BALTIMORE HARBOR
Watershed Assessment

Mayor
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DEPARTMENT OF PUBLIC WORKS

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ACRONYMS / GLOSSARY

BMP – Best Management Practice (for controlling pollutant discharges)

DOT – Department of Transportation

DPW – Department of Public Works

ENR – Enhanced Nutrient Reduction

ESD-Environmental Site Design (aka Low Impact Development / LID), comprehensive strategy for maintaining predevelopment runoff characteristics by integrating site design, natural hydrology, and smaller controls to capture and treat runoff at the source.

EPA – Environmental Protection Agency

Impervious Surface-surfaces that prevent stormwater from infiltrating to below the ground, includes rooftops, pavement, and gravel.

MDE – Maryland Department of the Environment

MD DNR – Maryland Department of Natural Resources

MEP – Maximum Extent Practicable

MS4 – Municipal Separate Storm Sewer System

NPDES – National Pollutant Discharge Elimination System

Nutrients – Total phosphorus and total nitrogen

Planning – Department of Planning

SWS – Subwatershed

TMDL – Total Maximum Daily Load, the maximum amount of a pollutant a water body can receive and still meet water quality standards; "pollution diet".

TN – Total Nitrogen

TP – Total Phosphorus

TSS – Total Suspended Solids

Watershed – an area of land that drains down slope to the lowest point, discharging to a river, river system or other body of water.

WA – Watershed Assessment

WIP – Watershed Implementation Plan; document that sets the way an agency will meet the regulatory requirements.

WLA – Waste Load Allocations

WQA – Water Quality Analysis, developed when supplemental data indicates the water body is meeting water quality standards for that substance

1 INTRODUCTION

The purpose of the Lower North Branch Patapsco (LNBP) Watershed Assessment report is to provide the framework to identify and prioritize best management practices (BMPs) for watershed restoration and TMDL compliance to meet the requirements of the Baltimore City's Municipal Separate Storm Sewer System (MS4) permit, while maximizing co-benefits that help communities within the watershed. Specifically, the report addresses the following:

- Determine current water quality conditions;
- Include the results of a visual watershed inspection;
- Identify and rank water quality problems; and
- Prioritize all structural and nonstructural water quality improvement projects

Pollutant load reduction benchmarks and deadlines that demonstrate progress toward meeting all applicable stormwater WLAs for the LNBP Watershed can be found in the "Baltimore City MS4 Restoration and TMDL WIP WIP, dated August 2015)", as well as in the City's MS4 Annual Reports.

1.1 Watershed Assessment Report Organization

This report is organized into the following chapters:

Chapter 1 – Introduction. Explains the purpose of the report and the location and scope of the watershed assessment, along with the methods used in the Watershed Assessment.

Chapter 2 - Watershed Characterization. Inventory of current watershed physical and social conditions, including 1) environmental factors, 2) social and economic factors relevant for prioritization of sites physically feasible sites, and 3) regulatory and planning documents.

Chapter 3 – Water Quality Assessment - Identify and rank water quality problems. Includes a description of the TMDLs for the watershed as well as a prioritization of contributing factors to water quality problems.

Chapter 4 – Suitability Analysis and Prioritization. Outlines the proposed prioritization approach based on suitability for improving water quality and meeting TMDL WLAs, maximizing potential co-benefits associated with restoration strategies, and prioritizing areas for potential projects, programs, and partnerships.

Chapter 5 – Stormwater Best Management Practices – Contains the prioritization of specific structural and non-structural practices, including a description of various BMPs (Projects, Programs, and Partnerships) based on priority areas.

Chapter 7 – References and data sources – Contains in text citations and data sources used in mapping.

1.2 Watershed Delineation and Location

The Baltimore Harbor watershed includes approximately 14,549.0 highly developed acres (22.7 square miles) within Baltimore City, and is one of five (5) 8-digit state defined watersheds within Baltimore City. The watershed drains to Baltimore Harbor and ultimately to the Chesapeake Bay. It is bordered in the East by Baltimore County and the Back River watershed, in the North by the Jones Falls watershed, in the West by the Gwynns Falls and Lower North Branch of the Patapsco River watersheds, and in the South by Anne Arundel County.

The 8 digit watershed boundary provided by the State was reviewed in the context of existing topography and storm drain systems, and outfalls within Baltimore City. The boundaries of the Baltimore Harbor watershed used for this report were adjusted to reflect the existing drainage patterns within Baltimore City boundaries. These changes are detailed in Figure 1-1.

For planning and management purposes, the Baltimore Harbor watershed is divided into four (4) smaller drainage areas or subwatersheds, which are listed in Table 1-1 along with respective acreages. In addition to characterizing the entire planning area, analyses were conducted on a subwatershed scale to provide detailed information for smaller areas and to focus restoration and preservation efforts. Success of restoration efforts can be more easily monitored and measured at this smaller scale. Figure 1-2 shows the four subwatersheds comprising the Baltimore Harbor watershed.

Table 1-1 Summary of CSA Distribution with Baltimore Harbor Watershed

Subwatershed	Inner Harbor	Middle Branch	Patapsco	Southwest Harbor
Acres	2,419.6	1,664.3	1,541.9	1,025.2
% of Watershed	61.4%	48.5%	45.0%	27.3%

The city of Baltimore is home to various organizations and initiatives that collect, compile, and analyze socio-economic, demographic, public health, and environmental data across the city. Neighborhoods often represent small geographic units with populations that are often too small to adequately protect privacy and/or provide a sample size sufficient to offer a representative perspective on neighborhood conditions. In response to this challenge, the Baltimore Neighborhood Indicators Alliance (BNIA) has identified 55 geographic areas, known as Community Statistical Areas (CSAs) (Figure 1-3) which combine clusters of similar Census Tracts that correspond to Baltimore's neighborhoods boundaries (Figure 1-4). Both BNIA and the Baltimore City Health Department collect and report publicly available data based on CSA's.

Given the quality and quantity of data available on CSAs, this report uses CSAs as the primary geographic unit of analysis for illustrating the environmental, public health, and socio-economic contexts of various areas at the watershed. This report was completed at a watershed scale, but any project-scale planning efforts will consider the unique context of neighborhoods when planning outreach, engagement, and implementation (Figure 1-4).

1.3 Assessment Approach

The Baltimore Harbor watershed is a densely populated urban environment. Therefore the relevance of human social behavior to water quality improvement efforts in Baltimore cannot be ignored. Watershed restoration activities used in Baltimore include a mix of constructed practices, programs, partnerships, and public outreach strategies that both directly treat and manage stormwater, and also aim to cultivate public acceptance, support, and stewardship of watershed restoration efforts by leveraging restoration activities as a tool to improve the health and safety of communities within the watershed.

1.4 Defining the Scope of Best Management Practices[1]

Stormwater management includes many strategies known as Best Management Practices (BMPs) to mitigate the negative impact of development on watersheds. These BMPs aim to reduce the level of contamination in stormwater before it enters surface waters, and reduce the excess volume and rate of flow resulting from impervious surfaces.

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[1] A more detailed description of these BMPs can be found in Section 5

Updated Baltimore Harbor (BH) Watershed Boundary & Context
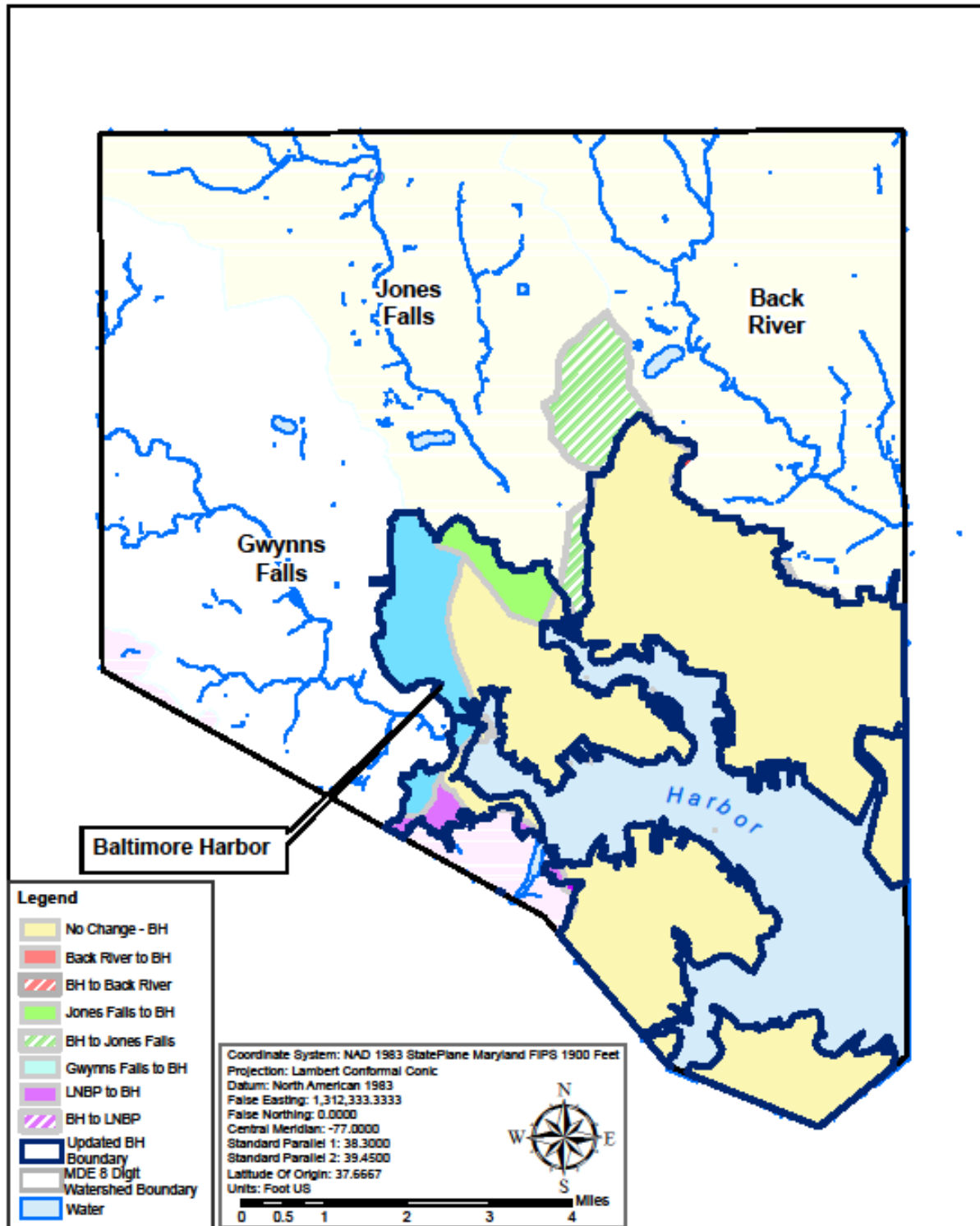
Figure 1-1 Updated Watershed Boundaries

Baltimore Harbor (BH) Sub-Watersheds
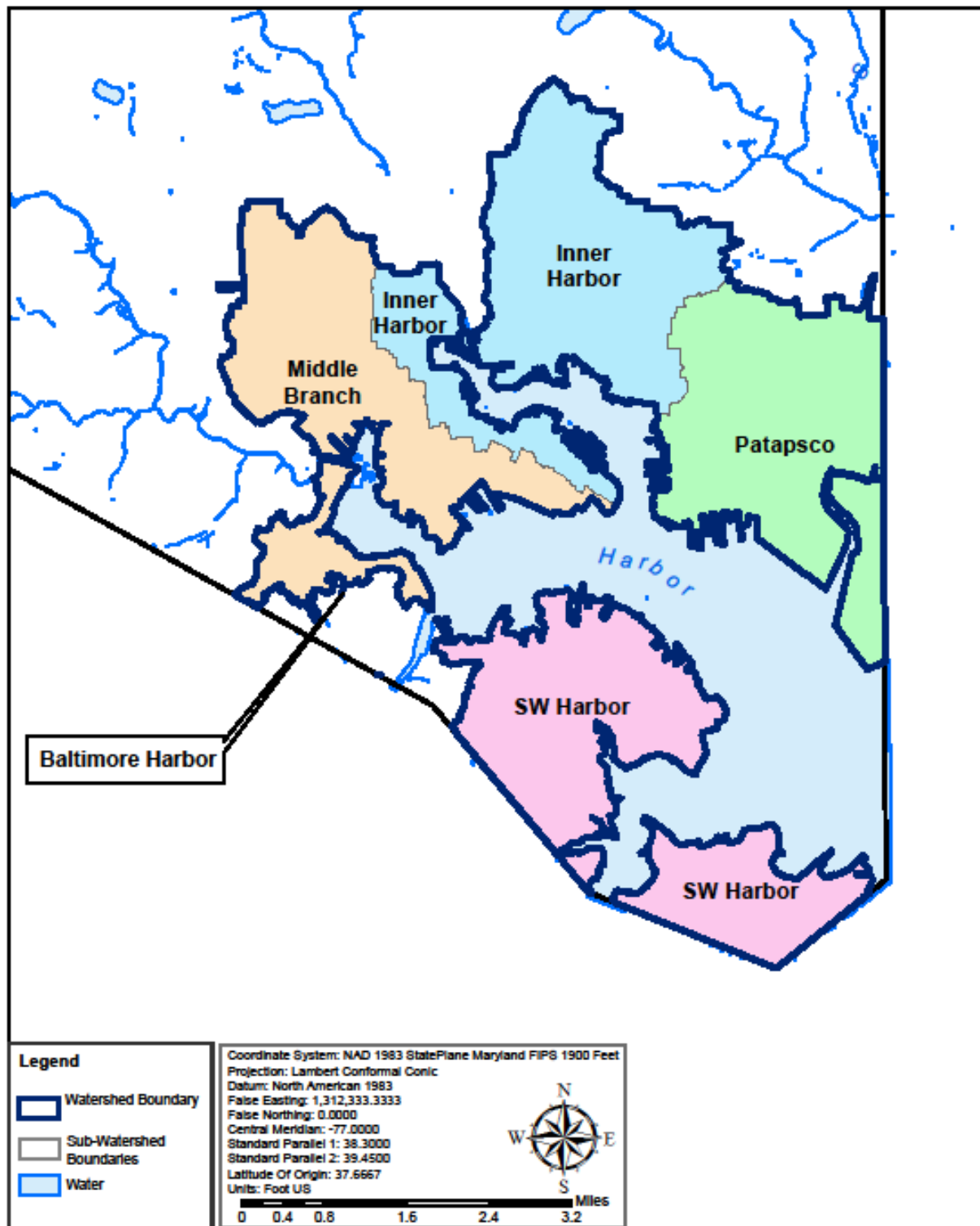
Figure 1-2 Baltimore Harbor Subwatersheds
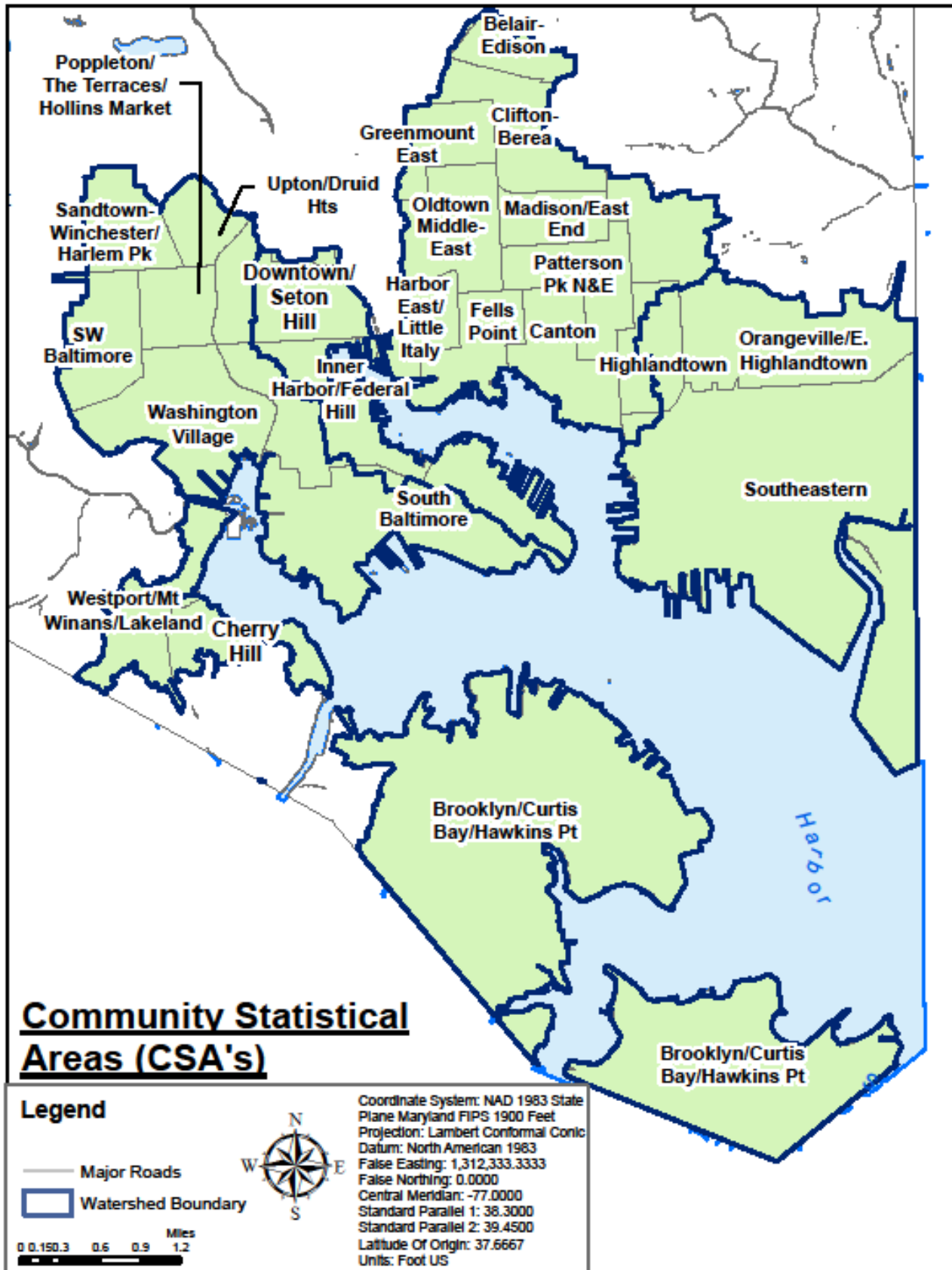
Figure 1-3 Baltimore Harbor CSAs
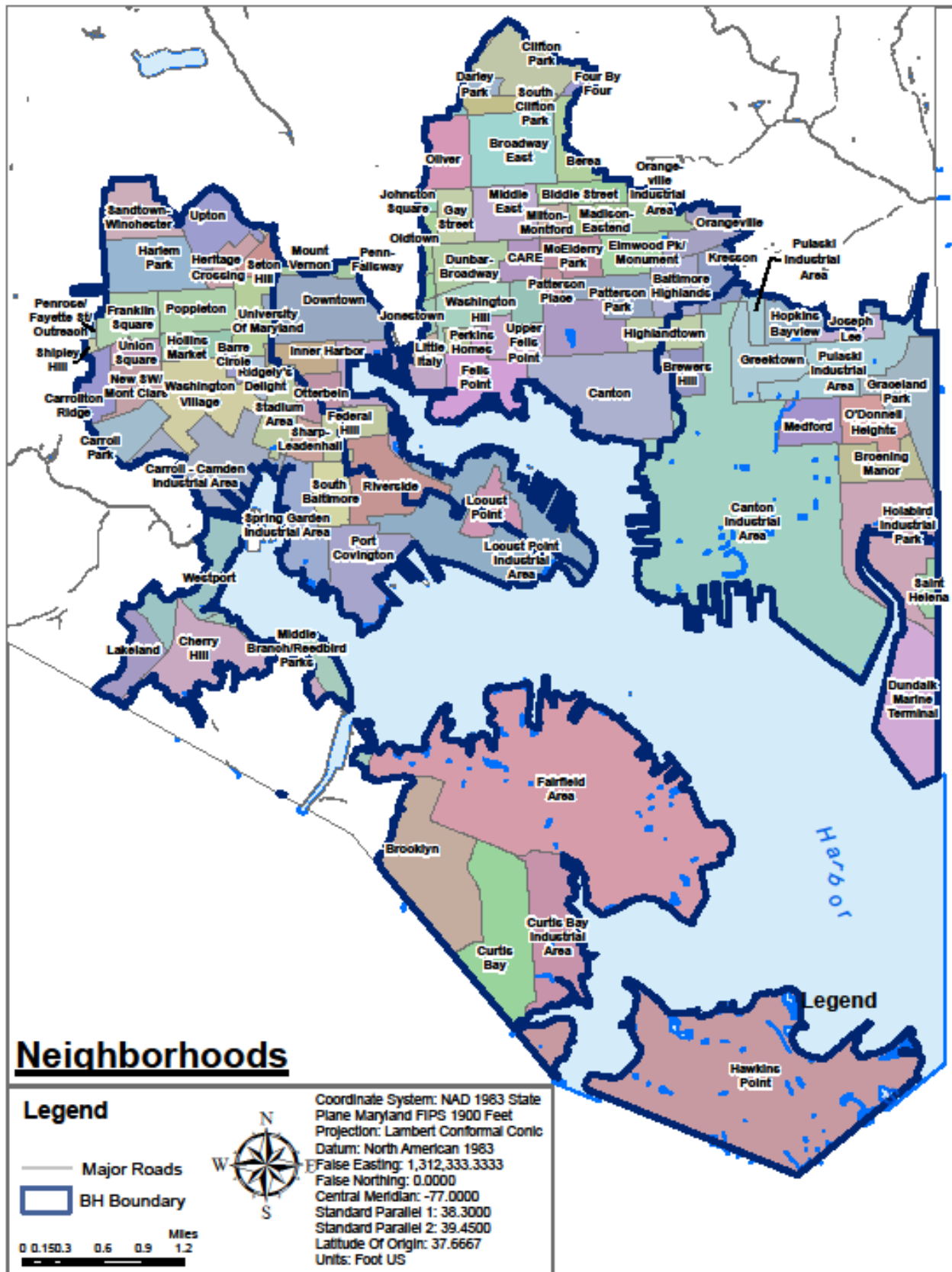
Figure 1-4 Baltimore Harbor Neighborhoods

Best Management Practices as defined within this document are inclusive of both modifications to the physical environment and operational strategies. This includes the following types of practices:

1) **Structural Practices:** capital projects like stormwater ponds, bio-swales, rain gardens/bioretention, impervious surface removal, and reforestation resulting in a definable asset. DPW will either be the lead for the installation of these projects and/or work in collaboration with other city agencies and the school system to provide capital funding.

2) **Programs:** DPW support services and operations, including street and proactive inlet cleaning, inspections, and public outreach and education.

3) **Partnerships:** Partnerships can result in BMPs that are installed by the public, private and non-profit sectors, whether as a requirement for development, projects by environmental non-profits or stormwater fee credits. Partnerships can also include public education, engagement, and initiatives that address co-benefits such as health and equity.

1.5 Method of Analysis

In order to identify and prioritize BMPs for watershed restoration, DPW performed an assessment of current watershed conditions to understand the physical and social context of the Baltimore Harbor Watershed.

1.5.1 Watershed Characterization

Data was collected on the following factors within the watershed, which will be described along with their relationship to water quality in Section 2 of this report.

- Land Use
  - Zoning
  - Land Use
  - Property Ownership
  - Development Trends
- Regulatory Conditions
  - NPDES Discharge Permits
  - Critical Area
  - Streams, Riparian Areas, & Floodplain
- Assessment of Physical Conditions
  - Slope
  - Hydrologic Soil Classification
  - Impervious Surfaces
  - Surface Temperature
  - Urban Tree Canopy Prioritization
- Wet Utility Networks
  - Storm Drain System
  - Sanitary Sewer System
  - Capital Improvement Projects
  - Sanitary Sewer Overflows (SSOs)
- Dirty Streets and Alleys / Clogged Storm Drains
- Social / Economic Conditions
- Planning Initiatives
- City-wide Initiatives

1.5.2   Waters Quality Assessment

Data was collected on water quality impairments and total maximum daily loads for the Baltimore Harbor and for the Chesapeake Bay.

1.5.3   Suitability Analysis and Prioritization

In order to prioritize areas within the watershed to sequentially focus future water quality improvement efforts, CSA's were analyzed and prioritized based on the following three (3) Prioritization Categories:

- Physical Feasibility
- Equity; and
- Health Supportive Community

Each of these three Prioritization categories was defined by analyzing data based on several factors. These factors and methodology is described in greater detail within Section 2 of this report.

Next, watershed opportunities and other stakeholder initiatives were identified and mapped to determine areas where water quality improvement activities could meet the priorities of multiple stakeholders, and to identify where aligned interests and opportunities for partnership and coordination may be present.

1.5.4   Identification of Best Management Practices

A list of the list of strategies were identified for implementing BMPs, developing new / enhancing existing programs, and conducting public outreach and education. These strategies represent various types of potential projects, programs, and partnerships that could be deployed within this watershed was generated, based on the opportunities identified within this report.

1.5.5   Recommendations

Each of the potential types of projects, programs, and partnerships that were identified was then linked to a set of factors that would represent ideal conditions for that particular strategy. A list of partners that may be relevant for each effort was also identified. These recommendations will serve as a framework for identifying potential partnerships and collaborations for future implementation.

2   WATERSHED CHARACTERIZATION

The following section includes an inventory of the physical and social/economic conditions which can influence and guide where installation of green stormwater infrastructure will be possible and impactful. Recent infrastructure projects and planning initiatives in the watershed area are also noted to inform future water quality improvements.

