3
6510_1	S: ITRN-Infiltration Trench	10/9/2008		3
6509_1	S: ITRN-Infiltration Trench	10/10/2008		3
6065_1	S: ITRN-Infiltration Trench	10/28/2008		3
3941_1	S: ITRN-Infiltration Trench	10/30/2008		3
3876_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	11/7/2008		3
5893_1	S: ODSW-Dry Swale	12/3/2008		3
5893_2	S: ODSW-Dry Swale	12/3/2008		3
4060_3	S: PWED-Extended Detention Structure, Wet	12/12/2008		3
4060_4	S: PWED-Extended Detention Structure, Wet	12/12/2008		3
4060_1	S: PWED-Extended Detention Structure, Wet	12/12/2008		3

Record Key	BMP Type	Built Date	Notes	Tier
4060_2	S: PWED-Extended Detention Structure, Wet	12/12/2008		3
6312_1	S: ITRN-Infiltration Trench	2/5/2009		3
6255_1	S: ODSW-Dry Swale	2/26/2009		3
6255_2	S: ITRN-Infiltration Trench	2/26/2009		3
4927_4	S: ITRN-Infiltration Trench	3/12/2009	Buffer DA	3
6052_12	S: ITRN-Infiltration Trench	3/13/2009		3
6052_11	S: ITRN-Infiltration Trench	3/13/2009	Buffer DA	3
6052_10	S: ITRN-Infiltration Trench	3/13/2009	Buffer DA	3
6052_9	S: ITRN-Infiltration Trench	3/13/2009	Buffer DA	3
6052_8	S: ITRN-Infiltration Trench	3/13/2009	Buffer DA	3
6052_7	S: ITRN-Infiltration Trench	3/13/2009	Buffer DA	3
6609_20	S: ITRN-Infiltration Trench	4/29/2009	Buffer DA	3
6609_22	S: ITRN-Infiltration Trench	4/29/2009	Buffer DA	3
6609_19	S: ITRN-Infiltration Trench	4/29/2009	Buffer DA	3
6609_21	S: ITRN-Infiltration Trench	4/29/2009	Buffer DA	3
6609_17	S: ITRN-Infiltration Trench	4/29/2009	Buffer DA	3
6609_18	S: ITRN-Infiltration Trench	4/29/2009	Buffer DA	3
6609_16	S: ITRN-Infiltration Trench	4/29/2009	Buffer DA	3
6609_15	S: ITRN-Infiltration Trench	4/29/2009	Buffer DA	3
6609_14	S: ITRN-Infiltration Trench	4/29/2009	Buffer DA	3
6609_23	S: ITRN-Infiltration Trench	4/29/2009	Buffer DA	3
6234_2	S: ITRN-Infiltration Trench	5/4/2009	Buffer DA	3
7258_2	S: ITRN-Infiltration Trench	6/6/2009		3
7258_1	S: ITRN-Infiltration Trench	6/6/2009		3
7143_1	S: ITRN-Infiltration Trench	6/26/2009		3
7143_2	S: ITRN-Infiltration Trench	6/26/2009		3
7096_1	S: ITRN-Infiltration Trench	6/29/2009		3
7096_2	S: ITRN-Infiltration Trench	6/29/2009		3
5043_1	S: ITRN-Infiltration Trench	7/1/2009		3
6972_1	S: ITRN-Infiltration Trench	8/1/2009	Buffer DA	3
6283_1	S: ITRN-Infiltration Trench	10/21/2009		3
2789_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	11/20/2009		3
3347_1	S: XDPD-Detention Structure (Dry Pond) (plain old pond)	12/4/2009		3
4793_1	S: ITRN-Infiltration Trench	12/11/2009		3
6048_1	S: ITRN-Infiltration Trench	12/14/2009		3
3390_1	S: PWET-Retention Pond (Wet Pond)	1/17/2010		3
6139_1	S: PMED-Micropool Extended Detention Pond	2/26/2010		3
7691_1	S: ITRN-Infiltration Trench	3/18/2010		3
5262_6	S: ITRN-Infiltration Trench	5/1/2010		3