2.1   Zoning / Land Use / Property Ownership

2.1.1   Zoning

Zoning is the process of dividing land in a municipality into zones (e.g. residential, industrial) in which certain land uses are permitted or prohibited. In the Baltimore Harbor watershed, zoning is a reflection of what we see as land use, and an indication of what will be permitted for future development (Table 2-1).

As shown in Figure 2-1, significant portions of the Baltimore Harbor watershed are zoned as industrial. 46.5% of the 6,665.7 acres of Industrial zoned land in the Baltimore Harbor Watershed are located in the SW Harbor, 32.9% in the Patapsco, 12.7% in the Middle Branch, and 7.8% in the Inner Harbor. Industrial zoned land represents 24.8% of the middle branch, 64.1% of the Patapsco, and 82.6% of the Southwest Harbor (82.6%) subwatersheds. Industrial land is typically regulated under separate NPDES permits. Where this is not the case, industrial use lands are generally limited in the types of BMP's that can be installed, in particular for infiltration based BMP's, depending on the current and past use of the land.

Residential, office, and commercial areas are dominant in the Inner Harbor and Middle Branch subwatersheds. These uses are co-located within the Baltimore Harbor watershed because they are considered compatible land, and serve the large population of people who live and/or work in the downtown area.   Residential zones account for 44.8% of the Inner Harbor Subwatershed (41.9% is high density), 39.0% of the Middle Branch (32.9% is high density), 17.2% of the Patapsco (4.2% is high density), and 11.3% of the Southwest Harbor subwatershed (<1% is high density). Commercial zones cover 25.5% of the Inner Harbor, 14.4% of the Middle Branch, 8.8% of the Patapsco, and 1.3% of the Southwest Harbor. Most of the 187.1 acres of office space in the watershed is located in the Patapsco (56.8%) followed by the Inner Harbor (35.5%) watersheds; although office zoned uses represent just a tiny fraction of these sub-watersheds (1.7% of the Inner Harbor, and 3.1% of the Patapsco). Together, these areas represent opportunities to develop incentives for private property owners and businesses.

Open space zoned areas represent good opportunities for ESD practices, as they typically are publicly owned and reduced spatial constraints and utility conflicts relative to the right-of-way. The majority of land zoned as open space in the Baltimore Harbor Watershed lies in the Inner Harbor subwatershed (41.6%), followed by the Middle Branch (28.6%). However, this represents a small percentage (11.4% or 450 Acres and 9% of 609.7 acres respectively) of these sub-watersheds.

In Table 2-2, the percentage of zoning type within the watershed is used to identify how different zoning types are distributed in order to target particular BMP opportunities.

Table 2-1 Zoning Type within Watershed

Zoning Type	Acres	% Watershed Area
No Data	435.3	3.0
Commercial	1847.5	12.7
Educational	0.4	0.0
Hospital	190.7	1.3
Industrial	6665.7	45.8
Office	187.1	1.3

Open Space	1082.3	7.4
Residential Detached	232.4	1.6
Residential High Density Rowhouse	2924.3	20.1
Residential Mixed Use	241.6	1.7
Residential Multifamily	32.8	0.2
Residential Rowhouse Low Density	531.6	3.7
Residential Transitional	154.2	1.1

Table 2-2 Zoning Type within Subwatersheds in Watershed

SubWS	Type	AREA (Ac.)	% of SubWS	% of Zoning Type within WS
Inner Harbor	No Data	35.6	0.9%	8.2 %
	Commercial	1,004.3	25.5%	54.4%
	Hospital	83.0	2.1%	99.9%
	Industrial	521.2	13.2%	43.5%
	Office	66.5	1.7%	7.8%
	Open Space	449.8	11.4%	35.6%
	Residential Detached	48.8	1.2%	41.6%
	Residential Rowhouse High Density	1,650.9	41.9%	21.0%
	Residential Mixed Use	40.6	1.0%	56.5%
	Residential Rowhouse Low Density	22.5	0.6%	16.8%
Middle Branch	No Data	399.2	11.6%	4.2%
	Commercial	492.8	14.4%	91.7%
	Hospital	33.3	1.0%	26.7%
	Industrial	849.7	24.8%	17.5%
	Office	6.8	0.2%	12.7%
	Open Space	309.7	9.0%	3.6%
	Residential Detached	1.3	0%	28.6%
	Residential Rowhouse High D.	1,129.8	32.9%	0.5%
	Residential Mixed Use	34.8	1.0%	38.6%
	Residential Multifamily	32.8	1.0%	14.4%
	Residential Rowhouse Low D.	141.7	4.1%	100.0%
Patapsco	No Data	0.4	0%	26.7%
	Commercial	302.4	8.8%	0.1%
	Hospital	74.5	2.2%	16.4%
	Industrial	2,194.4	64.1%	39.1%
	Office	106.2	3.1%	32.9%
	Open Space	155.1	4.5%	56.8%
	Residential Detached	148.6	4.3%	14.3%
	Residential Rowhouse High D.	142.8	4.2%	63.9%
	Residential Mixed Use	117.4	3.4%	4.9%
	Residential Rowhouse Low D.	131.2	3.8%	48.6%
	Residential Transitional	50.3	1.5%	24.7%

Southwest Harbor	Commercial	48.0	1.3%	32.6%
	Industrial	3,100.4	82.5%	2.6%
	Office	7.6	0.2%	46.%5
	Open Space	167.7	4.5%	4.1%
	Residential Detached	33.7%	0.9%	15.5%
	Residential Rowhouse High D.	0.8	0%	14.5%
	Residential Mixed Use	48.8	1.3%	0.0%
	Residential Rowhouse Low D.	236.3	6.3%	20.2%
	Residential Transitional	103.9	2.8%	44.4%

2.1.2   Land Use

Land use data was downloaded from the MD iMAP GIS portal. This dataset was compiled in 2010 to track how development has transformed land use generally over time at the state level. As such, the categorization differs from zoning, which represents the intended land use types established by the city going forward.

Predominant land use types present within the Baltimore Harbor planning area are industrial areas and high density residential (Figure 2-2 and Table 2-3). Residential areas were subdivided into three subcategories based on density: low density (1/2 to 5-acre lots); medium density (1/8 to 1/2-acre lots); and high density (less than 1/8-acre lots). Medium and high density residential make up the vast majority of residential areas within the planning area (approximately 99.9%). Subwatersheds with the highest percentages of residential areas include Inner Harbor and Middle Branch. Over one-third of the land areas in these subwatersheds are comprised of high density and medium density residential areas. Residential areas present an opportunity for community involvement in restoration efforts, pollutant source control, and environmental stewardship.

Nearly 37% of industrial land uses within the Baltimore Harbor planning area occur within the Patapsco subwatershed. Over 64% of the Patapsco subwatershed is comprised of industrial uses. Other urban land uses, including commercial, institutional, and transportation, make up a significant portion of the planning area (approximately 2,640 acres or 18% of total area). The majority of commercial land use occurs in the Inner Harbor subwatershed. Institutional areas such as community centers, schools, churches, medical facilities, and government offices comprise about 8% of the total area and may present opportunities to initiate environmentally sensitive management of the property and to promote environmental awareness education.

Table 2-3 Land Use Types

Land Use Type	Inner Harbor (Ac.)	Middle Branch (Ac.)	Patapsco (Ac.)	Southwest Harbor (Ac.)	% Watershed Area
Barren Land	0	4.8	0	342.5	2.4%
Commercial	602.0	206.6	173.5	33.7	7.0%
Forest	0	71.4	0	202.5	1.9%
High Density Residential	1,864.4	1,169.0	370.6	359.5	25.9%
Medium Density Residential	0	7.0	152.5	48.8	1.4%
Low Density Residential	0	0	0	2.8	0%
Industrial	590.6	1,063.8	2,239.2	2,215.2	42.0%
Institutional	437.6	436.2	148.1	55.3	7.4%
Other Developed Land	386.0	255.2	168.2	323.7	7.8%
Transportation	39.5	167.6	134.2	88.5	3.0%
Wetland	0	0	0	5.6	0%
Water	17.8	51.7	37.0	78.6	1.3%

Figure 2-1 Zoning Type within Watershed

Land Use Land Cover
(State of Maryland)

Legend

- ▭ DH Boundary
- ▩ Other Developed Lands
- ▩ Transportation
- ▩ Water
- ▨ Wetlands
- ▩ Medium Density Residential
- ▨ Industrial
- ▩ Institutional
- ▢ Low Density Residential
- ▩ Barren Land
- ▩ Commercial
- ▩ Forest
- ▩ High Density Residential

Coordinate System: NAD 1983 State Plane Maryland FIPS 1900 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
False Easting: 1,312,333.3333
False Northing: 0.0000
Central Meridian: -77.0000
Standard Parallel 1: 38.3000
Standard Parallel 2: 39.4500
Latitude Of Origin: 37.6667
Units: Foot US

0.5 0.25 0   0.5 Miles

Figure 2-2 Land Use within Watershed

2.1.3   Property Ownership

Property ownership is a critical consideration necessary to determine the magnitude of available space for restoration activities, the potential partnerships necessary for implementation, and the barriers that may be encountered. Currently, installation of stormwater management projects by DPW can only occur on publicly owned property, such as City owned land or within right-of-way (ROW). Public land is limited, and often contains physical constraints or barriers, such as utilities within the public ROW. For example, Reedbird Park is a closed landfill that limits the installation of facilities. Installing projects on federal, state, or private land would require additional tailored agreements, easements, or memorandums of understanding in order to protect any investment of public funds. Programs, partnerships, and incentives may be more effective to allow for restoration activities on land owned by others, which may contain fewer utilities or other constraints. Railways corridors have been identified as particularly limiting for restoration projects.

Baltimore city maintains a dataset which contains information on land parcels within the city limits and ownership information. This dataset was reviewed to identify parcels that were City-owned, State-owned, federal-owned, or privately owned. The area of rights-of-ways (ROW) was estimated by designating land area within the City limits that was not a parcel. Railway corridors were identified as parcels with above and below ground rail. For the ROW, a 20 ft. buffer was assumed on either side of rail lines crossing the assumed right of way area to determine the area of ROW impacted by railways (Figure 2-3).

Table 2-4 shows that the percentage of the watershed that is City-owned land is small relative to the percentage of the watershed that is under private ownership. Engaging private land owners will be critical to achieving restoration goals. A quarter of the watershed is impacted by rail, which will be a notable constraint.

Table 2-4 Property Ownership within Watershed

	Inner Harbor		Middle Branch		Patapsco		Southwest Harbor		Baltimore Harbor Overall	
	AREA (ac)	% of Sub WS	AREA (ac)	% of SubWS	AREA (ac)	% of SubWS	AREA (ac)	% of SubWS	AREA (ac)	% of WS
City Owned	682.5	17.3	492.5	14.3	152.4	4.5	529.7	14.1	1857.2	12.8
Private	1741.0	44.2	1411.1	41.1	1119.0	32.7	1158.7	30.9	5429.8	37.3
Right of Way (ROW)	1188.3	30.2	896.4	26.1	706.8	20.6	575.2	15.3	3366.7	23.1
Railroads	283.7	7.2	545.0	15.9	1504.2	43.9	1355.6	36.1	3700.1	25.4
State Owned	0.0	0.0	48.2	1.4	180.7	5.3	76.9	2.0	313.7	2.2
Federal Owned	42.3	1.1	24.7	0.7	6.9	0.2	5.1	0.1	79.0	0.5
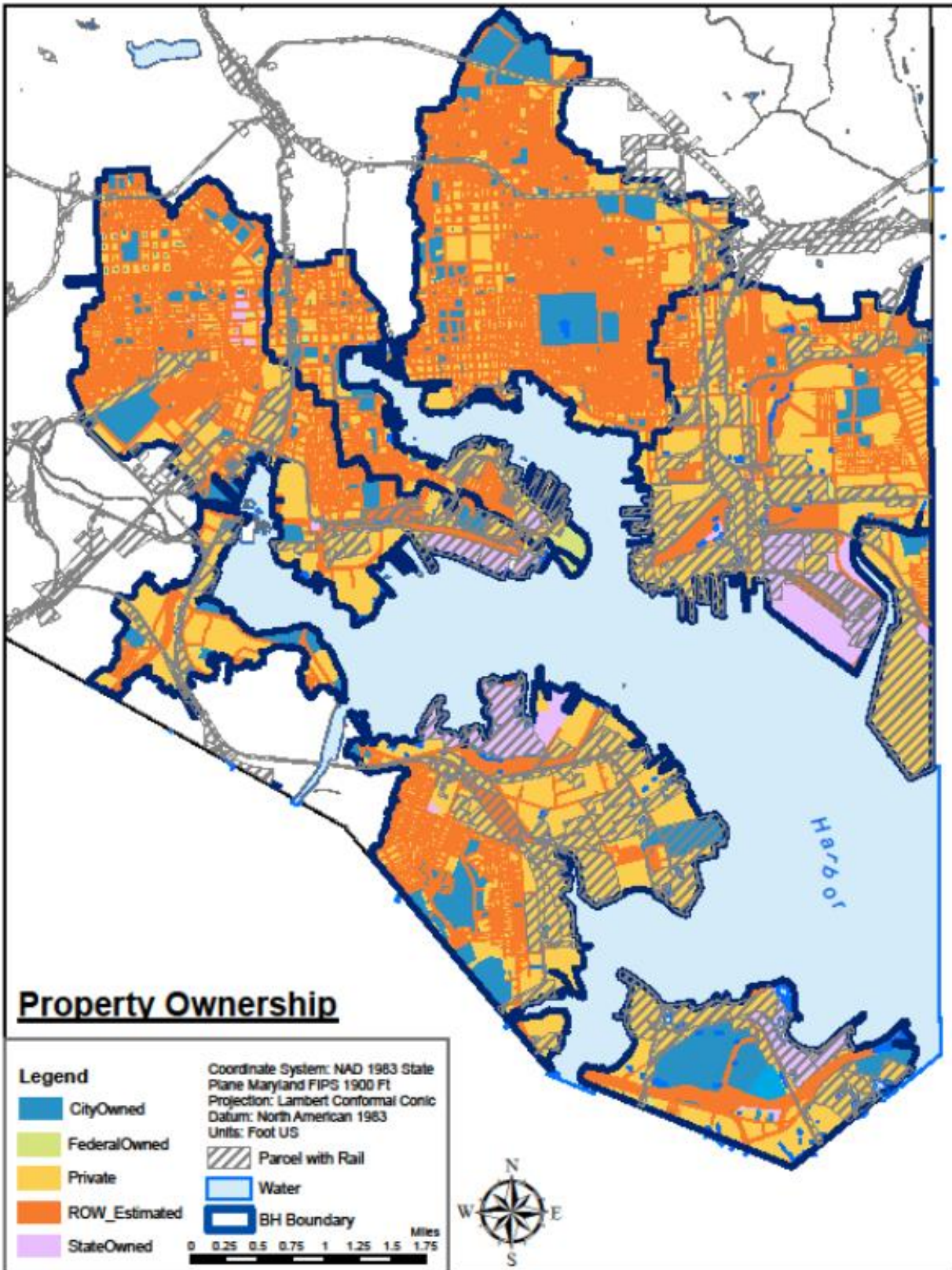
Figure 2-3 Property Ownership

2.2   Regulatory Conditions

2.2.1   Projected Development Trends

Estimating the geographic areas where private development is expected to occur can provide a forecast for the magnitude of watershed restoration activities that will likely be carried out through private development as a Partnership activity (see Section 5.4.2). DHCD has identified 1) Neighborhood SubCabinet areas (specific areas where the city is currently planning to drive concentrated re-development) 2) Major Redevelopment areas (specific areas where land transformation is expected to occur) and 3) Community Development Clusters (broad, general areas of potential re-development) (Figure 2-4).
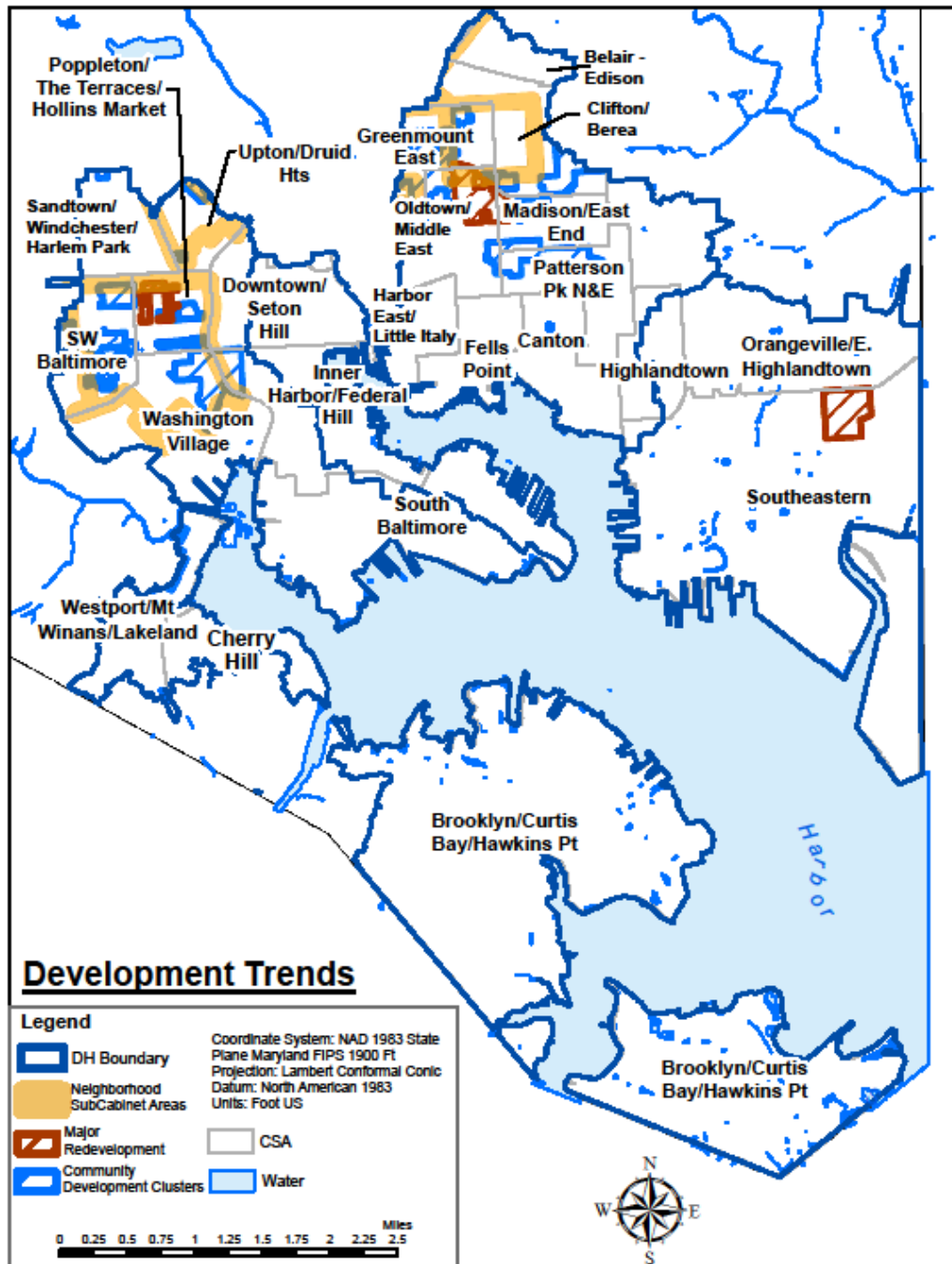
Figure 2-4 Development Trends

2.2.2   Critical Area

The State of Maryland Chesapeake Bay Critical Area Law establishes the Chesapeake Bay Critical Area Commission (CAC) and requires that the City of Baltimore and other jurisdictions prepare and adopt a Critical Area Management Program (CAMP) to:

1. Improve the water quality of the Bay by controlling pollution from stormwater runoff and;
2. To conserve and protect wildlife habitat along the shoreline of the Bay

The City's CAMP establishes guidelines for development of properties within the 1,000-foot strip of land measured from the mean high tide line or the bulkhead. The Critical Area is also separated into additional sub-areas. Within the watershed, these sub-areas are Intensely Developed Areas (IDA) and Resource Conservation Areas (RCA). Two of the requirements for development projects in the Critical Area are for IDA projects to reduce phosphorus levels in storm water runoff by 10% and RCA projects to limit lot coverage (impervious surfaces) to 15-25% of the lot, depending on the size of the lot.

Critical Areas extend along the entire shoreline of the Baltimore Harbor and two stream reaches (Curtis Creek in the Southwest Harbor subwatershed and Colgate Creek in the Patapsco subwatershed) (Figure 2-5).

2.2.3   NPDES Discharge Permits

Businesses and other facilities that discharge municipal or industrial wastewater or conduct activities that can contribute pollutants to a waterway are required to obtain a National Pollutant Discharge Elimination System (NPDES) permit. Tables 2-5 and 2-6 list the type of NPDES permit required depends on the nature of the activities conducted by the facility. The subwatershed with the most NPDES permits (by acreage) is Southwest Harbor. These permits are primarily for State properties (Maryland Port Administration) and Industrial permit holders. The Patapsco subwatershed has the second most acreage for Industrial permits (Figure 2-6).

Table 2-5 Acres of Land - NPDES by Sector within Subwatersheds

Subwatershed	Inner Harbor	Middle Branch	Patapsco	Southwest Harbor	Total
MS4 – Balt City	3,699.7	3008.5	2688.1	2285.0	11,681.2
Federal	50.8	27.6	6.9	5.1	90.5
State	19.6	107.3	594.1	331.0	1,052.1
Industrial	161.9	274.5	380.9	1,080.1	1,897.4

Table 2-6 Percentage of Land - NPDES by Sector within Subwatersheds

Subwatershed	Inner Harbor (% of SWS)	Middle Branch (% of SWS)	Patapsco (% of SWS)	Southwest Harbor (% of SWS)	Total (% of WS)
MS4 – Balt City	94.0%	87.6%	78.5%	60.9%	80.3%
Federal	1.3%	0.8%	0.2%	0.1%	0.6%
State	0.5%	3.1%	17.4%	8.8%	7.2%
Industrial	4.1%	8.0%	11.1%	28.8%	13.0%
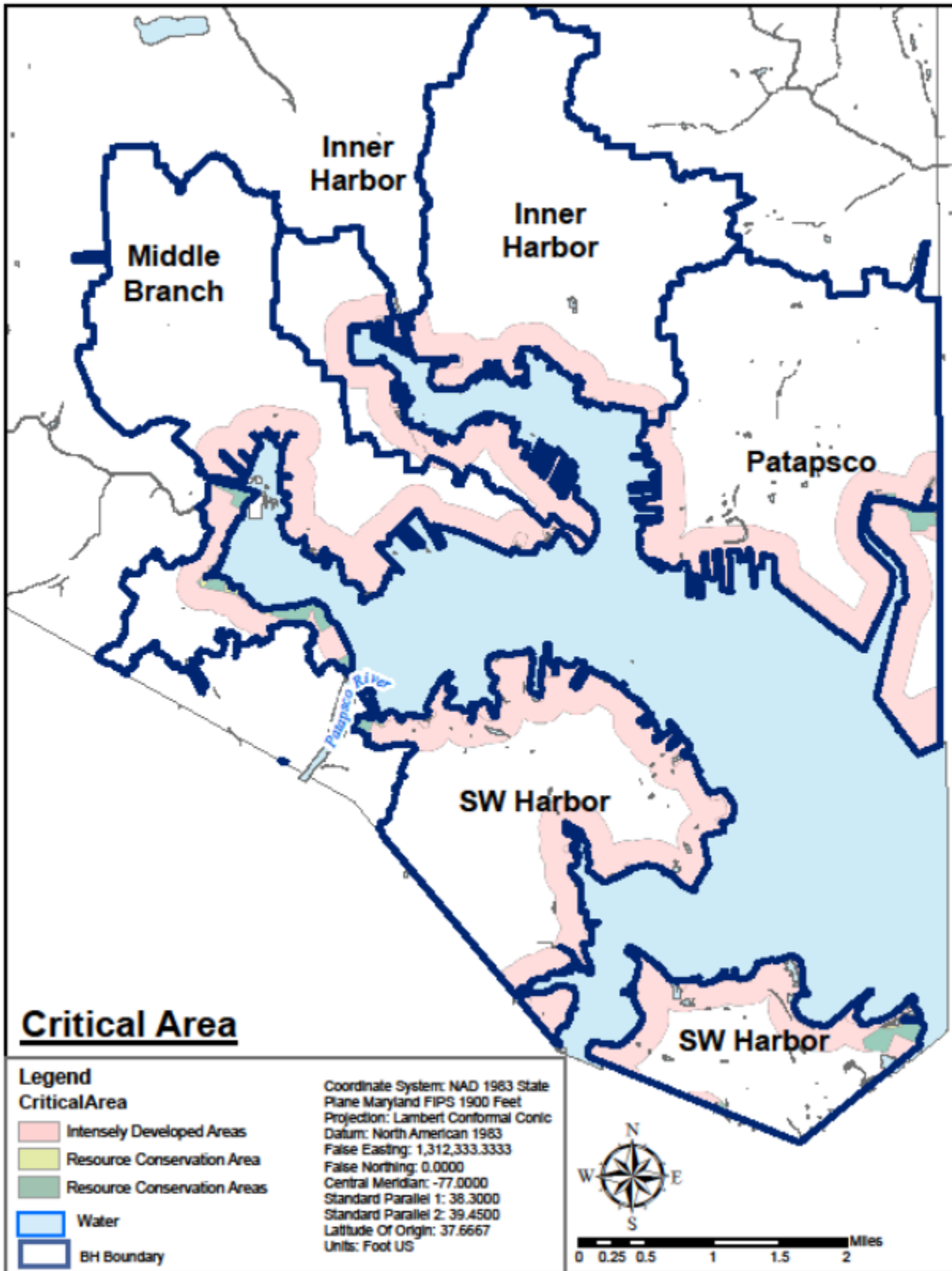
Figure 2-5 Critical Area
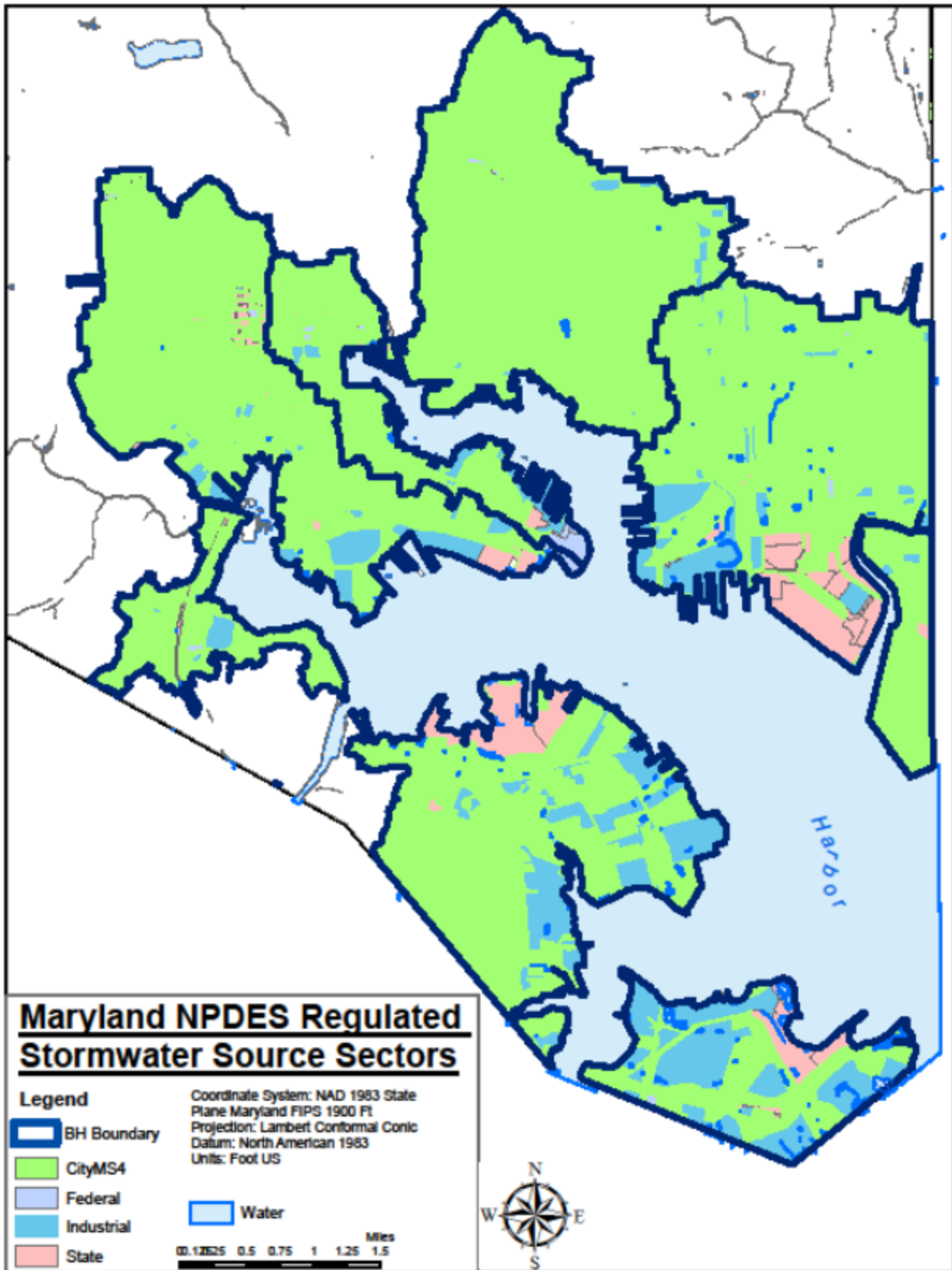
Figure 2-6 NPDES by Sector within Watershed