Record Key	BMP Type	Built Date	Notes	Tier
5262_4	S: ITRN-Infiltration Trench	5/1/2010		3
5262_5	S: ITRN-Infiltration Trench	5/1/2010		3
6975_1	S: ITRN-Infiltration Trench	5/10/2010		3
3819_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	5/15/2010		3
7592_1	S: ITRN-Infiltration Trench	6/7/2010		3
7592_2	S: ITRN-Infiltration Trench	6/7/2010		3
4667_1	S: ITRN-Infiltration Trench	6/10/2010		3
7131_2	S: PPKT-Pocket Pond	6/28/2010		3
5921_10	S: ITRN-Infiltration Trench	7/26/2010	Buffer DA	3
5921_9	S: ITRN-Infiltration Trench	7/26/2010	Buffer DA	3
5921_7	S: ITRN-Infiltration Trench	7/26/2010		3
6898_2	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	7/27/2010	Buffer DA	3
6928_2	S: ITRN-Infiltration Trench	9/16/2010	Buffer DA	3
5316_2	S: PWET-Retention Pond (Wet Pond)	11/1/2010		3
5316_3	S: PWET-Retention Pond (Wet Pond)	11/1/2010		3
5316_1	S: PWET-Retention Pond (Wet Pond)	11/1/2010		3
4849_5	S: ITRN-Infiltration Trench	4/21/2011		3
3795_1	S: ITRN-Infiltration Trench	5/4/2011		3
7693_1	S: ITRN-Infiltration Trench	7/1/2011		3
7922_1	S: ITRN-Infiltration Trench	7/14/2011		3
6683_2	S: PWED-Extended Detention Structure, Wet	9/8/2011		3
6683_3	S: PWED-Extended Detention Structure, Wet	9/8/2011		3
6683_1	S: PWED-Extended Detention Structure, Wet	9/8/2011		3
6181_1	S: ITRN-Infiltration Trench	11/21/2011		3
6181_2	S: ITRN-Infiltration Trench	11/21/2011	Buffer DA	3
7244_1	S: ITRN-Infiltration Trench	12/11/2011		3
6751_1	S: ITRN-Infiltration Trench	1/17/2012		3
7376_1	S: PWET-Retention Pond (Wet Pond)	2/8/2012		3
8093_4	S: ITRN-Infiltration Trench	4/13/2012		3
7951_1	S: ITRN-Infiltration Trench	4/25/2012		3
8059_7	S: ITRN-Infiltration Trench	5/21/2012	Buffer DA	3
8112_2	S: ITRN-Infiltration Trench	5/24/2012		3
8112_1	S: ITRN-Infiltration Trench	5/24/2012		3
8112_3	S: ITRN-Infiltration Trench	5/24/2012		3
8112_6	S: ITRN-Infiltration Trench	5/24/2012		3
8112_5	S: ITRN-Infiltration Trench	5/24/2012		3
8112_4	S: ITRN-Infiltration Trench	5/24/2012		3
6192_1	S: ODSW-Dry Swale	6/27/2012		3
5971_9	S: ITRN-Infiltration Trench	10/21/2012	Buffer DA	3