2.3 Assessment of Physical Conditions

2.1.1 Slope

While topography describes the shape of the land, slope describes steepness, which can affect the direction and magnitude of surface water flows, degree of soil erosion, and suitability for stormwater management. Slope data for the Lower North Branch Patapsco watershed is divided into the following four slope ranges:

- Gently sloping (0 to 5% slopes)
- Undulating, rolling (5 to 10% slopes)
- Strongly sloping (10 to 15% slopes)
- Moderately steep - steep (15%+)

Figure 2-7 and Table 2-7 provides a summary of the breakdown of percent slopes for the entire watershed. Because the optimal slope range for installing stormwater infrastructure practices like bioretention is 0-10%, the acreage and percent of these slopes was calculated for each subwatershed (see Table 2-8). The Patapsco subwatershed has the most acreage that falls within this slope range, followed by the Inner Harbor. Although 0-10% slopes are optimal, this does not preclude other ESD practices like regenerative conveyance systems being installed on steeper slopes.

Table 2-7 Slope Ranges within Watershed

Slope	0-5%	5-10%	10-15%	15%+
Acres	8,084.2	3,790.7	1,195.1	1,474.8
% of Watershed	55.6%	26.1%	8.2%	10.1%

Table 2-8 Slope Ranges in Watershed within Subwatersheds

	Inner Harbor	Middle Branch	Patapsco	Southwest Harbor
Acres of slopes 0-5%	2,037.2	1,889.0	2,209.5	1,948.5
% of 0-5% slopes within the Subwatershed	51.7%	55.0%	64.6%	51.9%
% of 0-5% slopes within the Watershed	25.2%	23.4%	27.3%	24.1%
Acres of slopes 5-10%	1,275.6	957.0	724.4	1,948.5
% of 5-10% Slopes within the subwatershed	32.4%	27.9%	21.2%	22.1%
% of 5-10% Slopes within the watershed	33.7%	25.3%	19.1%	22.0%
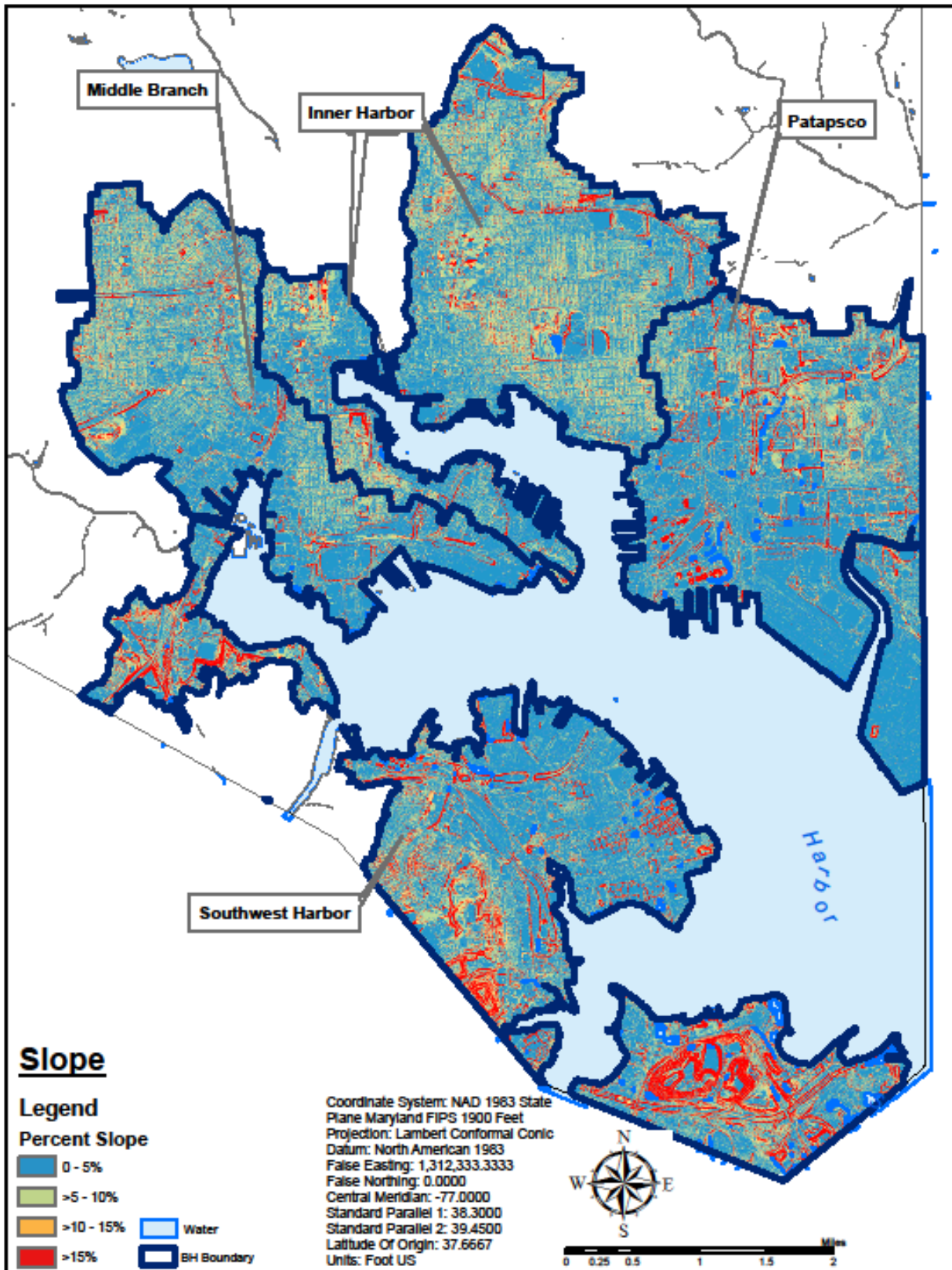
Figure 2-7 Slope Ranges within Watershed

2.3.1 Soils

Soils are an important consideration when evaluating hazards and opportunities related to efforts to improve stormwater quality and manage stormwater quantity. In particular, soil characteristics can determine the rate of infiltration, runoff, erosion that occurs as a result of a storm, and also influences plant health, which contributes to all of these factors. The Natural Resources Conservation Services (NRCS) classifies soils into four hydrologic soil groups (HSG) based on their runoff potential, which is estimated based on the infiltration rate (or the ability of a soil to absorb precipitation) of the soil when thoroughly wetted and not protected by vegetation[2]. Soils with high runoff potential have low infiltration capacity resulting in runoff, or overland flow. Infiltration is influenced by disturbances to the soil profile such as land development activities, and so can be highly variable across small geographies, especially within urban areas.

The four hydrologic soil groups range from A to D, from highest infiltration rates to lowest, respectively. Dual designations (i.e. C/D) represent the classification in its artificially drained versus un-drained, natural condition. Brief descriptions of each hydrologic soil group are provided below. Further explanation can be found in the USDA/NRCS publication, *Urban Hydrology for Small Watersheds, Technical Release 55* (USDA, 1986).

- **Group A** soils include sand, loamy sand, or sandy loam types. These soils have a high infiltration rate and low runoff potential even when thoroughly wet.

- **Group B** soils include silt loam and loam types. They have a moderate infiltration rate when thoroughly wet. These soils mainly consist of somewhat deep to deep, moderately well to well drained soils with moderately fine texture to moderately coarse texture.

- **Group C** soils are sandy clay loam. These soils have a low infiltration rate when thoroughly wet. These types of soils typically have a layer that hinders downward movement of water.

- **Group D** soils include clay loam, silt clay loam, sandy clay, silty clay, or clay types. These soils have a very low infiltration rate and high runoff potential when thoroughly wet.

As shown in Figure 2-8 and Table 2-9, 89% of the watershed is hydrologic groups C and D. These soils have low to very low infiltration rates and therefore, bioretention and micro-bioretention practices will require an underdrain.

Table 2-9 Hydrologic Soil Groups within Watershed

Soil Groups	Group A	Group B	Group C	C/D	Group D	Unknown
Acres	689.4	405.6	2875.0	12.8	10,077.6	477.5
% of Watershed	4.7%	2.9%	19.8%	0.2%	69.3%	3.3%

Tables 2-10 shows that the Southwest Harbor SWS, followed by the Patapsco SWS have the greatest number of acres with A and B group soils, whereas these areas where good infiltration can be expected are less prevalent within the Middle Branch and Inner Harbor SWS. While the Inner Harbor SWS has a similar acreage of A & B soils relative to the Middle Branch SWS there is a larger of the SWS in the Inner Harbor that has C and D soils, where it will be may be more challenging to install infiltration based ESD's. However, a substantial area was identified for both where opportunities for infiltration based practices exist. Additionally, where soils preclude use of infiltration based practices, opportunities for non-infiltration based practices, such as tree planting, rainwater harvesting, and street sweeping, remain viable in these areas.

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[2] Part 630 Hydrology National Engineering Handbook:
https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba

Table 2-10 Acres of Hydrologic Soil Groups within Subwatersheds

Soil Group	Inner Harbor	Middle Branch	Patapsco	Southwest Harbor
A	43.1	82.4	47.8	516.1
B	109.2	71.7	156.5	68.2
C	400.2	745.0	567.2	1,162.7
C/D	0	0	8.1	0
D	3,324.6	2,470.2	2,629.8	1,605.7
Unknown	60.7	63.3	17.4	336.1
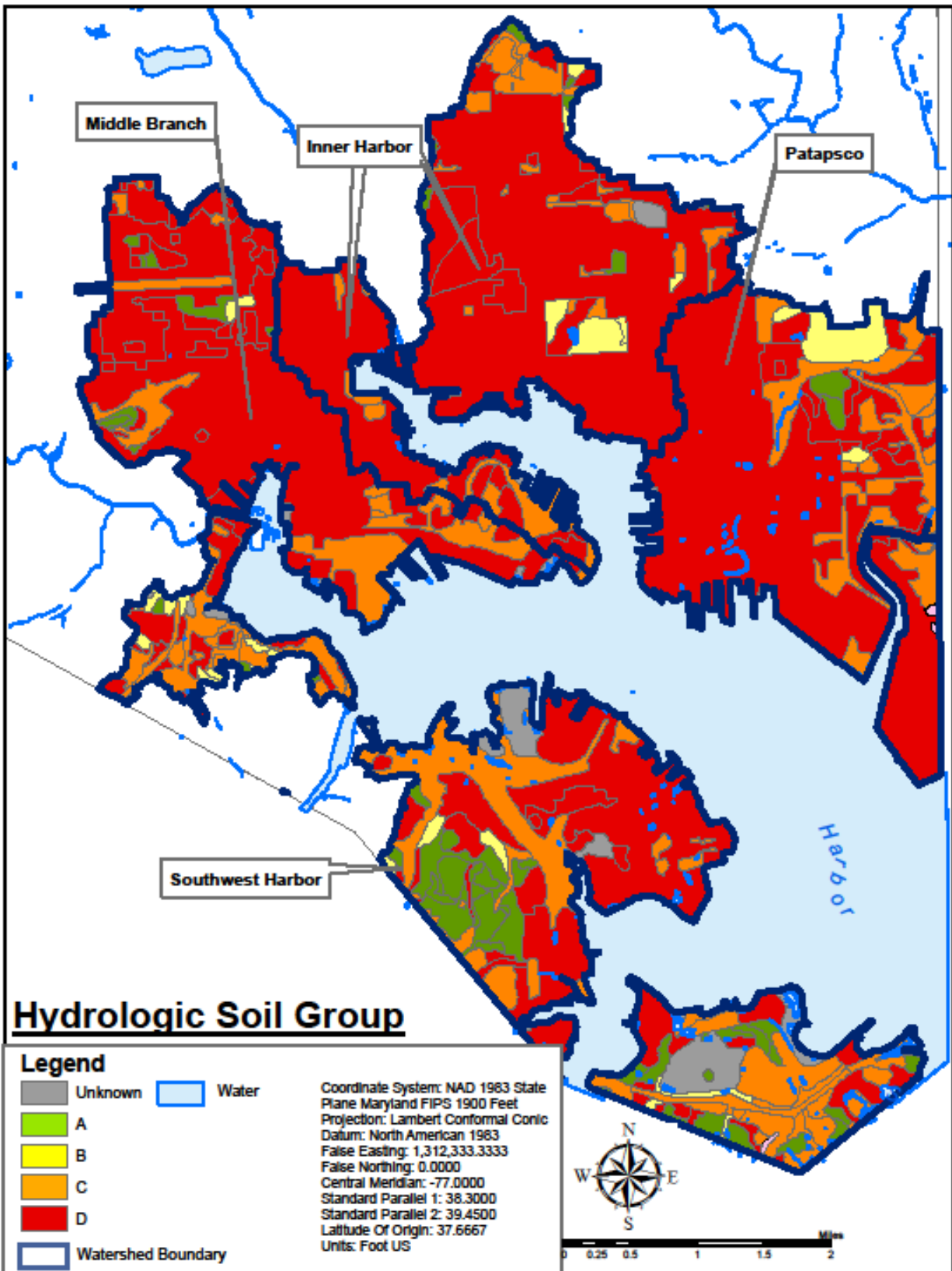
Figure 2-8 Hydrologic Soil Groups within Watershed

2.3.2 Stream / Shoreline Systems

There are nearly 12.8 miles of stream in the planning area, all of which drain to the Chesapeake Bay (Table 2-11). The subwatershed with the most stream miles is Southwest Harbor, followed by Patapsco and the Middle Branch (Figure 2-9).

Table 2-11 Stream Miles by Subwatershed

Subwatershed	Stream Miles
Inner Harbor	0.8
Middle Branch	2.2
Patapsco	3.4
Southwest Harbor	6.4
Total	*12.8*

2.3.3 Stream Riparian Buffers

Riparian buffers refer to the vegetated areas adjacent to streams and other water bodies that protect them from pollutant loads while also providing bank stabilization and habitat. Forested buffer areas along streams play a crucial role in improving water quality and flood mitigation as they intercept and reduce surface runoff, stabilize stream banks, trap sediment, and provide habitat for terrestrial and aquatic life.

The condition of the stream riparian buffers in the Baltimore Harbor watershed was analyzed assuming a 100-foot wide buffer on both sides of all streams. The condition of the riparian buffer was classified using four categories: impervious, open pervious, forest, or wetland. Table 2-12 summarizes stream riparian buffer conditions by subwatershed, and the distribution is shown in Figure 2-10.

Table 2-12 Land Cover in the 100ft Stream Buffer

Subwatershed	IMPERVIOUS		OPEN PERVIOUS		FOREST		WETLAND		TOTAL WATERSHED ACRES	TOTAL % OF WATERSHED
	Acres	%	Acres	%	Acres	%	Acres	%		
Inner Harbor	70.9	50.9%	67.8	48.7%	0.6	0.4%	0.0	0.0%	139.3	3.5%
Middle Branch	28.8	23.2%	81.7	65.7%	13.9	11.2%	0.0	0.0%	124.4	3.6%
Patapsco	78.7	63.7%	43.7	35.4%	1.0	0.8%	0.0	0.0%	123.4	3.0%
Southwest Harbor	48.3	20.8%	150.3	64.5%	30.3	13.0%	3.9	1.7%	232.9	5.8%
Total	*226.8*	*36.6%*	*343.5*	*55.4%*	*45.8*	*7.4%*	*3.9*	*0.6%*	*620.0*	*4.0%*

Total impervious areas within the stream riparian buffer zone are relatively high with approximately 37% of all stream riparian buffers within the watershed covered by impervious surfaces, with about 55% designated as open pervious. The Inner Harbor and Patapsco subwatersheds have the highest percentages of impervious area in the buffer zone, both over 50%. All of the subwatersheds have at least 20% impervious buffer area. Subwatersheds with the highest acreages of forested buffer include Middle Branch and Southwest Harbor ranging from approximately 14 to 30 acres.

Areas of open pervious represent areas with potential opportunities for re-forestation, while forested buffer areas should be preserved. Areas that are currently impervious within the stream riparian buffers may present opportunities for impervious removal and reforestation on a case by case basis. However, the opportunity for potential stream riparian buffer restoration within the Baltimore Harbor watershed is heavily constrained by current land uses including densely populated residential, commercial, and industrial land.
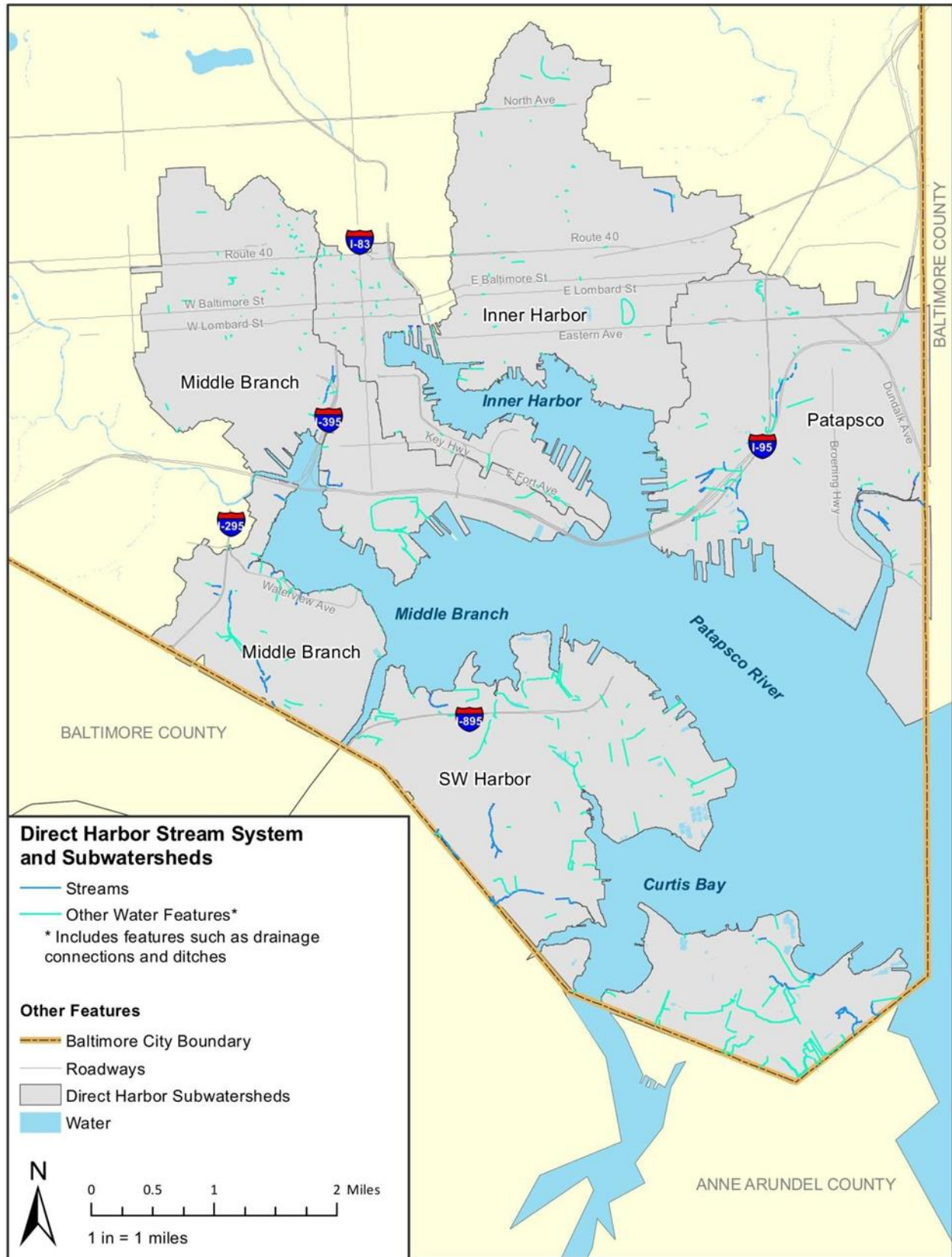
Figure 2-9 Stream System within Watershed
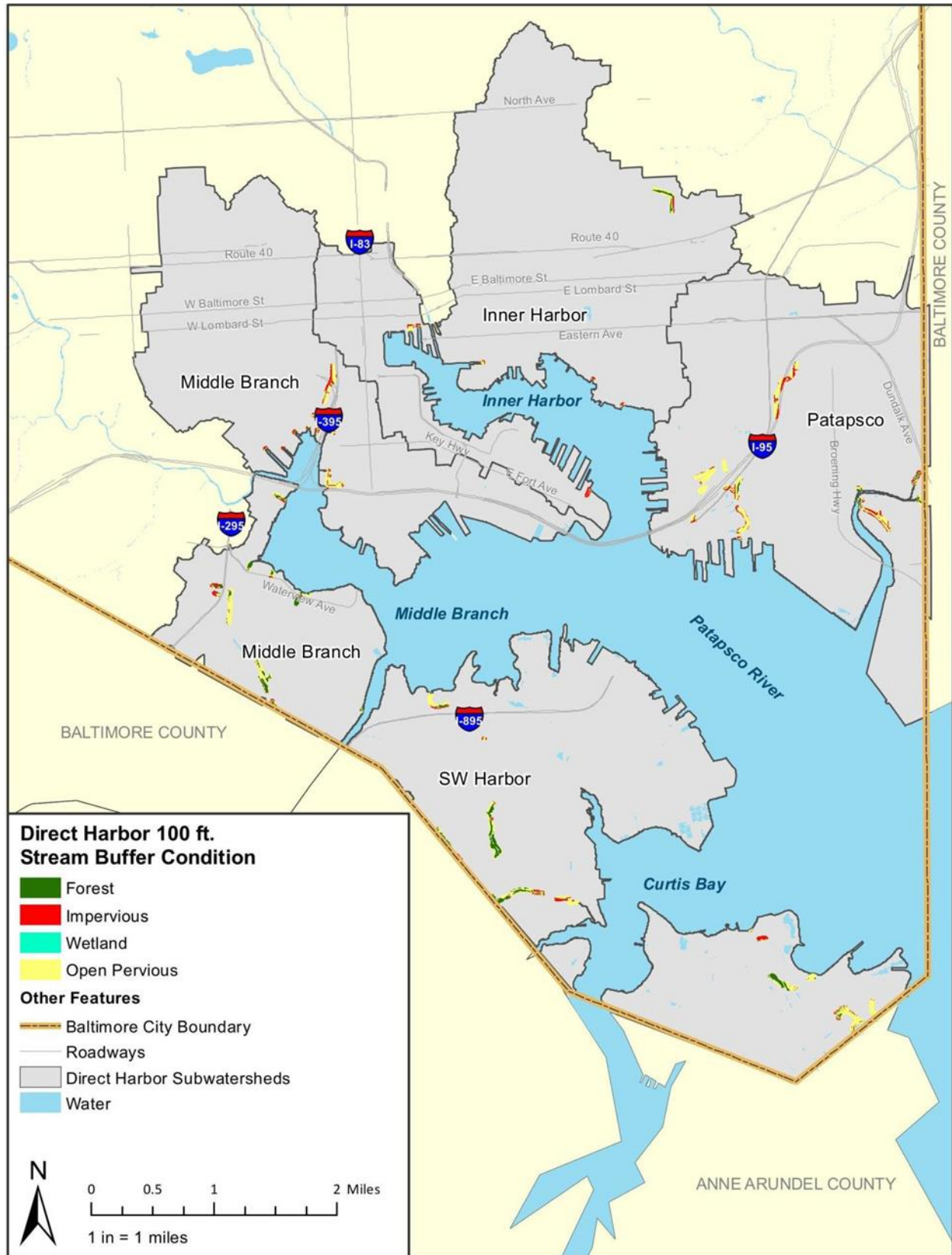
Figure 2-10 100 FT Stream Buffers

2.3.4 Tidal Waters

The tidal waters of Baltimore Harbor encompass approximately 6,931 acres. The tidal waters of Baltimore Harbor are mesohaline, characterized by very low species diversity with salt concentrations of 5 to 18 parts per thousand (ppt).

2.3.5 Shoreline Riparian Buffers

The Baltimore Harbor watershed contains approximately 59 miles of coastline (Table 2-13). The Southwest Harbor subwatershed has the greatest length of coastline at approximately 22 miles. This subwatershed comprises approximately 37% of all coastline miles in the planning area.

Table 2-13 Baltimore Harbor Shoreline Mileage

	Inner Harbor	**Middle Branch**	**Patapsco**	**Southwest Harbor**	**Total**
Coastline (miles)	11.6	12.4	13.1	21.5	58.6

A riparian buffer analysis similar to the stream riparian buffer study was conducted to characterize the vegetative condition of coastline buffers in the Baltimore Harbor planning area. Coastline buffer condition was analyzed based on a 100-foot buffer along tidal waters and classified as one of four categories: impervious, open pervious, forest, or wetland. Table 2-14 summarizes coastline riparian buffer conditions by subwatershed, and the distribution is shown in Figure 2-11.

Table 2-14 Land Cover in the 100ft Shoreline Buffer

Subwatershed	IMPERVIOUS		OPEN PERVIOUS		FOREST		WETLAND		TOTAL ACRES	TOTAL % of WATERSHED
	Acres	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**		
Inner Harbor	72.9	52.5%	65.5	47.1%	0.6	0.4%	0.0	0.0%	139.0	22.5%
Middle Branch	29.4	23.7%	93.5	75.4%	1.0	0.8%	0.0	0.0%	124.0	20.0%
Patapsco	80.4	65.4%	28.7	23.3%	13.9	11.3%	0.0	0.0%	123.0	19.9%
Southwest Harbor	49.3	21.2%	149.4	64.1%	30.3	13.0%	4.0	1.7%	233.0	37.6%
Total	***232.1***	***37.5%***	***337.1***	***54.5%***	***45.8***	***7.4%***	***4.0***	***0.6%***	***619.0***	***100.0%***

Over half of the coastline in the planning area, approximately 55%, is designated as open pervious. Open pervious areas present potential opportunities for re-forestation. The amount of coastline buffer that is forested is approximately 7% of the total planning area, with the highest percentage in Southwest Harbor, which also has the highest percentage of forested stream buffer. Wetland areas exist only within the Southwest Harbor, and make up significantly less (approximately 1%) of the coastline buffer, which is indicative of the heavily urbanized condition of the watershed. These forested and wetland areas may present potential opportunities for preservation.

There is a relatively high percentage of impervious area in the coastline buffer zone at approximately 38%. The subwatersheds with the most acres of impervious area in the coastline buffer zone include Inner Harbor and Patapsco, which all contain large amounts of private shoreline properties. These areas may present opportunities for shoreline restoration; however, restoration potential will be heavily influenced by property ownership and land use.
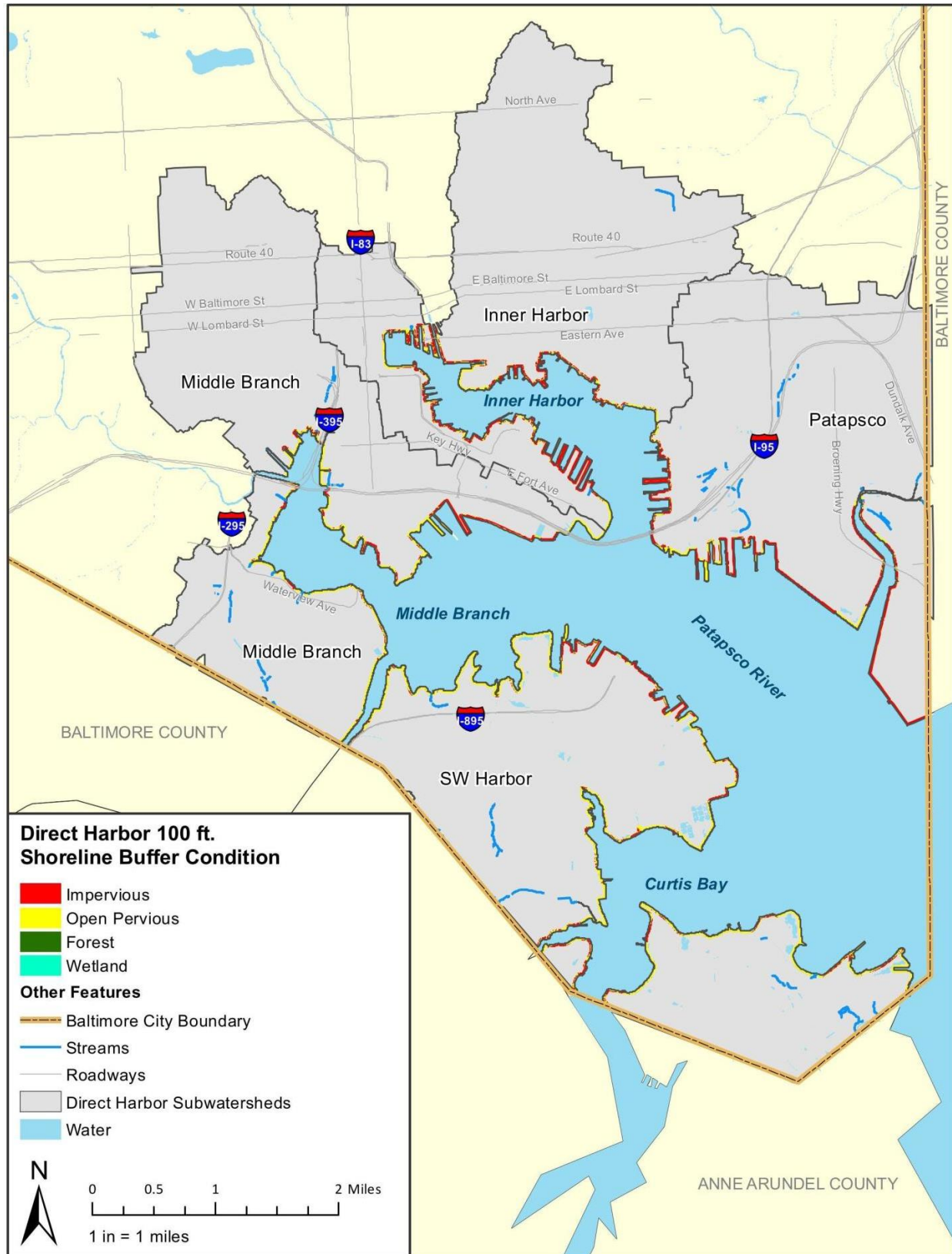
Figure 2-11 100 ft Shoreline Buffer

2.4 Impervious Surfaces

Impervious surface is a primary factor when determining rates and volumes of stormwater runoff. Research has been conducted that link the degree of urbanization (typically measured by amount of impervious cover) with various watershed-based indicators of water quality, such as diversity and abundance of aquatic and terrestrial life. For the purpose of this watershed assessment, impervious surface includes buildings, roads and sidewalks, parking lots, and other impermeable surfaces.

Table 2-15 includes Eligible MS4 Impervious, which is the impervious area not currently being treated for each of the subwatersheds within the regulated MS4 area for Baltimore City. For the purposes of this report, "impervious" is used interchangeably with "eligible impervious" or "eligible MS4 impervious" unless otherwise noted[3].

All of the subwatersheds within the Baltimore Harbor watershed can be characterized as ultra-urban. The Inner Harbor subwatershed has the highest percentage of impervious, followed by the Middle Branch and the Patapsco, with Southwest Harbor having the lowest percentage.

Table 2-15 Eligible MS4 Impervious by Subwatershed within Watershed

Subwatershed	Inner Harbor	Middle Branch	Patapsco	Southwest Harbor
Acres	2,419.6	1,664.3	1,541.9	1,025.2
% of subwatershed acres	61.4%	48.5%	45.0%	27.3%

The velocity of runoff generated from impervious surfaces increases with increasing slope. High velocity runoff can result in increased erosion and an increase in the amount of pollutants transported to storm drain systems and surface waters. Impervious surfaces with steep slopes above 10% can limit the suite of ESD practices available for restoration efforts, and can require additional design to mitigate the potential for erosion and bypass. Table 2-16 provides a summary of the percentage of eligible impervious surfaces that fall into each of the four slope categories.

The majority of eligible impervious in the watershed is 5% or less, indicating that management with typical ESD practices may be possible (Figure 2-12). For areas with higher slopes, alternative practices can be used for restoration.

Table 2-16 Eligible Impervious and Percent Slope

Slope %	0-5%	5-10%	10-15%	15%+
Acres	4,167.0	1795.7	423.1	248.7
% of Eligible Impervious in Watershed	62.7%	27.0%	6.4%	3.8%

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[3] Impervious surfaces within drainage areas spatially delineated in DPW GIS databases for stormwater management facilities installed post 2010 were assumed to be treated to the maximum extent practicable (MEP) and were removed from the Eligible Impervious totals. Not all drainage areas for stormwater management facilities installed post 2010 are spatially delineated in DPW GIS records. Eligible Impervious may include some areas already managed to the MEP, which would be determined during individual site investigations during future implementation efforts.
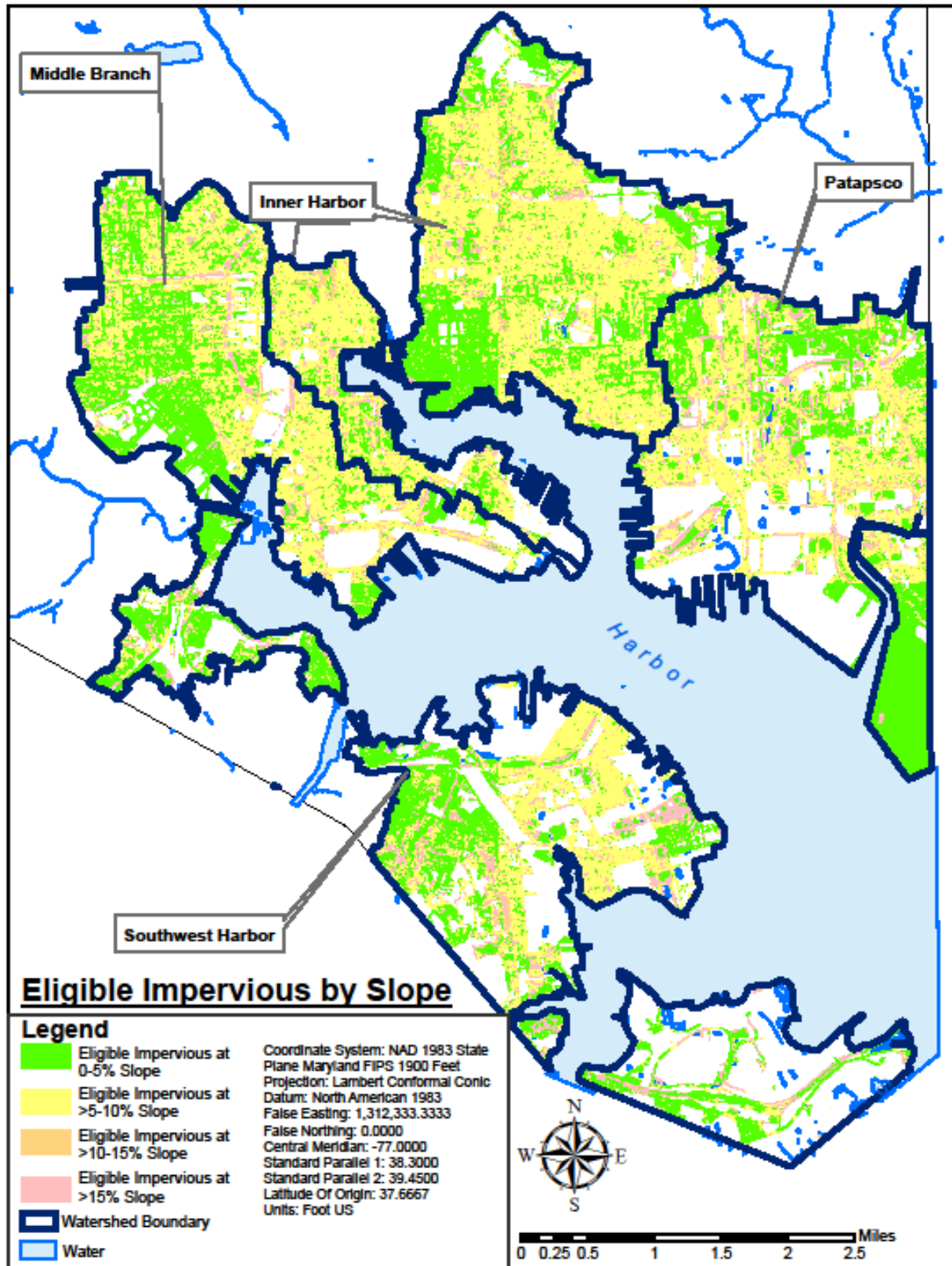
Figure 2-12 Eligible Impervious by Slope within Watershed

Table 2-17 shows where within the watershed the eligible impervious with 0-5% slopes can be found. The greatest percentage of eligible impervious with 0-5% slopes can be found in the Inner Harbor subwatershed, followed by the Middle Branch and Patapsco, followed by the Southwest Harbor.

Table 2-17 Distribution of Eligible Impervious at 0-5% Slope within Subwatersheds

	Subwatershed	Inner Harbor	Middle Branch	Patapsco	Southwest Harbor
0-5% Slope	Acres 0-5% slope	1,345.4	1,026.9	1099.1	695.6
	% of Eligible Impervious in Watershed	55.6%	61.7%	71.3%	67.9%
	% of 0-5% Sloped Eligible Impervious in Watershed	32.3%	24.6%	26.4%	16.7%
>5-10% Slope	Acres >5-10% slope	793.5	461.5	322.0	218.6
	% of Eligible Impervious in Watershed	20.7%	13.4%	9.4%	5.8%
	% of >5-10% Sloped Eligible Impervious in Watershed	44.2%	25.7%	17.9%	12.2%

Property ownership is critical to understanding the extent of the opportunity for DPW to install BMP practices as part of the restoration strategy. Therefore, the distribution of eligible impervious by property ownership type was assessed (Table 2-18). The majority of eligible impervious in the Baltimore Harbor Watershed is on private property, followed by within the public right-of-way. This highlights the importance of working with private property owners to support restoration efforts.

Table 2-18 Eligible Impervious by Property Ownership Type

Type	AREA (ac) of Eligible Impervious	As % of Eligible Impervious
City Owned (non-ROW)	457.4	7.8%
Private	3132.2	47.1%
Right of Way (ROW)	2047.4	30.8%
Railroads	963.33	14.5%

Table 2-19 shows the distribution of impervious surfaces on various land ownership types across subwatersheds. The majority of impervious surfaces on city-owned property are contained within the Inner Harbor subwatershed (49.5%), but this represents only 10.6% of the eligible impervious within that subwatershed. Most of the eligible impervious in the Inner Harbor is on private property. Eligible impervious in the right-of-way is evenly distributed between the Inner Harbor and the Middle branch subwatersheds (38.8% and 34.6% respectively), with slightly less within the Patapsco and Southwest Harbor watersheds. For all subwatersheds, the percentage of eligible impervious within the right-of-way is similar (26-32.9%). Most properties impacted by rail can be found in the Patapsco subwatershed, where 33.5% of the eligible impervious can be found on property impacted by rail.

This demonstrates that the greatest potential for installed restoration projects on public land exist in the Inner Harbor and Middle Branch watersheds, and highlights the importance of programs and incentives aimed at property owners.

Table 2-19 Distribution of Eligible Impervious under various Property Ownership within Subwatersheds (SWS)

Subwatershed	Type	AREA (ac) of Eligible Impervious	As % of Eligible Impervious within SWS	As % of Eligible Impervious in Ownership Type within WS
Inner Harbor	City Owned (non-ROW)	256.3	10.6%	49.5%
	Private	1,305.2	53.9%	41.7%
	Railroads	72.1	2.6%	7.5%
	Right of Way (ROW)	759.4	32.9%	38.8%
Middle Branch	City Owned (non-ROW)	161.7	9.7%	31.2%
	Private	808.4	48.6%	25.8%
	Railroads	118.7	7.1%	12.3%
	Right of Way (ROW)	575.6	34.6%	28.1%
Patapsco	City Owned (non-ROW)	39.4	2.6%	7.6%
	Private	584.2	37.9%	18.7%
	Railroads	518.1	33.5%	53.8%
	Right of Way (ROW)	400.2	26.0%	19.5%
Southwest Harbor	City Owned (non-ROW)	60.2	5.9%	11.6%
	Private	215.8	21.1%	13.9%
	Railroads	254.4	24.8%	26.4%
	Right of Way (ROW)	276.2	27.0%	13.5%

2.5 Surface Temperatures

Surface temperatures represent heat energy given off by the land, buildings, and other surfaces. Sometimes referred to as the heat island effect, impervious surfaces, like roads, parking lots, and buildings, Elevated temperatures from urban heat islands, particularly during the summer, can affect a community's environment and quality of life, including elevated air pollutants, impaired water quality, and compromised human health.

Figures 2-13 and 2-14 illustrate daytime and nighttime summer temperature readings. Impervious surfaces absorb heat during the day and release heat at day and during the night. Thus, the highest temperatures for daytime temperatures are those Subwatersheds with large amounts of impervious surfaces, including Inner Harbor and Middle Branch. These subwatersheds have the highest nighttime temperatures as well. These subwatersheds are characterized by their large amount of dense, rowhouse neighborhoods, office buildings, and of green spaces and trees.
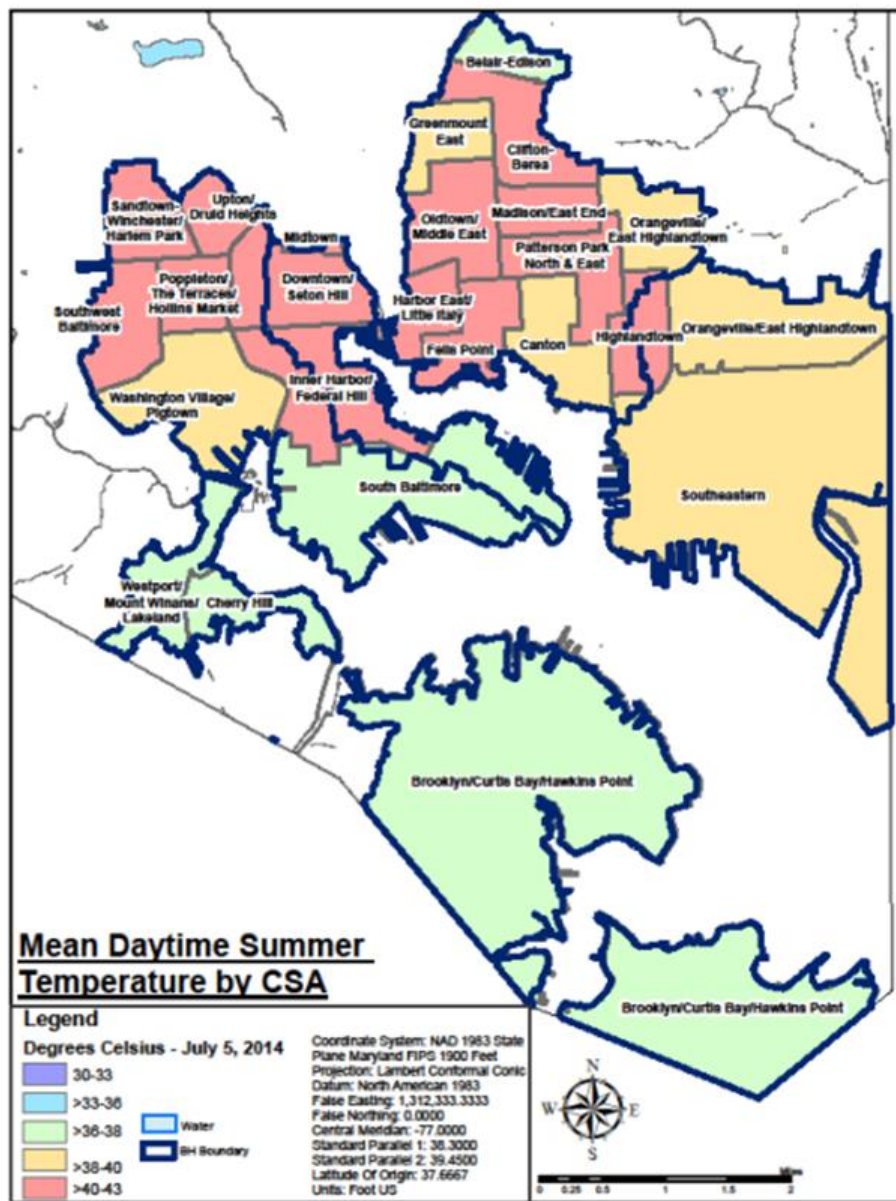
Figure 2-13 Daytime Summer Temperature within Subwatersheds
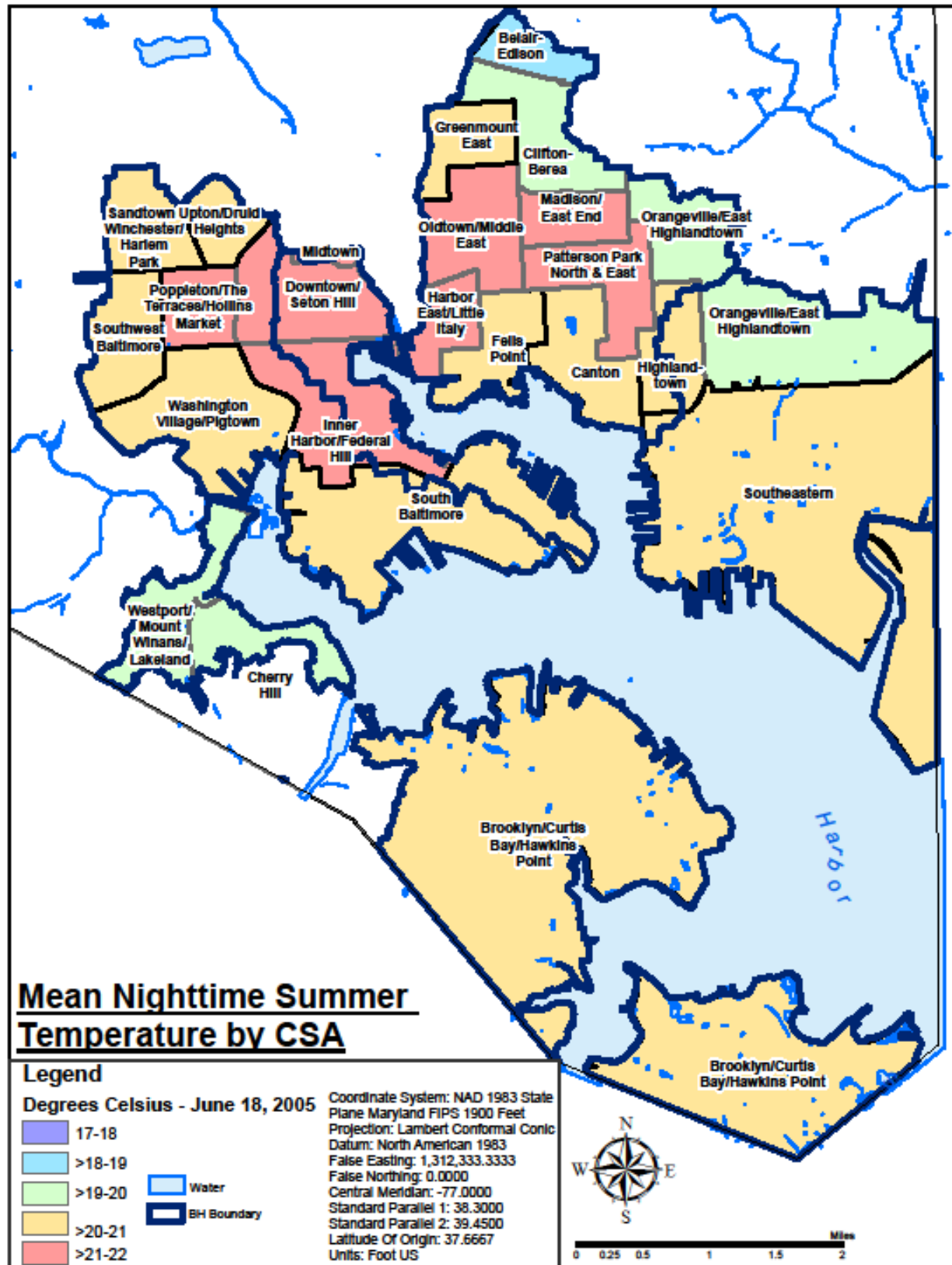
Figure 2-14 Nighttime Summer Temperature within Subwatersheds

2.6   Urban Tree Canopy (UTC) Priority Planting Map

In 2012, TreeBaltimore, created a priority planting map to guide their work and that of their partners for tree planting. The priority map considered multiple factors, including heat island effect, existing tree canopy, and impervious areas. These priority neighborhoods will also be considered as locations for various BMPs in order to complement the planting of trees (Figure 2-15). The predominant priority zone of each subwatershed is summarized in Table 2-20.