Record Key	BMP Type	Built Date	Notes	Tier
5971_8	S: ITRN-Infiltration Trench	10/21/2012	Buffer DA	3
5971_10	S: ITRN-Infiltration Trench	10/21/2012	Buffer DA	3
5971_7	S: ITRN-Infiltration Trench	10/21/2012	Buffer DA	3
5971_5	S: ITRN-Infiltration Trench	10/21/2012		3
5971_6	S: ITRN-Infiltration Trench	10/21/2012		3
3736_1	S: ITRN-Infiltration Trench	2/14/2013		3
6578_4	S: ITRN-Infiltration Trench	5/10/2013		3
6578_5	S: ITRN-Infiltration Trench	5/10/2013		3
6578_6	S: ITRN-Infiltration Trench	5/10/2013		3
4101_2	S: PWED-Extended Detention Structure, Wet	11/4/2013		3
4101_3	S: PWED-Extended Detention Structure, Wet	11/4/2013		3
4101_1	S: PWED-Extended Detention Structure, Wet	11/4/2013		3
1393_1	S: IBAS-Infiltration Basin	11/21/2013		3
7956_2	S: ITRN-Infiltration Trench	12/2/2013		3
7899_12	S: PWET-Retention Pond (Wet Pond)	12/19/2013		3
7899_11	S: PWET-Retention Pond (Wet Pond)	12/19/2013		3
6535_1	S: ODSW-Dry Swale	1/28/2014		3
3973_2	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	3/3/2014		3
3973_3	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	3/3/2014		3
3973_1	S: XDED-Extended Detention Structure, Dry (designed for 1" 24 hour)	3/3/2014		3
4256_1	S: PWED-Extended Detention Structure, Wet	9/25/2014		3
7906_1	S: PMED-Micropool Extended Detention Pond	10/20/2014		3
7727_7	S: PWET-Retention Pond (Wet Pond)	12/24/2014		3
7727_2	S: PWET-Retention Pond (Wet Pond)	12/24/2014		3
7148_1	S: ITRN-Infiltration Trench	3/2/2015		3
5139_1	S: PWED-Extended Detention Structure, Wet	3/17/2015		3
7367_1	S: PWED-Extended Detention Structure, Wet	4/30/2015		3
7846_1	S: PWED-Extended Detention Structure, Wet	6/8/2015		3
6167_2	S: ITRN-Infiltration Trench	7/14/2015		3
6850_1	S: PWET-Retention Pond (Wet Pond)	7/20/2015		3
7322_3	S: ITRN-Infiltration Trench	8/4/2015	Buffer DA	3
7090_7	S: ITRN-Infiltration Trench	12/10/2015		3
7090_6	S: ITRN-Infiltration Trench	12/10/2015		3
5602_9	S: ITRN-Infiltration Trench	12/21/2015	Buffer DA	3
5602_10	S: ITRN-Infiltration Trench	12/21/2015	Buffer DA	3
4875_1	S: ITRN-Infiltration Trench	12/24/2015		3
8291_1	S: PWET-Retention Pond (Wet Pond)	2/1/2016		3
8562_5	S: ITRN-Infiltration Trench	2/2/2016		3
5656_4	S: ODSW-Dry Swale	2/20/2016		3

Record Key	BMP Type	Built Date	Notes	Tier
5656_3	S: ODSW-Dry Swale	2/20/2016		3
5656_2	S: ODSW-Dry Swale	2/20/2016		3
5656_1	S: ODSW-Dry Swale	2/20/2016		3
6722_7	S: ITRN-Infiltration Trench	3/22/2016	Buffer DA	3
6722_8	S: ITRN-Infiltration Trench	3/22/2016	Buffer DA	3
6722_11	S: ITRN-Infiltration Trench	3/22/2016	Buffer DA	3
6722_9	S: ITRN-Infiltration Trench	3/22/2016	Buffer DA	3
6722_12	S: ITRN-Infiltration Trench	3/22/2016	Buffer DA	3
6722_10	S: ITRN-Infiltration Trench	3/22/2016	Buffer DA	3
6722_13	S: ODSW-Dry Swale	3/22/2016		3
8680_2	S: ITRN-Infiltration Trench	5/1/2016		3
3467_3	S: ITRN-Infiltration Trench	5/13/2016		3
3467_2	S: ITRN-Infiltration Trench	5/13/2016		3
3467_1	S: PWED-Extended Detention Structure, Wet	5/13/2016		3
4486_1	S: ITRN-Infiltration Trench	6/15/2016		3
9323_6	S: ITRN-Infiltration Trench	8/16/2016		3
9323_7	S: ITRN-Infiltration Trench	8/16/2016		3
9323_5	S: ITRN-Infiltration Trench	8/16/2016		3
9323_4	S: ITRN-Infiltration Trench	8/16/2016		3
4056_1	S: ITRN-Infiltration Trench	2/17/2017		3
8601_3	S: PMED-Micropool Extended Detention Pond	7/31/2017		3
8601_2	S: PMED-Micropool Extended Detention Pond	7/31/2017		3
6969_1	S: PWED-Extended Detention Structure, Wet	9/26/2017		3

Appendix B: Public Comment Period Documentation

Documentation of the 30-day Public Comment period will be included here, as well as documentation of responses to comments received.