Table 2-20 UTC Priority Planting Areas by CSAs

CSA	Inner Harbor	Middle Branch	Patapsco	Southwest Harbor
UTC Priority	High/Medium High	High/Medium High	High-Medium	Medium High - Low
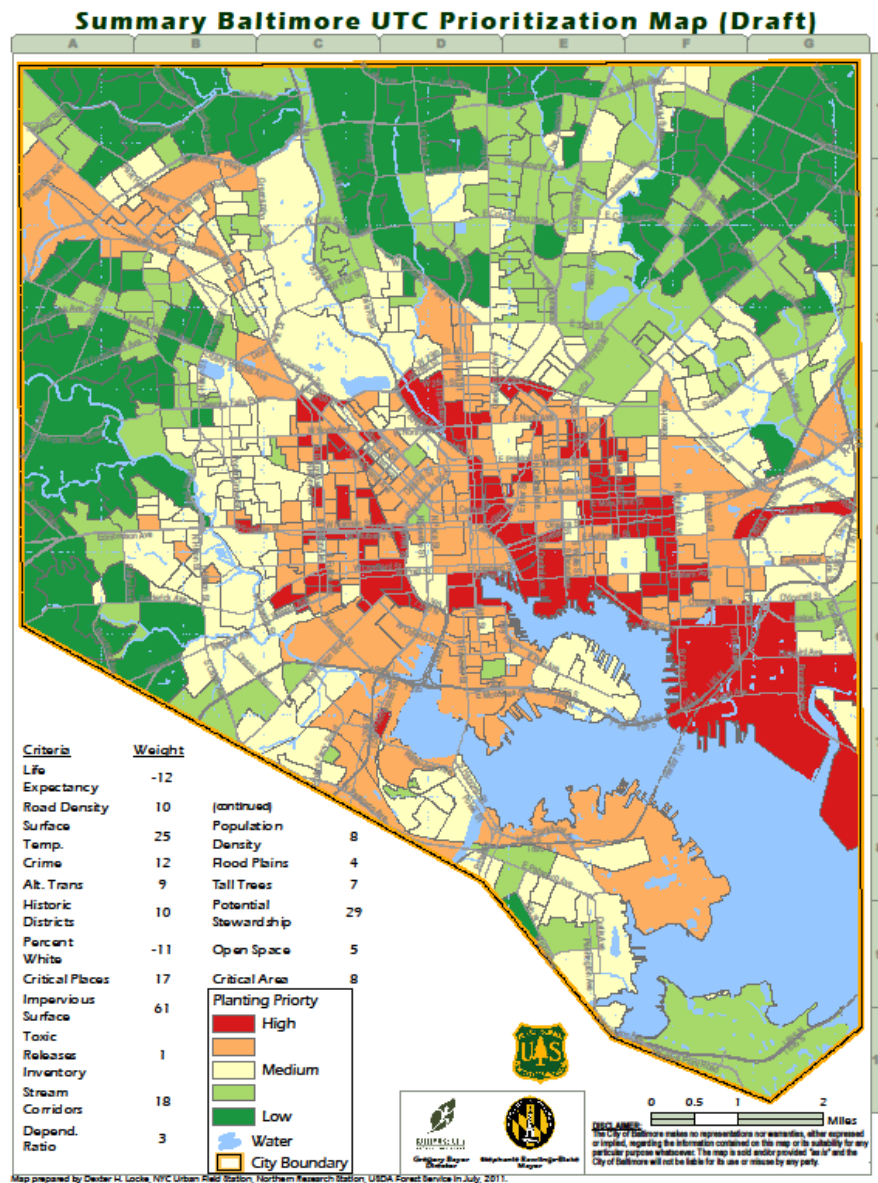
Figure 2-15 UTC Priority Planting Map

2.7 Wet Water Utilities (Storm Drain and Sanitary Sewer)

Baltimore City has separate utility systems for conveying stormwater and wastewater. While Baltimore City has three separate water utility systems (stormwater, wastewater, and drinking water), for the purpose of the watershed assessment, only stormwater and wastewater infrastructure will be referenced, given the more direct relationship to the TMDL impairments. In addition to the statistics for these two systems, current and planned capital improvement program (CIP) projects are also noted, as well as sanitary sewer overflows (SSO).

2.7.1 Storm Drain System

Baltimore City has about 116 miles of streams, the primary ones being the Jones Falls, Herring Run, and Gwynns Falls. However, this represents a fraction of what was originally a network of small streams and creeks that were piped and paved over as the city developed in the late 19th and early 20th centuries. Some of these streams were either entirely buried or significantly covered, like Harris Creek (originally running from Patterson Park to the Harbor). Replacing the historic hydrology of the City is a storm drain infrastructure, primarily installed prior to 1950. In the Baltimore Harbor watershed this represents 380.8 miles of storm drain pipes. Additionally, there are 491 outfalls and 16,614 storm drain inlets within the watershed.

Approximately 57% of storm drain pipes in the Baltimore Harbor watershed were installed prior to 1950, with the average age being 69.2 years. Storm drain pipes installed prior to 1950 are predominant in the Middle Branch and Inner Harbor subwatersheds. These pipes are more likely to be in need of repair.

2.7.2 Sanitary Sewer System

In the Baltimore Harbor watershed there are 364.2 miles of sanitary sewer pipes. Eighty-three percent (83%) of these pipes were installed prior to 1950, with the average age being 86.6 years. Sanitary sewer pipes installed prior to 1950 are found primarily in the Inner Harbor and Middle Branch subwatersheds. Similar to the storm drain pipes, these are more likely to be cracked and in need of repair, which can result in ground water infiltrating into the sanitary sewer lines.

2.7.3 Wastewater Treatment Plant

Patapsco Wastewater Treatment Plant is located within the Baltimore Harbor planning area and treats a portion of the Baltimore Harbor watershed. The Patapsco Wastewater Treatment Plant, located at Wagner's Point in Southwest Harbor subwatershed, is a secondary facility with enhanced nutrient removal, chlorination, and de-chlorination. Additional wastewater from the Baltimore Harbor watershed is conveyed to the Back River Wastewater Treatment Plant located in the Back River watershed.

2.7.4 Capital Improvement Program (CIP)

To guide the City in making necessary physical improvements, the City Charter requires the Planning Commission to annually recommend a six-year Capital Improvement Program (CIP) to the Board of Estimates. Each year, the Planning Department works with the various City agencies to prepare a new six-year program.

Table 2-22 lists the various CIP projects for the watershed. Included in the CIP projects for Baltimore Harbor are several that are aimed at reducing SSO's as part of the Consent Decree (those identified with the preface SC). Other work includes replacement of water mains (WC preface). Stormwater ESD projects (ER4127) will be constructed in 2019 in the Inner Harbor subwatershed. Construction activities carried out as part of the MS4 permit will be coordinated around CIP projects to minimize land disturbance and impact to surrounding communities.

Table 2-21 CIP Projects

Contract	Name	Phase
ER4127	Environmental Restoration Project 11	DESIGN
SC892	Structural rehabilitation CCChambers at PWWTP	CONSTRUCTION
SC903	Improvement of Patapsco Collection System	TO BE COMPLETE
SC914	Improvements to Sanitary Sewers in Low Level Sewershed BL	TO BE COMPLETE
SC919	Improvements to Sanitary Sewers in the Outfall Sewershed	TO BE COMPLETE
SC926	Electrical Distribution System at Patapsco WWTP	
SC930	Clinton St. Force Main Replacement	CONSTRUCTION
SC938	Headworks Facilities Improvements at the Patapsco WWTP	DESIGN
SC948	Rehabilitation of Brooklyn Pumping Station	CONSTRUCTION
SC950	Caroline Street Pumping Station	CONSTRUCTION
SC962	Improvements to Sanitary Sewers in the South East Area of Baltimore City	CONSTRUCTION
SC963	Improvements to Sanitary Sewers in the South West Area of Baltimore City and Maidens Choice Pressure Sewer Assessment and Uplands Sewer Replacement	CONSTRUCTION
SC965	Improvements to the Sanitary Sewers in the North East Area of Baltimore City	CONSTRUCTION
SC976	Improvements in the Greenmount, Hampden, and Bolton Hill Areas in Jones Falls	CONSTRUCTION
WC1270	Water Infrastructure Rehabilitation	TO BE COMPLETE
WC1272	Pennington Ave & Vicinity Water Main Replacement	CONSTRUCTION
WC1293	Water Main Replacement Ridgemeade Ave, Poole St., Bakers St., Winchester St., Fayette St. et al	CONSTRUCTION
WC1314	Oliver Neighborhood & Vicinity Water Main Replacements	CONSTRUCTION
WC1339	Upton Neighborhood and Vicinity - Water Main Rehabilitation	CONSTRUCTION
WC1363	Allendale Neighborhood and Vicinity Water Main Rehabilitation	CONSTRUCTION
WC1365	Berea Neighborhood and Vicinity Water Main Rehabilitation	DESIGN
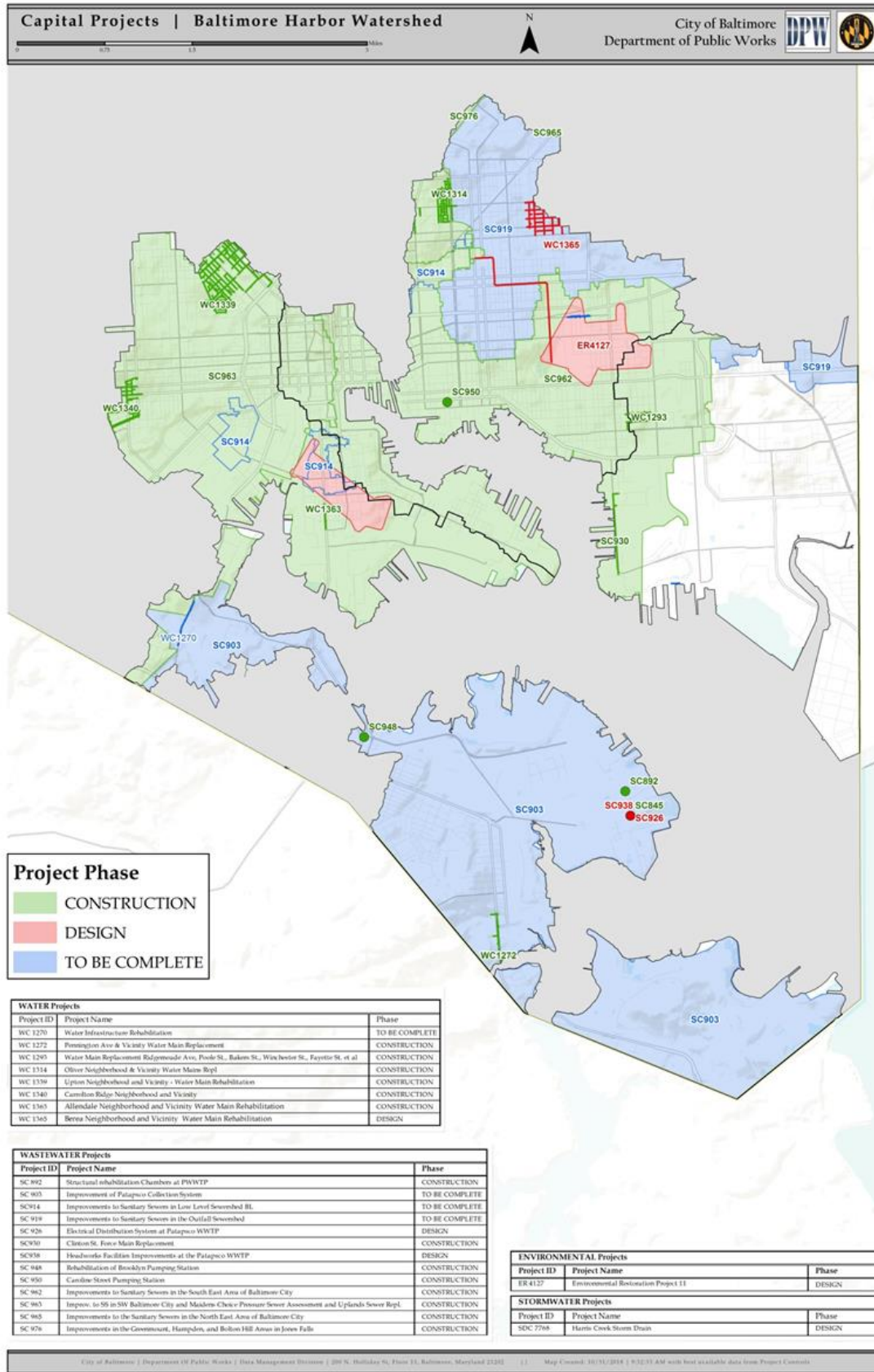
Figure 2-16 CIP Projects within Watershed

2.7.5   Sanitary Sewer Overflows (SSO)

Sewers can become clogged by tree roots, grease, or other items that should not be flushed down the drain (e.g., wipes, diapers, plastic products, paper towels, etc.), which can result in dry weather SSO's. Sewers can also develop cracks and breaks, which cause stormwater and groundwater to infiltrate the sewer system during wet weather, which can cause wet weather SSO's. Finally, sewers can fail due to deterioration, resulting in both dry and wet weather SSO's. These SSO's can cause sewers to overflow into waterways or even back up into basements. CIP projects like SC914 are intended to reduce the amount of stormwater that infiltrates into the ground and into sanitary sewers to prevent wet weather overflows. Outreach to residents and businesses about proper disposal of waste and flushables are aimed at preventing dry weather SSO's. These types of projects are part of the City's Consent Decree.

Figure 2-17 shows the location of SSOs in the LNBP. During 2017, there were sixty-nine dry weather SSOs and one wet weather SSO. Dry weather SSOs are sanitary sewer overflows that is unrelated to precipitation related flows (including storm water and snow melt runoff). These types of overflows are typically caused by some type of blockage, often as a result of poor FOG practices (fats, oils, and grease), rags and other material improperly disposed of, and tree roots. These areas provide an opportunity for education and outreach regarding FOG and flushables.

SSOs Baltimore Harbor Watershed	
Dry Weather	69
Wet Weather	1

● Wet Weather SSO
● Dry Weather SSO
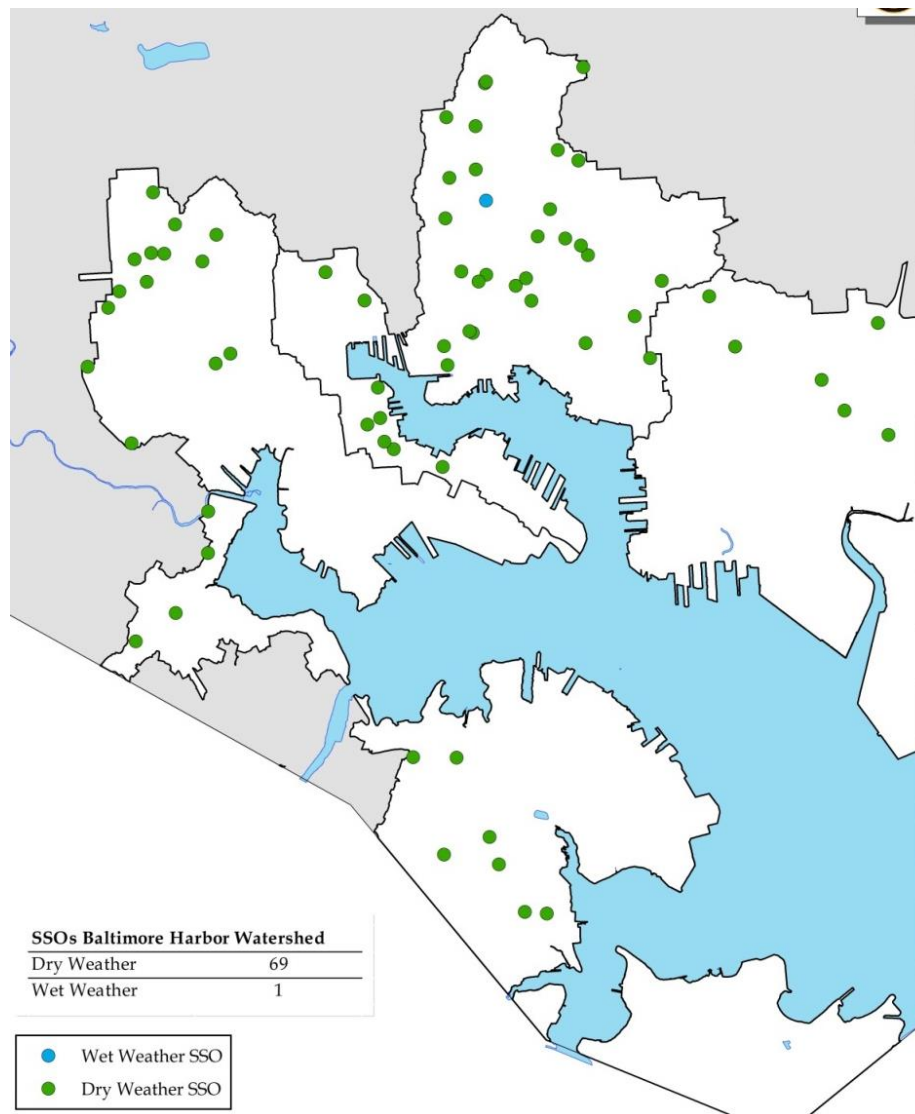
Figure 2-17 Dry and Wet Weather SSOs

2.8 Dirty Streets / Alleys and Clogged Storm Drains

Dirty streets and alleys not only diminish the quality of life of neighborhoods, they also carry pollutants into waterways[4]. The Dirty Streets and Alleys variable compiled by CSA's is defined as the rate of service requests for dirty streets and alleys through Baltimore's 311 system per 1,000 residents. Clogged storm drains represent the rate of service requests for addressing clogged storm drains made through Baltimore's 311 system per 1,000 residents. Both indicators represent reflect a combination of environmental condition and resident engagement, and can be used to target trash reduction programs. Patterson Park North and East has the highest rates of dirty streets/alleys, followed by Southwest Baltimore. Downtown/Seton Hill has the highest rate of clogged storm drains, followed by Fells Point (Table 2-22 and Figures 2-18 and 2-19).

Table 2-22 Rate of Dirty Streets / Alleys and Storm Drains per 1,000 Residents

SWS	CSA	Rate of Dirty Streets and Alleys Reports per 1,000 Residents	Rate of Clogged Storm Drain Reports per 1,000 Residents
Inner Harbor (IH)	Belair-Edison	74.9	2.6
	Canton	46.5	4.7
	Clifton-Berea	140.0	3.4
	Fells Point	56.3	7.9
	Greenmount East	176.1	5.3
	Harbor East/Little Italy	27.7	5.5
	Madison/East End	237.6	6.6
	Midtown	37.5	4.7
	Midway/Coldstream	101.7	3.1
	Oldtown/Middle East	41.1	4.5
	Patterson Park North & East	207.0	6.1
IH & MB	Downtown/Seton Hill	29.8	9.5
	Inner Harbor/Federal Hill	34.8	5.5
	South Baltimore	25.9	4.1
Middle Branch (MB)	Cherry Hill	8.0	2.4
	Poppleton/The Terraces/Hollins Market	85.5	5.9
	Sandtown-Winchester/Harlem Park	89.2	2.8
	Southwest Baltimore	185.1	3.0
	Upton/Druid Heights	55.0	2.2
	Washington Village/Pigtown	157.9	7.5
	Westport/Mount Winans/Lakeland	43.8	3.2
IH & PT	Highlandtown	160.7	5.5
	Southeastern	30.0	4.3
Patapsco (PT)	Orangeville/East Highlandtown	138.1	5.5
SW Harbor	Brooklyn/Curtis Bay/Hawkins Point	71.1	1.8

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[4] See Section 3.2 for a description of trash related programs.
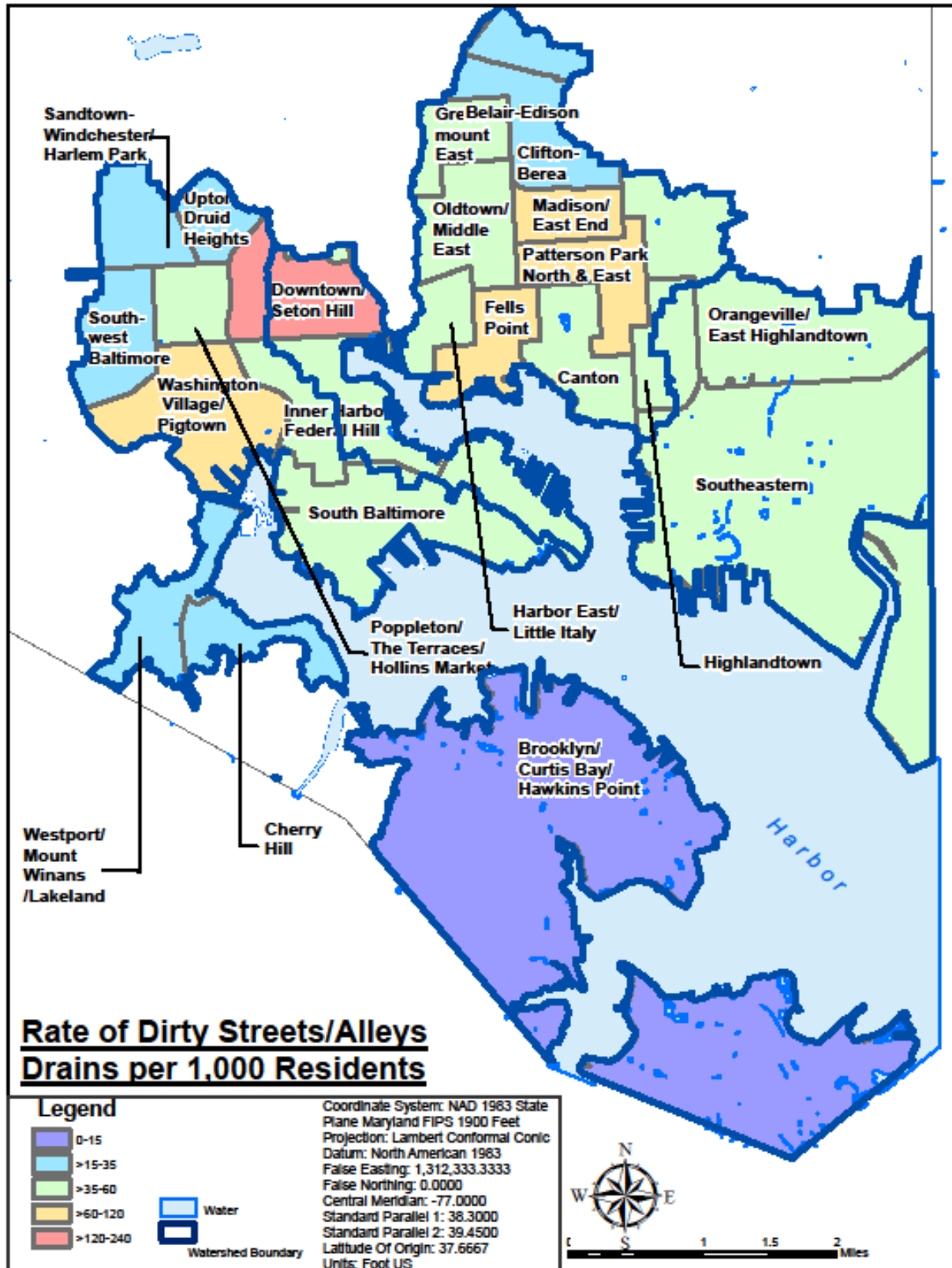
Figure 2-18 Rate of Dirty Streets/Alleys per 1,000 Residents
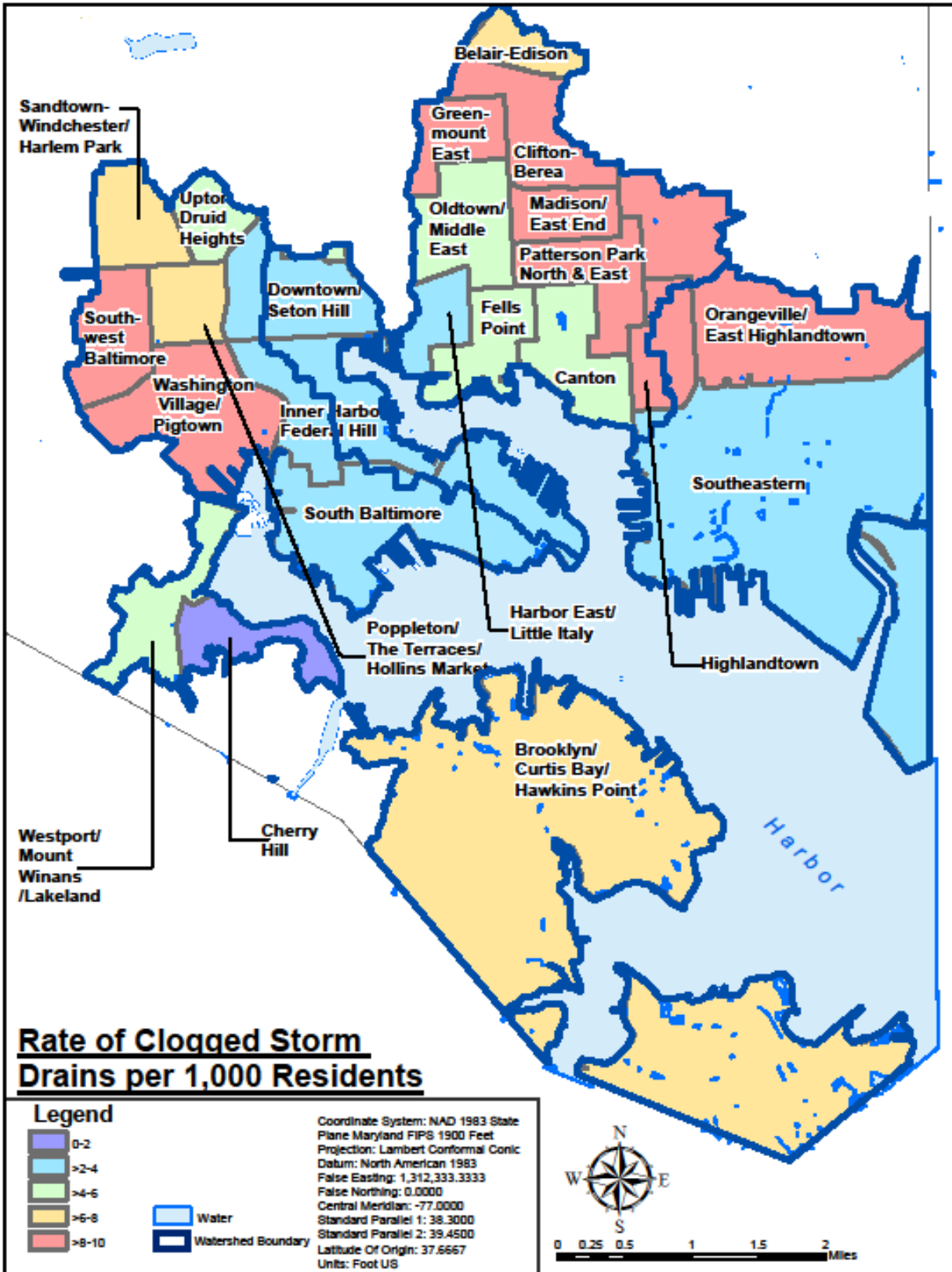
Figure 2-19 Rate of Reported Clogged Storm Drains per 1,000 Residents
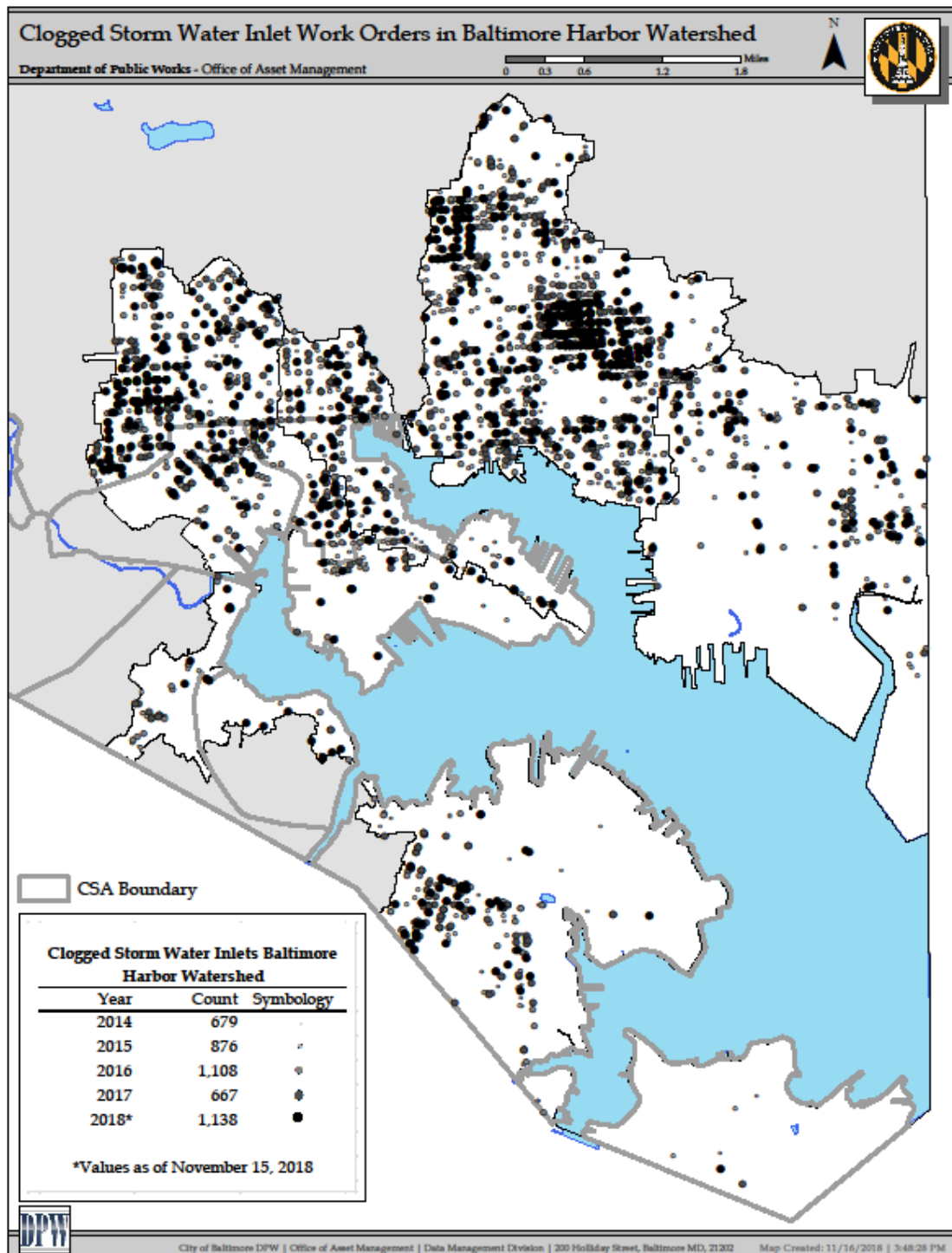
Figure 2-20 Clogged Inlet Locations

Figure 2-20 shows the location of customer service complaints (CSRs) between the years 2014-2018. The Inner Harbor subwatershed has the most CSRs, followed by the Middle Branch subwatershed. Repeat CSRs tend to be clustered in commercial areas and along commercial corridors such as Federal Hill, the downtown, Brooklyn, Washington Boulevard, Fort Avenue, Eastern Avenue, and Dundalk Avenue. Clusters of repeat CSRs are also located in neighborhoods where storm drain inlet screens have been installed, including Franklin Square, Oliver, McElderry Park, and Baltimore Highlands.

2.9   Social / Economic Conditions

Understanding the human component of a watershed is critical to help inform the types of BMPs that should be considered and also to identify geographic areas that should be prioritized in order to achieve maximum co-benefit. For instance, understanding the age distribution within neighborhoods can also start to inform the types of outreach and engagement activates that might be effective. Additionally, the built environment is a known determinant of health outcomes, and modification of the built environment through installation of ESD or can mitigate hazardous environmental exposures (e.g. heat burden and air quality), or provide health supporting resources (e.g. access to nature).

Therefore, in addition to assessing the physical conditions within the watershed relevant for improving water quality, data was also gathered on a wide variety of socio-economic and human health related factors as part of the watershed characterization. The full range of factors used for prioritization is discussed in the Suitability Analysis Chapter. Table 2-23 is a summary of five (5) key factors.

Table 2-23 Social / Economic Conditions by CSA

SWS	CSA	Hardship Index	% White	% Age <18	% Age 65+	Median Income
Inner Harbor (IH)	Belair-Edison	55	9.3	28.0	8.4	$38,906
	Canton	11	90.1	7.5	10.3	$91,736
	Clifton-Berea	61	3.3	21.1	15.6	$25,738
	Fells Point	23	80.5	10.7	6.0	$77,433
	Greenmount East	73	2.9	24.5	12.9	$23,277
	Harbor East/Little Italy	58	33.1	22.0	6.0	$36,579
	Madison/East End	90	5.2	29.5	6.5	$27,454
	Midtown	32	54.4	6.2	13.6	$38,867
	Midway/Coldstream	72	2.3	22.2	13.0	$34,523
	Oldtown/Middle East	80	8.1	24.6	13.3	$14,105
	Patterson Pk N&E	50	54.1	21.8	6.1	$56,652
IH & MB	Downtown/Seton Hill	26	49.3	6.1	4.4	$44,819
	Inner Harbor/Federal Hill	16	79.2	11.6	11.5	$88,854
	South Baltimore	17	89.7	11.3	7.8	$88,487
Middle Branch (MB)	Cherry Hill	74	5.1	37.2	8.2	$22,659
	Poppleton/The Terraces/Hollins Mkt	75	17.2	25.9	9.0	$17,228
	Sandtown-Winchester/Harlem Pk	80	0.8	26.0	11.4	$24,374
	Southwest Baltimore	76	17.4	26.8	11.2	$24,946
	Upton/Druid Hts	82	3.7	31.7	10.4	$15,950
	Washington Village	56	39.6	19.3	8.0	$48,175
	Westport/Mt Winans/Lakeland	64	24.2	28.5	6.9	$41,368
IH & PT	Highlandtown	38	80.1	15.3	10.0	$71,660
	Southeastern	69	55.2	27.1	13.5	$32,102
Patapsco (PT)	Orangeville/E. Highlandtown	59	63.9	25.0	12.4	$40,431
SW Harbor	Brooklyn/Curtis Bay/Hawkins Pt	76	48.4	27.2	6.3	$35,862

Age Distribution
This includes the percent of persons 5 to 17 years old, as well as the percentage of persons 65 years old and above (out of all persons living in an area). Age distribution is important because it can begin to inform age appropriate outreach formats and engagement strategies.

Percentage of White
This is defined by the total number of persons that identify themselves as being racially White (and ethnically non-Hispanic) out of the total number of persons living in an area. 'White' refers to a person having origins in any of the original peoples of Europe, the Middle East, or North Africa. It includes people who indicated their race(s) as 'White'. Percentage of white is used as an indicator of concentrations of populations not identifying as minority or people of color (i.e. African-American and Hispanic) and will inversely prioritized within the Equity prioritization analysis.

Median Income
The median household income is the middle value of the incomes earned in the prior year by households within an area. Income and earnings are inflation-adjusted for the last year of the 5-year period. The median value is used as opposed to the average so that both extremely high and extremely low prices do not distort the total amount of income earned by households in an area.

Hardship Index[1]
The Hardship Index is a composite score of socioeconomic hardship within a CSA, relative to other CSAs and to the City. The Hardship Index combines six indicators of public health significance: percentage of occupied housing units with more than one person per room; percentage of households living below the federal poverty level; percentage of persons aged 16 years or older in the labor force that are unemployed; percentage of persons aged 25 years or older without a high school diploma; percentage of the population under 18 or over 64 years of age (i.e., dependency); and per capita income. Areas with high hardship indices will be prioritized in the Equity prioritization analysis.

2.10 Planning Initiatives

In addition to understanding the water quality goals of the watershed, it is important to understand related community needs and goals that have been identified for the area. Since 2006, there have been several plans within the Baltimore Harbor watershed. These include:

Baltimore City MS4 Restoration and TMDL WIP
Baltimore's MS4 Permit was issued on December 27, 2013. As required by the permit, the City is required to develop a Watershed Implementation Plan (WIP). The WIP identifies strategies to meet the 20% impervious restoration requirement of the Permit as well as Total Maximum Daily Load (TMDL) waste load allocations for each receiving water body. The WIP listed specific projects and the City's ability to meet TMDLs, in particular pollutant load reduction benchmarks and deadlines that demonstrate progress toward meeting all applicable stormwater WLAs for the LNBP Watershed.

2.10.1 Community Plans

Oldtown Redevelopment Plan (2010, updated 2016), Madison Square Area Plan (2006), Monument-McElderry-Fayette Area Plan (2006).
These three plans focus on land use, the housing market, commercial and industrial businesses, open space, and development opportunities in the area.

Southwest Partnership Vision Plan (2015).
The Southwest Partnership, which consists of Barre Circle, Franklin Square, Hollins Roundhouse, Mount

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[1] Baltimore City Health Department 2017 Neighborhood Health Profile report

Clare, Union Square, Pigtown, Poppleton, University of Maryland, University of Maryland BioPark, University of Maryland Medical System, Bon Secours Baltimore Health System, and the B&O Railroad Museum, prepared a vision plan to guide redevelopment of the area. The plan includes the following focus areas: Housing, Commercial Development, Safe and Walkable Streets, Education and Workforce Development, and Preservation & Promotion.

Port Covington Master Plan (2016).
Port Covington is an aging, underutilized industrial area that covers over 260 acres and three miles of waterfront along the Middle Branch. The master plan, prepared by Sagamore Development Company (SDC), envisions new housing, commercial development, parks and open space, and the future home and global headquarters of Under Armour. The plan also calls for integrating ecological functions in multiple ways, from buildings to streets to parks and restored shoreline along the Middle Branch.

South Baltimore Gateway Master Plan (2015).
The Plan was developed for the twelve neighborhoods surrounding the Horseshoe Casino, and includes the Baltimore Harbor watershed neighborhoods of Cherry Hill, Westport, Mt. Wynans, Pigtown, Sharp Ledenhall, and South Baltimore. The Plan is provides guidance for investment of the Casino's Local Impact Grant funds. Included was the recommendation, "Adopt a "Complete Streets" plan for each neighborhood". A Complete Streets study and implementation strategy was completed by the Department of Transportation (DOT) for these neighborhoods in 2016 and 2017.

South Baltimore Complete Streets Plan
The South Baltimore Complete Streets Plan includes a parking study and planned areas where multi-modal transit features can be implemented. This plan should be consulted to minimize conflicts with planned right of way modifications and minimize conflicts during construction or damage to facilities due to planned work following construction. The existing parking study also may serve as a resource when considering whether stormwater bump outs are feasible.

Oliver and Highlandtown Deep Blue Plans (2017).
The Deep Blue Plan is a partnership between Blue Water Baltimore (BWB), the Neighborhood Design Center (NDC), the Baltimore City Department of Public Works (DPW), and the communities of Oliver and Highlandtown. Master plans for each community identify potential stormwater management projects on both public and private property.

2.10.2   Small Watershed Action Plans (SWAPs) and Harbor Plans

Harris Creek WS246 Small Watershed Action Plan (2006).
Commissioned by Baltimore City Department of Public Works (DPW), this report recommends short-term projects (within 10 years), such as non-structural practices, regional facilities, and smaller scale facilities, as well as long-term greening projects, such as green roofs, permeable pavement for parking, or reduction of impervious area from streets and sidewalks.

Masonville Cove SWAP (2014).
Masonville Cove, a reclaimed waterfront north of the Brooklyn community, features urban habitat reclamation and restoration that has been designated the nation's first Urban Wildlife Refuge Partnership. Led by the National Aquarium, the SWAP identified a need to expand the reach of restoration and environmental education efforts upstream into the contributing watershed. Recommendations include implementing bioretention projects, a regenerative stormwater conveyance project, and developing an education/outreach/stewardship plan around reducing litter in the two affected communities of Brooklyn and Curtis Bay.

Watershed Management Plan for Watershed 263 (2006).
In 2006 DPW commissioned Watershed Management Plan for Watershed 263 (WS263) located in west Baltimore. This plan provides recommendations for water quality BMPs to treat 20 percent of the impervious area in the watershed, meeting the requirements of the City's stormwater NPDES permit. The Watershed

Management Plan is unique in that it 1) is for a watershed that is completely piped, and 2) combines goals that improve both water quality and quality of life for watershed residents.

Healthy Harbor Plan (2011).
Released in 2011 by the Waterfront Partnership, the Healthy Harbor Plan is a ten-year strategy for making the Baltimore Harbor safe for swimming and fishing. The plan outlines goals for city and county government, residents, and businesses. Recommendations fall into three categories: Fecal Bacteria, Trash and Litter, and Polluted Stormwater Runoff.

Inner Harbor Master Plan2.0 (2013).
Commissioned by the Waterfront Partnership, the master plan is an update of the original 1970's plan. The overall intent is to provide a visionary and realistic plan which can be implemented as funds are available. Elements of the plan include: developing new civic spaces and pedestrian connections, integrating green infrastructure, and providing a framework which can accommodate changes in priorities, timing, and funding.

Middle Branch Master Plan (2007).
Created by the DOP, the goal of the Middle Branch Master Plan is to highlight and capitalize on the uniquely green character of the Middle Branch estuary to build a model community based on sustainable principles. Focus areas include improving water quality and habitat, open space and recreation, and transportation.

Middle Branch Waterfront
Parks and People, Baltimore City Department of Recreation and Parks, South Baltimore Gateway Partnership and community stakeholders are currently doing outreach and visioning related to a plan to create upgrades to Middle Branch Park aimed at connecting several multi-use trails running parallel to the Baltimore Harbor. Middle Branch Park is in the Baltimore Harbor Watershed but immediately adjacent to the BALTIMORE HARBOR, and so this massive multi-year planned effort should be considered due to its adjacency.

2.10.3 Other Plans

Baltimore Green Network Plan (2018)
The Baltimore Green Network Plan, led by the Department of Planning, is a collective vision for the City to strengthen communities by creating an interconnected network of greenspaces. The goal is to transform vacant properties into community assets such as recreation areas, parks, trails, public squares, and urban gardens and farms. Additionally, the plan includes recommendations for connecting the city's existing parks, water bodies, and natural areas through natural corridors and community corridors. A portion of the network is located in Cherry Hill.

Downtown Open Space Plan (2011).
Created by the Downtown Partnership, the purpose of the open space plan is to increase the amount of open spaces in Downtown and enhance the network of spaces (and streets) that currently exists within the study area, including tree planting and stormwater mitigation.

Fort Worthington INSPIRE Schools Plan (2017).
INSPIRE, which stands for Investing in Neighborhoods and Schools to Promote Improvement, Revitalization, and Excellence, is led by the Department of Planning (DOP). The plan includes Fort Worthington Elementary/Middle School and focuses on the quarter-mile area around each school.

Community Benefits Plans – Healthcare Facilities
Non-profit hospitals are required to complete Community Health Needs Assessments and make Community Benefits investments in order to keep their tax exempt status. These needs assessments and targeted investments often contain data that can be useful to understanding community needs and priorities for outreach, and supporting the ability to recognize health related opportunities and co-benefits. There are several hospitals located in the Baltimore Harbor watershed, including Medstar Harbor Hospital (see below), the Johns Hopkins Medical System, and Mercy Hospital.

Medstar Harbor Hospital – Community Health Needs Assessment 2018
The service area and the more focused community benefits area for Medstar Harbor Hospital overlaps with the Baltimore Harbor watershed. Key focus areas identified that align with green infrastructure co-benefits include chronic disease preventions (diabetes and physical activity), access to mental health supporting resources, and the social determinants of health (employment). Additionally, smoking cessation is identified as a priority. Cigarette butts contribute to water quality issues, so there is a potential for messaging to be developed to spread awareness of the environmental impact of smoking alongside the health risks.

2.11 City-wide Initiatives

Bmore Beautiful
BMORE Beautiful is a City-led peer to peer beautification program that launched April 2017. The goal of the program is to change behaviors and attitudes towards the beautification of the City as well as encourage residents, businesses and organizations to become directly involved in activities and projects that will keep their neighborhoods clean. Bmore Beautiful works closely with forty-seven (47) neighborhoods across Baltimore on beatification projects and cleanliness challenges, as well as providing educational and outreach materials. Twenty-five (25) Bmore Beautiful neighborhoods are located in the Baltimore Harbor Watershed.

TreeBaltimore
TreeBaltimore is a mayoral initiative led by the Baltimore City of Recreation and Parks in partnership with non-profits like Blue Water Baltimore, the Parks & People Foundation, and Baltimore Tree Trust, as well as with community groups, schools, businesses, and City agencies. TreeBaltimore strives to increase the urban tree canopy through the establishment, management and preservation of trees to reach the goal of 40% tree canopy cover by 2037. Information can be found at www.treebaltimore.org.

Workforce Development
Several non-profits offer some type of workforce development. Civic Work's Center for Green Careers offers a stormwater installation and maintenance program that connects applicants to private sector jobs. Others, like Blue Water Baltimore and the Parks & People Foundation, hire and train people as part of construction crews and youth programs. While none of these initiatives are located within the LNBP watershed, they all draw participants from underserved neighborhoods like those found in the area. Additionally, DPW has a YH2O program, which trains young adults for water related jobs. Given current plans for installing green stormwater infrastructure within the watershed (Section 5.1.3) as well as those identified in this assessment, there is an opportunity to incorporate workforce development and local hiring into projects.

Green Schools Initiative
The Baltimore Green Schools Program is an initiative of the Office of Sustainability and includes the Green, Healthy, Smart Challenge grant program, the Baltimore Energy Challenge grant program, promoting youth environmental leadership through paid internships and engagement in green teams and in school initiatives, and supporting professional development for teachers. As part of the State Environmental Literacy Standards and the Chesapeake Bay Agreement, all schools must include a Meaningful Watershed Educational Experience (MWEE) in elementary, middle, and high schools for students. Green schools present an opportunity to prioritize green infrastructure, since installation of these facilities can support environmental education within schools, especially those schools with active environmental leadership initiatives.

Social and Emotional Learning Intensive Learning Sites - Schools
In 2017, Baltimore City Schools partnered with the Collaborative for Academic, Social, and Emotional Learning (CASEL), and identified 20 pilot schools to receive intensive instruction in social and emotional learning. The focus areas established include Restorative Practices, Literacy, and Social Emotional Learning. The initiative will continue into the 2018-19 school year and, if deemed valuable, may continue in subsequent years.

3   WATER QUALITY ASSESSMENT

Water is an integral part of the habitats of all species – human, animal, and plants. Because habitat conditions affect the ability of natural communities to find food and shelter and carry on natural processes, it is necessary to evaluate the state of existing land, water, and biological elements that provide for their needs.

3.1   Total Daily Maximum Loads (TMDLs)

The Clean Water Act (CWA) requires states, territories and authorized tribes to: develop water quality standards for all jurisdictional surface waters; monitor these surface waters; and identify and list impaired waters. More specifically, Section 305(b) of the CWA requires annual water quality assessments to determine the status of jurisdictional waters. Section 303(d) requires states to identify and periodically update a list of Water Quality Limited Segments (WQLS), or impaired waters that fail to meet applicable state water quality standards established for designated uses and biological integrity. The State of Maryland most recently compiled the results of these water quality assessments within the *2016 Integrated Report of Surface Water Quality in Maryland States*, which was approved by USEPA in November of 2017.

Based on these water quality assessments (WQA), states must also establish priority rankings and develop Total Maximum Daily Loads (TMDLs) for waters on the 303(d) list, which generally target pollutants including sediment, metals, bacteria, nutrients, and pesticides, for USEPA approval. The USEPA defines a TMDL as the maximum amount of a pollutant that a water body can receive and still safely meet state water quality standards.

3.1.1   Local TMDLs

The waters of the MD 8-digit Baltimore Harbor watershed are designated as Use I - Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life. Table 3-1 lists the three (3) pollutants with TMDLs currently approved by the EPA. Additionally, the Baltimore Harbor has eight additional impairment listings (Table 3-2).

Table 3-1 Local TMDLs for the Baltimore Harbor

Impairment	Issue Date	MS4 Baseline Load	WLA	Units	Description	% Reduction
Total Nitrogen	2007	260,323.0	221,274.0	LBS/ year	Annual Avg.	15%
Total Phosphorus	2007	28,177.0	23,951.0	LBS/ year	Annual Avg.	15%
Trash	2015	217,495.7	228,370.6	LBS/ year	Annual Avg.	NA

http://www.mde.state.md.us/programs/Water/TMDL/CurrentStatus/Pages/Programs/WaterPrograms/TMDL/Submittals/Index.aspx

Table 3-2 Baltimore Harbor Water Quality Impairment Listings

Impairment	Applicable Segment	Status	Approval Date
Pesticides (Chlordane)	MD-PATMH-02130903	TMDL Complete	March 2001
PCBs	Tidal subsegment of MD-PATMH- 02130903	TMDL Complete	October 2012
Bacterial (Enterococcus)	Tidal subsegment of MD-PATMH: Middle Branch/Northwest Harbor	Impaired	1998
Biological (Fish and Benthic Community)	Chesapeake Bay segment of MD- PATMH-02130903	Impaired	
Zinc	Tidal subsegment of MD-PATMH: Middle Harbor	Impaired	

Zinc	Tidal subsegments of MD-PATMH: Inner Harbor/Northwest Branch	WQA	January 2005
Lead	Tidal subsegment MD-PATMH: Inner Harbor/Northwest Branch	WQA	January 2005
Chromium	Tidal subsegments of MD-PATMH: Inner Harbor/Northwest Branch	WQA	January 2005

http://www.mde.state.md.us/programs/Water/TMDL/CurrentStatus/Pages/Programs/WaterPrograms/TMDL/Submittals/Index.aspx

Nutrients (Nitrogen and Phosphorus)
Total nitrogen and total phosphorus TMDLs were assigned to contributing nonpoint and point sources in the Baltimore Harbor watershed. Table 3-1 summarizes the average annual allocations of total nitrogen and phosphorus developed based on existing relative contributions and reductions necessary to meet TMDLs for the MD-PATMH tidal segment.

This assessment intends to address some of the actions needed to achieve reduction in nitrogen and phosphorus from urban stormwater systems, municipal wastewater treatment plants (WWTPs) discharging to the MD-PATMH tidal segment include the Patapsco WWTP (located within the watershed), and industrial point sources that discharge directly into Baltimore Harbor. TMDLs set for industrial point sources vary from plant to plant and are based on implementation of available technologies to achieve water quality criteria.

Sediment
Although there is no local TMDL for sediment, given the emphasis of the Chesapeake Bay TMDL (see Section 3.1.2 on nutrient and sediment reduction, this report will also address these pollutants.

Bacteria (Enterococcus)
Bacteria were first added to the impaired list for the Baltimore Harbor in 1998. Bacteria from human sources results from unpermitted discharges from the wastewater collection system. Much of this is not contributed by stormwater, as the City's routine surface water monitoring program has shown elevated bacteria levels during the dry weather periods due to failing sanitary sewer infrastructure, undocumented / unpermitted sanitary connections, consumer behavior and poor pet waste management. The City is addressing these challenges separately, under a Modified Consent Decree. Additionally, a schedule for Bacteria TMDL compliance can be found in the Baltimore City MS4 Restoration and TMDL WIP.

Trash and Debris
On January 5, 2015, the USEPA approved the report entitled "Total Maximum Daily Loads (TMDL) of Trash and Debris for the Middle Branch and Northwest Branch Portions of the Patapsco River Mesohaline Tidal Chesapeake Bay Segment, Baltimore City and County, Maryland". In compliance with the MS4 permit, DPW prepared the "Implementation Plan for the Middle Branch/Northwest Branch Trash TMDL in Baltimore City" in January 2016, which included the City's strategies for meeting the Total Maximum Daily Load (TMDL) waste load allocations.

In order to meet the goal of 100% reduction of the WLA, the City identified a diverse approach:

- Installing debris collection projects in-line and at the end of pipe to capture trash;

- Employing a variety of operational programs, such as mechanical street sweeping, preventive inlet cleaning, and routine waterway cleaning; and

- Fostering partnerships to encourage litter reduction and increased recycling, coupled with an increase in environmental stewardship within the communities.

Specifically, the City will employ a two-part, three-phase strategy to meet the WLA. The first part will employ projects and programs to capture trash as a stop gap measure. Project installation and program expansion will occur over a ten year period, with another 10 years of operations and data collection to validate trash loading rates. By FY 2035, the City expects to phase out some of the collection devices and decrease the level of program service. The second part of the plan will be concurrent with the first, employing partnerships as a sustainable

method for compliance with the trash TMDL. The initial 5-year phase will be to initiate education and outreach pilots, while creating and testing anti-litter campaigns. The pilot programs would be expanded over the next 5 years. After 10 years, the education and outreach programs would be modified based on data collected from surveys and collection data.

PCBs (Polychlorinated biphenyls) and Pesticides (Chlordane)
PCBs are a class of man-made chemicals used extensively between the 1940s and 1970s. Their dielectric and flame resistant properties made them ideal as heat transfer fluids, flame retardants, hydraulic fluids, and dielectric fluids. They are bioaccumulative organic compounds, resistive to environmental degradation, and carcinogenic, causing both acute and chronic toxic effects. The Baltimore Harbor watershed was listed as impaired in 1998 for PCBs. Disposal of PCB-contaminated sediment is the only method for pollutant reduction. The City proposes to complete source targeting and decision of monitoring locations by 2020. Monitoring and load reduction is proposed to occur by 2040.

Chlordane is a pesticide introduced in the 1940s that was used to control insects for agricultural, home, and commercial purposes. It is a bioaccumulative chemical that is carcinogenic and can cause both acute and chronic toxic effects, similar to the biological effects of PCBs. Chlordane was listed as an impairment in the Baltimore Harbor watershed in 1996. Because the majority of chlordane use has ceased since 1988, the only significant source of chlordane in the watershed is from in-situ Baltimore Harbor sediments that were exposed to chlordane in the past. Chlordane concentrations in the watershed are expected to decline over time through biodegradation and dispersal during the natural recovery process of the estuary.

Metals (Lead, Zinc, and Chromium)
WQAs have been approved for lead, zinc, and chromium in the Inner Harbor and Northwest Branch subsegments of the Patapsco River Mesohaline; however, no WQA has been developed for zinc in the Middle Harbor subsegment and a TMDL will need to be developed for this listing.

3.1.2   Chesapeake Bay Total Maximum Daily Load (TMDL)
The Chesapeake Bay TMDL, established by the US Environmental Protection Agency (EPA), set pollution limits for nitrogen, phosphorus, and sediment in the Chesapeake Bay Watershed. Pollutant load reduction goals are: 25 percent reduction in nitrogen, 24 percent reduction in phosphorus, and 20 percent reduction in sediment.

The City only has two primary source sectors: wastewater treatment plants and stormwater. The City owns and operates the two largest wastewater treatment plants in the State; both are in the process of implementing Enhanced Nutrient Reduction (ENR) technology upgrades. The ENR upgrades are part of the State's WIP to significantly reduce the nitrogen waste loads, and thus are partially funded by revenues from the state-managed Chesapeake Bay Restoration fund.

Pollutant loadings from stormwater are expected to be addressed within the state's timeline through the current 20% impervious area restoration goal of the MS4 permit and future Permit goals. Estimated reductions for nutrients and sediments associated with the 20% reduction are shown in Appendix E of the Baltimore City MS4 and TMDL WIP.

Table 3-3 lists the various water quality impairments and factors that contribute to the impairments. The water quality improvement opportunities for addressing these impairments can be found in Section 5.4.

Table 3-3 Water Quality Impairments and Contributing Factors

Impairment	Contributing Factors
Nutrients Phosphorus Nitrogen	Untreated impervious surfaces Land Use (residential / large property owners: over-fertilization, improper disposal of grass clipping, leaf litter) Sanitary Sewer overflows (age / condition of pipes, clogged pipes (FOG / debris) Behavior (pet waste not disposed of properly / rats)

Impairment	Contributing Factors
Sediments	Untreated impervious surfaces Degraded streams and culverts Steep slopes Bare soil (no vegetative cover) Development practices (Improperly maintained ESC practices)
Bacteria	Untreated Impervious surfaces Sanitary Sewer Overflows (age of pipes/improper disposal of fats/oil/grease (FOG)) Behavior (Pet waste not disposed of properly/Rats)
PCBs	Land Use (Legacy PCBs due to past industrial uses)
Trash	Untreated Impervious surfaces (runoff) Behavior (Trash not disposed of properly) Land Use (Corner stores / fast food establishments)
Metals	Untreated Impervious surfaces Land Use (industrial) Often bound to sediment (see contributing factors for sediment)

3.2   Steam Impact Sampling

As described in Section 5.2.4, DPW provides monthly stream impact sampling at seven (7) locations within the Baltimore Harbor watershed. Monitoring is done for nutrients (nitrogen and phosphorus) and bacteria (Enterococci). The FY18 MS4 Annual Report includes data for FY18 as well as historic trends from April 2009 through June 2018. This data can be used to identify contributing drainage areas to target water quality improvement efforts.

For nutrients, three monitoring stations showed an increase in FY18 in sampling results above the threshold for one or both of the nutrients. These are Linwood and Elliot, Lakewood & Hudson (Also known as Harris Creek), and Waterview Avenue. The contributing drainage areas to these monitoring locations provide opportunities for water quality improvement projects.

Light Street and Janey Run monitoring locations tested over 50% in the percentage of counts at or below the infrequent full body contact rule (65% and 60%, respectively) for Enterococci. While the historic data shows a smaller percentage of counts at or below the infrequent full body contact rule, the contributing drainage areas for these monitoring locations should be targeted.

3.2.1   Baltimore Harbor Storm Drain Ammonia Survey
During Fiscal years 2016 and 2017, DPW conducted the Baltimore Harbor Storm Drain Survey. A total of fifty-one (51) stormwater assets were visited, mostly storm drain manholes. The purpose of the survey was to conduct water quality sampling on smaller storm drain systems that were not part of the routine field screening programs. Sampling was performed during low tide and dry weather (no rain event within 48 hours). Only three (3) samples were determined to be related to sewage based on enterococcus analysis; and, therefore, warranted the initiation of a pollution source tracking (PST) Investigation. Additional information can be found in IDDE section of the FY16 and FY17 MS4 Annual Reports.

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4 SUITABILITY ANALYSIS AND PRIORITIZATION

4.1 Introduction

The regulatory purpose of the Baltimore Harbor Watershed Assessment is to identify and prioritize strategies and locations for projects, programs and partnerships to improve water quality, as required by the MS4 permit. Achieving the primary, regulatory goal of water quality improvement in a densely populated urban environment requires a full consideration of the not just the physical conditions of the watershed, but also factors related to human behavior and the interface between human populations and the environment is required.

This watershed assessment includes the additional, non-regulatory, goal of leveraging this watershed assessment to identify strategies and prioritize locations to better serve communities in Baltimore. Baltimore is a city with geographic disparities in environmental quality, socio-economic stability, and health outcomes; all which can be affected by projects (which change the physical environment) and programs and partnerships (which interact with social and economic systems affecting communities). Through considering a broad range of factors not typically included in watershed assessments, this analysis aims to maximize the co-benefits of projects, programs, and partnerships implemented as part of MS4 permit compliance to reduce inequities for community members who live, work, and play within the watershed.

The following primary (regulatory) and secondary (non-regulatory) goals were established to guide the suitability analysis.

1. **Primary Goals (Driven by regulatory requirements)**
   a. Reduce pollutant loads for Nitrogen, Phosphorus, and Sediment , bacteria, trash, and metals
      i. Identify areas where installed restoration projects will be feasible and effective
      ii. Identify areas where opportunities exist to engage private land owners and businesses in restoration efforts
      iii. Identify tailored strategies and partnerships to ensure that public education and outreach efforts reach diverse community members across all neighborhoods

2. **Secondary Goals (Non-regulatory best practices identified locally)**
   a. Maximize the co-benefits associated with implementation of restoration efforts, in particular for vulnerable communities, including:
      i. Heat Island Mitigation
      ii. Provision of Accessible Green Spaces
      iii. Air Quality Enhancements
      iv. Pedestrian safety & comfort
      v. Support Educational and Workforce Development initiatives
      vi. Foster community acceptance and stewardship
      vii. Align with Existing Community Needs/Goals
      viii. Maximize the primary benefits associated with implementation of restoration efforts:
      ix. Decrease flooding
      x. Protect and restore shorelines, buffers, and natural areas
      xi. Improve existing green spaces
      xii. Increase tree canopy
   b. Prioritize geographic locations where co-benefits can address the greatest need
   c. Maximize efficiencies within implementation
   d. Support aligned initiatives.

4.2 Methodology for Prioritization

The suitability analysis, as first described in Section 1.6, was performed to identify areas where various projects and programs were most appropriate for achieving the primary and secondary goals, based on an assessment of

physical watershed conditions, socio-economic related conditions, and health supportive neighborhood conditions. The suitability analysis s included the following steps:

1. **Prioritization by Community Statistical Areas (CSA's) and by Sub-Watershed:**
   a. Prioritization by CSA: A scoring process was developed to assess and prioritize CSA's within each sub-watershed based on:
      i. the feasibility for implementation of ESD projects like bioretention, based on the physical conditions within the area of each CSA within the watershed;
      ii. an assessment of socio-economic conditions within CSA's; and
      iii. an assessment of the health supportive conditions and health risks related to the built environment (inclusive of the physical environment and systems potentially impacted by the planning, design, and development of the physical environment) within CSA's.

   b. Prioritization by Sub-Watershed: Once CSA's within sub-watersheds were prioritized, sub-watershed's based on: the feasibility for implementation of ESD projects based on:
      i. the physical conditions within each sub-watershed; and
      ii. cumulative scores for CSA's within each sub watershed based on socio-economic conditions; and
      iii. cumulative scores for CSA's within each sub watershed based on health supportive conditions and health risks related to the built environment

2. **Identification of watershed resources and areas of opportunity:**
   a. Watershed Resources and Opportunities: Locations were identified where opportunities may exist to inform the development of programs and partnerships within the watershed.

3. **Identification of suitable Projects, Programs, and Partnerships by Priority area:** (Discussed in Ch. 5)
   a. Identification of Suitable locations for Projects and Programs: A list was compiled of the ideal conditions for various types of projects and programs identified by subwatershed. Once this list was compiled, areas where ideal conditions exist based on the suitability analysis were identified.

   b. Identification of potential partners: A list of potential partners that would be beneficial to engage based on the projects, programs, and locations identified was then generated.

4.2.1   Prioritization by Community Statistical Areas within Sub-Watersheds

Geographic areas within the watershed were first prioritized based on Community Statistical Areas (CSA's). To accomplish this, three main prioritization categories were identified as relevant for achieving the goals of this watershed assessment. Multiple factors were then identified to characterize and represent each of these prioritization categories within the CSA's, and ultimately within each sub-watershed.

The three (3) Prioritization Categories were defined as:

- Physical Feasibility
- Equity; and
- Health Supportive Community

Each CSA was first assigned a score for each factor based on its ranking relative to other CSA's within the sub-watershed. The scores for all factors were then summed to create a cumulative score within each prioritization category. The CSA's within each sub-watershed were then assigned a priority designation within each prioritization category.

A composite score was then created from results of the categorical prioritization, by assigning points to each priority designation within the prioritization categories. These composite scores were summed for each CSA, and then an overall priority designation was assigned within each sub-watershed. The points assigned to priority designations within each prioritization category were summed to create the overall prioritization score, to avoid

the artificial weighting of importance based on the number of factors identified in the three prioritization categories, which would have resulted from summing the raw scores.

4.2.1.1   Prioritization based on Physical Feasibility

Physical feasibility factors were defined based on the conditions which would be ideal for implementation of ESD projects. Prioritizing CSA's based on physical feasibility is critical to ensuring that water quality goals can be met in a timely and cost effective way. As a public utility implementing projects with public funds, identifying locations based on physical feasibility provides the additional of providing the greatest benefit while minimizing the cost burden for the public.

Factors considered for Physical Feasibility of installing ESD practices included the following:

- Percent of Eligible Impervious available in watershed within CSA
- Percent of 0-5% slopes available in watershed within CSA
- Percent of Eligible Impervious within Rights of Way or on Public Land available in watershed within CSA
- Percent of Hydrologic Soil Groups A & B available in watershed within CSA

Physical feasibility data was extracted for the area of each CSA within the watershed using Arc GIS mapping software. Five categories were defined for each factor based natural breaks in the data across CSA's in the watershed, which were then reviewed to ensure the categories were reasonable with regard to assessing relevant differences between CSA's.

Each CSA was ranked from lowest to highest priority relative to the other CSA's within the watershed for each factor, and assigned a score from 1-5 based on its rank. Scores were summed across all physical feasibility factors to create a composite "rank score" within this prioritization category.

4.2.1.2   Prioritization based on Equity & Prioritization based on Health Supportive Community

Factors within the Equity and Health Supportive Community prioritization categories were identified based on their ability to assess some need that could be addressed by co-benefits associated with ESD implementation.

Human health is broadly defined to include socio-economic factors affected through modification of the built environment, environmental exposures (heat, air quality), and access to health supportive resources (safe areas to exercise, access to nature and areas for stress mitigation, employment resources, etc.). This framework is based on the scope of factors considered to be health relevant within the field of public health, and is supported by the recently published Green Infrastructure & Health Guide (2018) prepared by the Oregon Health and Outdoors Initiative in partnership with the Green Infrastructure Leadership Exchange.

For equity, socio-economic factors were identified which could identify vulnerable populations where improvements to environmental quality could provide the greatest benefit. For health supportive communities, factors known to be relevant to health for all communities were identified that could be modified through either installation of ESD projects, or implementation of restoration related programs, outreach and engagement.

Factors considered for the Equity Prioritization Category were as follows:

- Higher priority was assigned to CSA's with lower values for:
  - Percent White
  - Median Income
  - Life Expectancy
- Higher priority was assigned to CSA's with higher values for:
  - Hardship Index
  - Percent No HS Diploma
  - Households Poverty

Factors considered for the Health Supportive Communities[5] Prioritization Category were as follows:

- o Percent of CSA covered by Not shaded Impervious surfaces
- o Daytime Surface Temperature within CSA's
- o Nighttime Surface Temperatures within CSA's
- o Percent that Walked to Work within CSA's
- o Percent Unemployed within CSA's
- o Percent without Access to a Vehicle within CSA's
- o Violent Crime Rate within CSA's
- o Percent Canopy within CSA's
- o Percent of CSA area covered by Parks and Greenspace

To prioritize each CSA based on Equity and Health Supportive Community related factor, five categories were defined for each factor based natural breaks in the data considering all CSA's across the city of Baltimore. These categories were reviewed to ensure the cut-points were reasonable with regard to assessing relevant differences between CSA's.

Each CSA was then assigned a score from 1-5 based on its rank relative to other CSA's across the city for each factor within each prioritization category. Scores were summed across all equity factors and across all health supportive community factors respectively to create a composite "rank score" within each prioritization category.

4.2.1.3 Scoring and Overall Prioritization

Once rank scores were computed for each CSA within each prioritization category, cut points for prioritization based on quintiles were established based on the spread of the rank-scores within each sub-watershed. Priority designation (and priority rank scores) was assigned based on which percentile included the rank score. Each CSA was then ranked relative to others within each sub-watershed based on this composite "rank score" to arrive at a priority designation within each prioritization category.

To arrive at an overall prioritization, and avoid inflating the importance of any of the three Prioritization Categories simply based on the number of factors available for consideration, a Priority Score was assigned to each CSA based on the priority designation within each category. The highest number of points was assigned to the CSA with the highest priority rank within each category.

The Priority Scores for each of the 3 prioritization categories were then summed to come up with a final, composite Overall Score. Cut points for prioritization were again established based on quintiles derived from the spread of the Overall Rank-Scores within each sub-watershed. CSA's were then ranked in order of priority to assign each a final priority designation within each sub-watershed.

4.2.2 Prioritization by Sub-Watersheds

To prioritize sub-watersheds, data was extracted based on each physical feasibility factor using sub-watersheds as the geographic units. Sub-watersheds were then ranked and assigned a score based on each factor, which were summed to create a priority designation within the Physical Feasibility prioritization category.

For both the Equity and Health Supportive Community prioritization categories, the mean of the scores for all CSA-s within each sub-watershed was calculated. Sub-watersheds then were ranked relative to other based on these scores within each respective prioritization category. Points were assigned to each priority designation within each of the prioritization categories, which were summed to create an overall prioritization score. Each sub-watershed was assigned an overall priority designation based on these scores.

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[5] Health Equity is addressed by considering locations where vulnerable populations co-occur with health liabilities, and is captured in the overall prioritization.

The South West Harbor sub watershed consisted of a single CSA, Brooklyn/Curtis Bay/Hawkins Point (Table 4-3 and Figures 4-1 through 4-4). By default, this would always be the first priority CSA within the SW Harbor watershed, and would therefore be assigned the highest priority rank score. In order to avoid inflating the SW Harbor watershed relative to other sub-watersheds based on it having a single (by default top priority) CSA, the priority rank score was assigned considering other CSA's with similar rank scores within all sub-watersheds (Table 4-1 through 4-3 and Figures 4-5 through 4-8).

Table 4-1 Prioritization of CSA's by Sub-Watershed – Inner Harbor

Category	Factor	Inner Harbor																
		S. Baltimore	Inner Harb / Fed. Hill	Clifton / Berea	Belair-Edison	Oldtown / MidEast	Madison East End	Midtown	Midway Coldstream	Patterson Park	Harbor East / Little Italy	Canton	Fells Point	Greenmount East	DT/ Seton Hill	S. Eastern	Orangeville	Highland-town
Equity SES	% White(Inv)	1	1	5	4	4	5	1	5	2	3	1	1	5	2	2	2	1
Equity SES	% NoHSDiploma	1	1	4	2	5	5	3	5	3	3	1	1	3	1	4	5	3
Equity SES	MedianIncome	1	1	4	3	5	4	3	4	1	3	1	1	4	2	3	3	1
Equity SES	HHPoverty	1	1	4	3	5	4	2	4	4	4	1	1	4	2	4	2	2
EquityOutcomes	LifeExpectancy	2	1	5	3	4	4	2	4	3	3	2	2	5	5	3	3	3
Equity SES	Hardship Index	1	1	4	3	5	5	2	5	3	3	1	1	5	2	4	3	2
Equity Rank Score (Points Total)		7	6	26	18	28	27	13	27	16	19	7	7	26	14	20	18	12
Equity Priority Rank Score (1=Low Priority)		1	1	4	3	5	5	2	5	3	4	1	1	4	2	4	3	2
Equity Priority Designation (1=High Priority)		5	5	2	3	**1**	**1**	4	**1**	3	2	5	5	2	4	2	3	4
Health- EnvEx	%ImperviousNotShaded	4	4	3	2	4	3	4	5	3	4	3	3	3	4	5	4	4
Heath-EnvEx	DaytimeSurTemp	3	5	5	3	5	5	5	5	5	5	4	5	4	5	4	4	5
Heath-EnvEx	NightimeSurTemp	4	5	3	2	5	5	5	4	5	5	4	4	4	5	4	3	4
Heath-EnvEx	%Walked	1	4	2	1	2	3	4	5	2	4	1	4	2	5	1	1	2
HealthResources	%Unemploy	1	1	5	4	3	5	2	5	2	4	1	1	5	1	3	2	2
HealthResources	NoVehicle	1	2	4	3	5	5	4	4	2	3	1	2	5	4	3	3	2
HealthResources	ViolentCrime	1	2	3	2	4	3	3	3	3	4	1	2	3	5	2	3	3
HealthResources	PercentCanopy	5	5	5	3	5	5	4	4	5	5	4	5	4	5	5	4	5
HealthResources	PercentParksGS	5	4	4	2	4	4	4	4	4	5	3	5	4	5	5	4	5
Health Supportive Comm. Rank Score		25	32	34	22	37	38	35	39	31	39	22	31	34	39	32	28	32
Health Supp. Comm. Priority Rank Score		1	2	3	1	4	5	4	5	2	5	1	2	3	5	2	1	2
Health Supp. Comm. Priority Designation		5	4	3	5	2	**1**	2	**1**	4	**1**	5	4	3	**1**	4	5	4
Physical Feasibility	% Eligible Impervious	1	2	2	1	2	2	2	1	2	2	2	2	2	2	1	2	1
	% ABS oils	1	1	2	3	1	1	1	1	4	1	4	1	2	1	1	2	1
	% <5% Slope	2	2	2	1	1	1	1	1	2	2	2	2	1	2	1	1	1
	% E. Imperv. Pub Land/	1	2	2	1	2	2	1	1	2	2	2	2	3	3	1	1	1
Physical Feasibility Rank Score		5	7	8	6	6	6	5	4	10	7	10	7	7	8	4	6	4
Physical Feasibility Priority Rank Score		1	3	4	2	2	2	1	1	5	3	5	3	3	4	1	1	1
Physical Feasibility Priority Designation		5	3	2	4	4	4	5	5	**1**	3	**1**	3	3	2	5	5	5
Overall Score		3	6	11	6	11	12	7	11	10	12	7	6	10	11	7	5	5
Overall Priority		5	5	2	5	2	**1**	4	2	3	**1**	4	5	3	2	4	5	5

Table 4-2 Prioritization of CSA's by Sub-Watershed (cont.) – Middle Branch, Patapsco, SW Harbor

Subwatersheds		Middle Branch										Patapsco			SW Harbor
Category	Factor	Sandtown Winchester / Harlem Park	Upton/ Druid Heights	Poppleton / Hollins Market	Downtown / Seton Hill	SW Baltimore	Washington Village	Inner Harbor /	Westport / Mt Winans / Lakeland	Cherry Hill	S. Baltimore	S.Eastern	Orangeville	Highland-town	Brooklyn / Curtis Bay / Hawkins Point
Equity SES	% White(Inv)	5	5	3	2	3	2	1	3	5	1	2	2	1	2
Equity SES	% NoHSDiploma	5	4	5	1	5	3	1	5	3	1	4	5	3	4
Equity SES	MedianIncome	4	5	5	2	4	3	1	3	4	1	3	3	1	3
Equity SES	HHPoverty	4	5	5	2	5	4	1	3	5	1	4	2	2	4
EquityOutcomes	LifeExpectancy	4	4	4	5	5	4	1	3	4	2	3	3	3	4
Equity SES	Hardship Index	5	5	5	2	5	3	1	4	5	1	4	3	2	5
Equity Rank Score (Points Total)		27	28	27	14	27	19	6	21	26	7	20	18	12	22
Equity Priority Rank Score (1=Low Priority)		4	5	4	2	4	2	1	2	3	1	5	3	1	4
Equity Priority Designation (1=High Priority)		2	**1**	2	4	2	4	5	3	3	5	**1**	2	3	**1**
Health- EnvEx	%ImperviousNotShaded	3	3	3	4	3	3	4	3	2	4	5	4	4	4
Heath-EnvEx	DaytimeSurTemp	5	5	5	5	5	4	5	3	3	3	4	4	5	3
Heath-EnvEx	NightimeSurTemp	4	4	5	5	4	4	5	3	3	4	4	3	4	4
Heath-EnvEx	%Walked	1	2	4	5	2	4	4	1	2	1	1	1	2	1
HealthResources	%Unemploy	4	4	4	1	4	4	1	4	4	1	3	2	2	4
HealthResources	NoVehicle	5	5	5	4	5	3	2	3	5	1	3	3	2	3
HealthResources	ViolentCrime	3	4	4	5	4	4	2	3	3	1	2	3	3	3
HealthResources	PercentCanopy	3	4	4	5	4	4	5	3	3	5	5	4	5	3
HealthResources	PercentParksGS	4	4	4	5	4	3	3	3	3	5	5	4	5	4
Health Supportive Comm. Rank Score		32	35	38	39	35	33	31	26	28	25	32	28	32	29
Health Supp. Comm. Priority Rank Score		3	4	5	5	4	4	2	1	2	1	3	1	3	2
Health Supp. Comm. Priority Designation		3	2	**1**	**1**	2	2	4	5	4	5	**1**	2	**1**	**1**
Physical Feasibility	% Eligible Impervious	3	2	2	2	3	3	2	2	2	3	5	4	2	1
	% ABS oils	2	1	4	1	1	3	1	4	4	1	3	5	1	5
	% <5% Slope	4	1	2	1	2	4	2	2	2	4	4	1	1	3
	% E. Imperv. Pub Land/	3	2	2	2	3	3	2	1	1	3	5	4	1	3
Physical Feasibility Rank Score		12	6	10	6	9	13	7	9	9	11	17	14	5	12
Physical Feasibility Priority Rank Score		5	1	3	1	2	5	1	2	2	4	5	3	1	5
Physical Feasibility Priority Designation		**1**	5	3	5	4	**1**	5	4	4	2	**1**	2	3	**1**
Overall Score		12	10	12	8	10	11	4	5	7	6	13	7	5	11
Overall Priority		**1**	3	**1**	3	3	2	5	5	4	4	**1**	2	3	**1**

Table 4-3 Prioritization by Subwatershed

		Inner Harbor	Middle Branch	Patapsco	SW Harbor
Equity	**Mean Rank Score**	17.1	20.2	16.7	22.0
	Prioritization Score	2	3	1	4
	Prioritization Designation (1=High Priority)	3	2	4	1
Health Supportive Community	**Mean Rank Score**	32.4	32.2	30.7	29
	Prioritization Score	4	4	3	2
	Prioritization Designation	**1**	**1**	**2**	**3**
Physical Feasibility	**Rank Score**	12	11	10	10
	Prioritization Score	4	3	2	2
	Prioritization Designation	**1**	**2**	**3**	**3**
Overall	**Rank Score**	10	10	6	8
	Overall Priority	1	1	3	2
	Priority CSAs	**Priority Area 1** • Madison East End • Harbor East / Little Italy **Priority Area 2** • Clifton / Berea • Oldtown / MidEast • Midway Coldstream • Downtown / Seton Hill	**Priority Area 1** • Sandtown Winchester / Harlem Park • Poppleton / Hollins Market **Priority Area 2** • Washington Village	**Priority Area 1** • Southeastern **Priority Area 2** • Orangeville	**Priority Area 1** • Brooklyn / Curtis Bay/ Hawkins Point

Figure 4-1 Priority of Subwatershed by Physical Feasibility
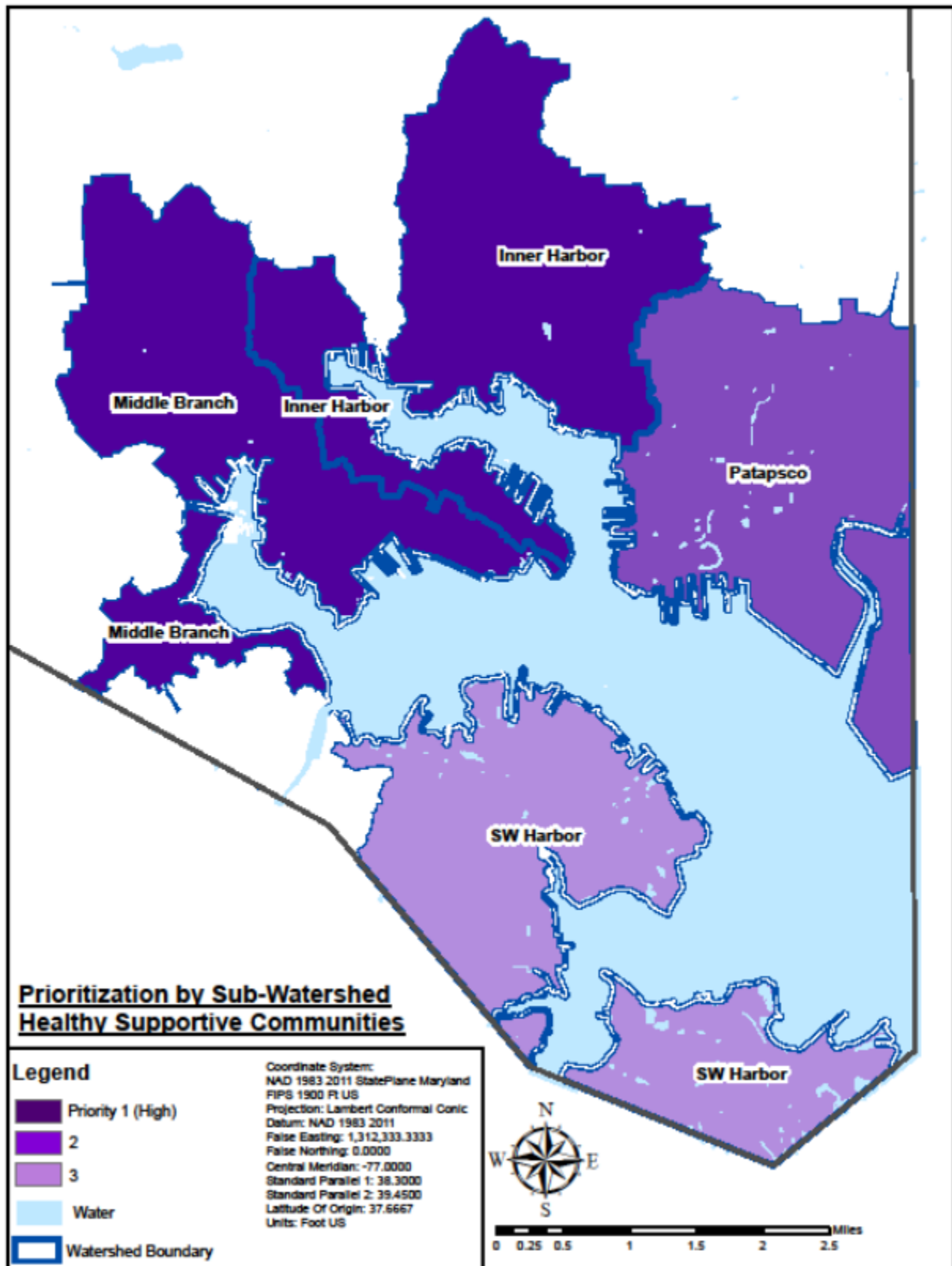
Figure 4-2 Priority of Subwatersheds by Healthy Supportive Communities
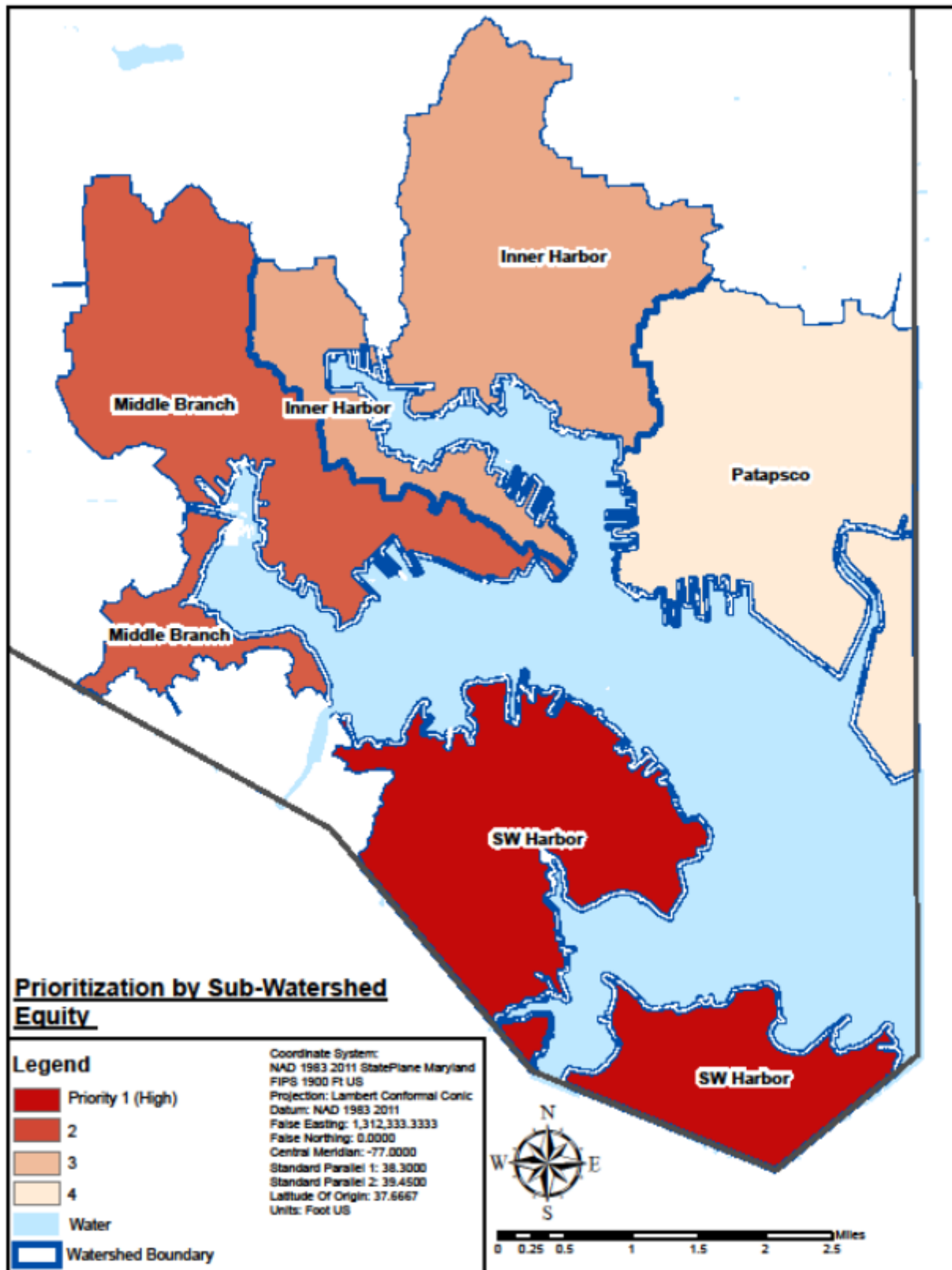
Figure 4-3 Prioritization of Subwatersheds by Equity Factors
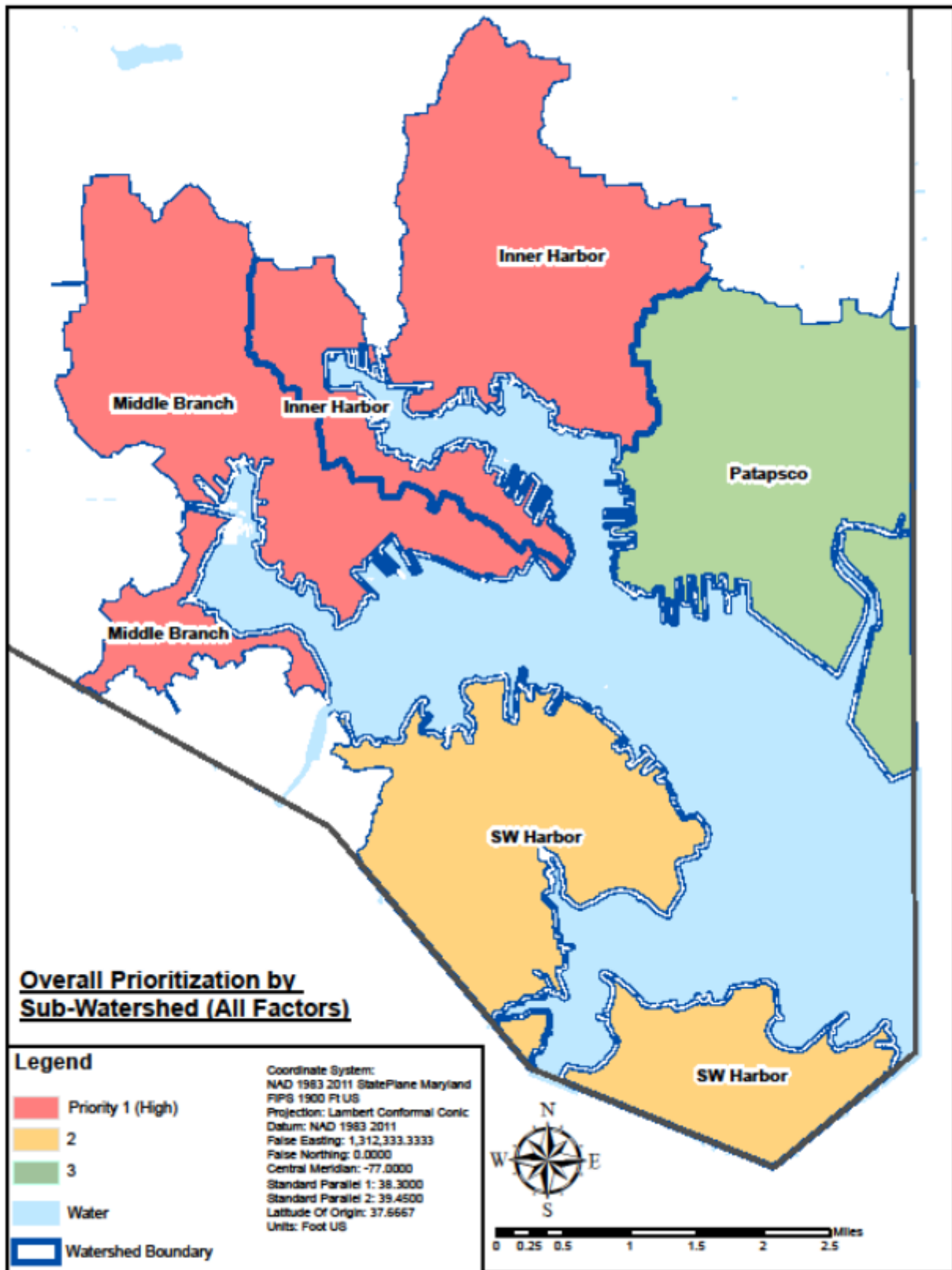
Figure 4-4 Overall Prioritization by Subwatershed
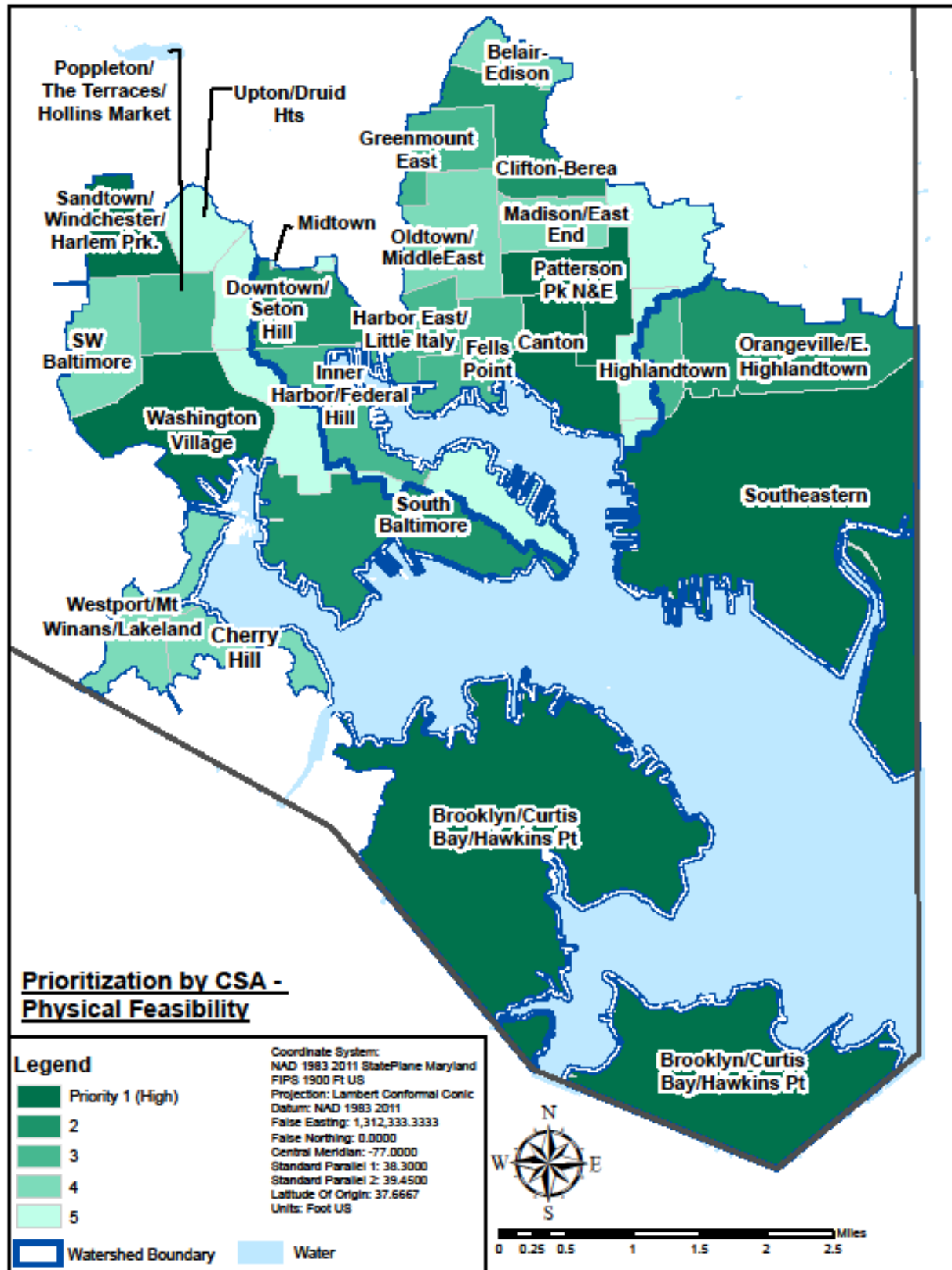
Figure 4-5 Prioritization of CSA's by Physical Feasibility Factors
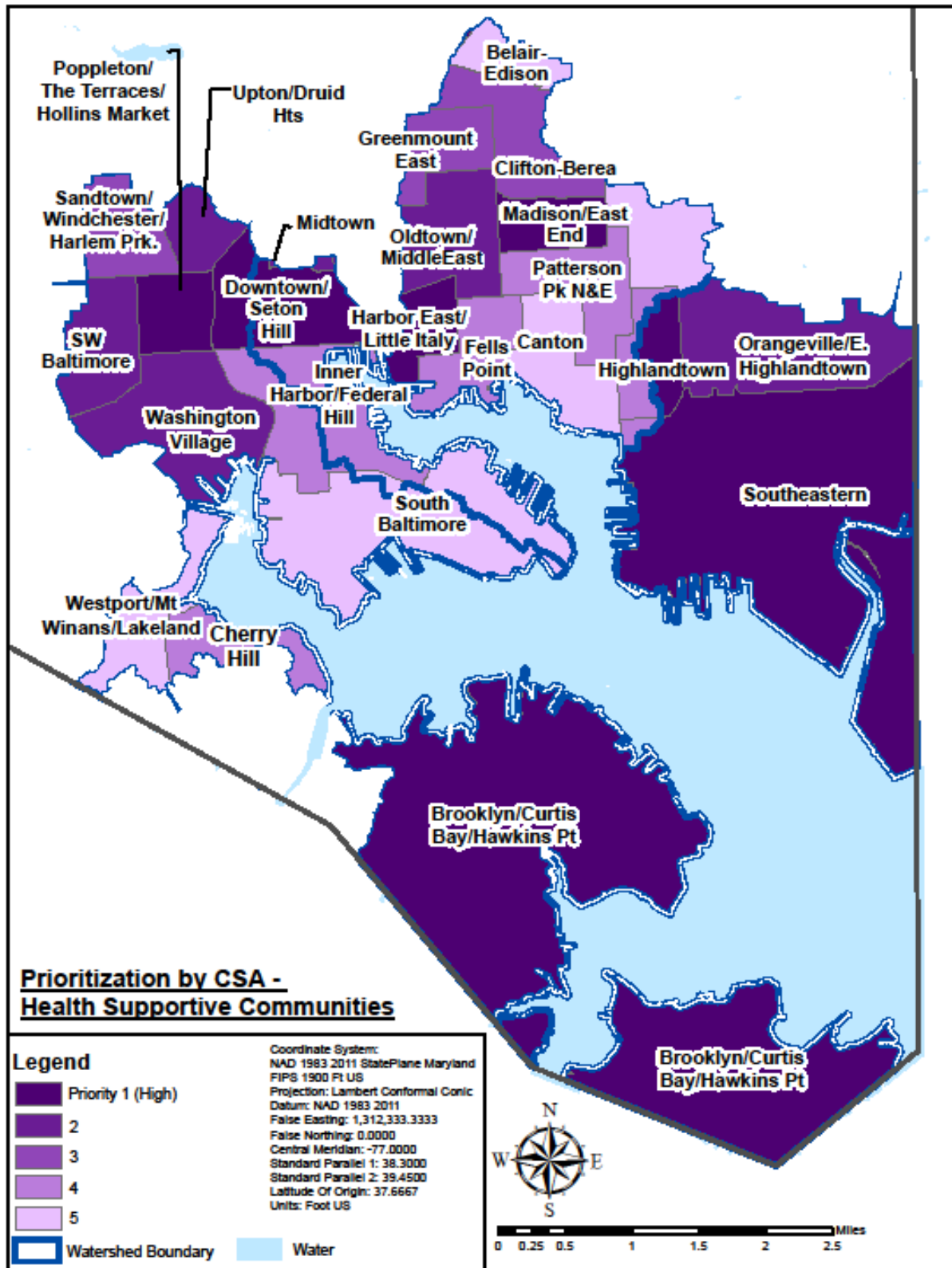
Figure 4-6 Prioritization of CSA's by Health Supportive Community Factors
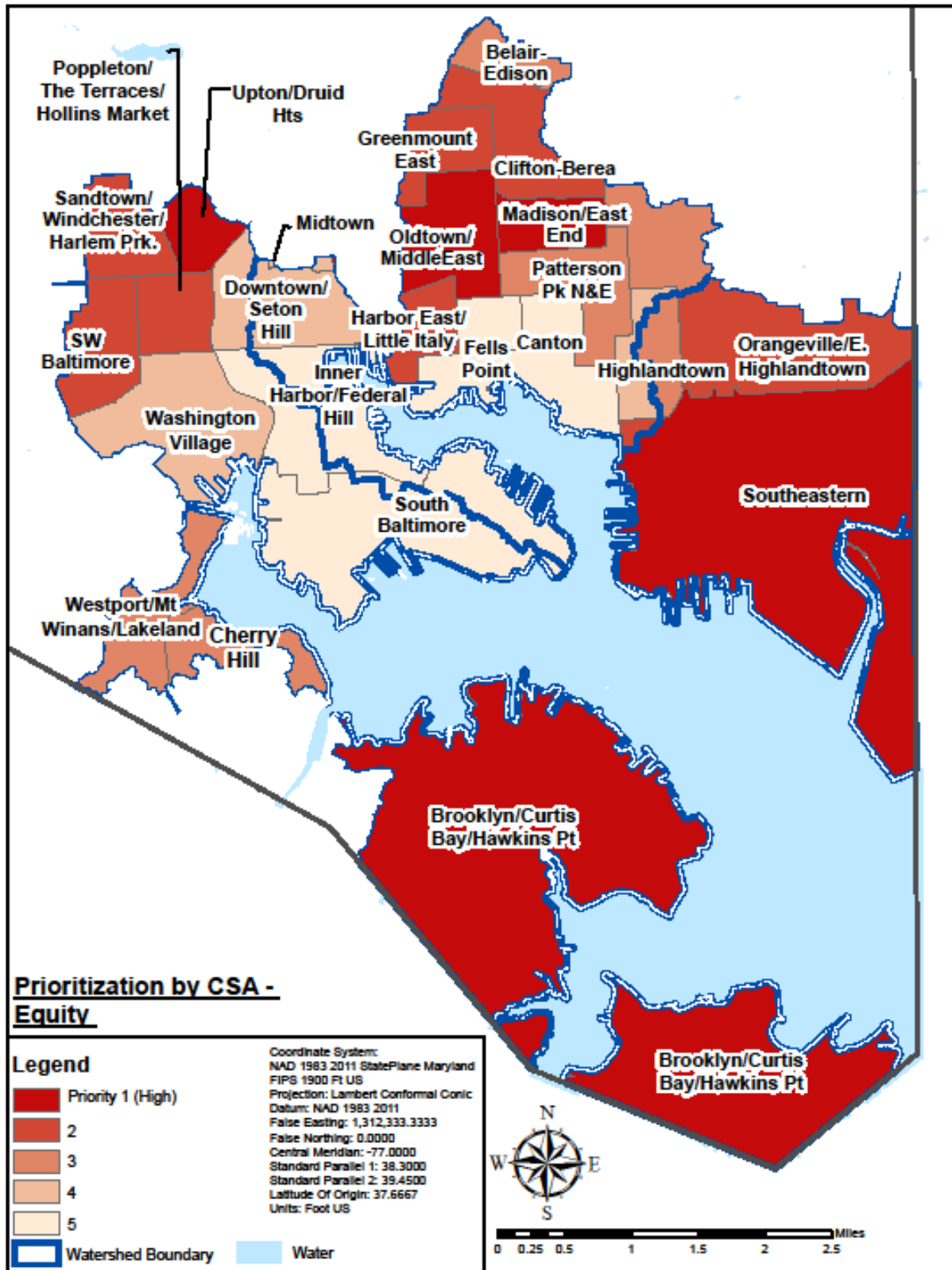
Figure 4-7 Prioritization of CSA's by Equity related Factors
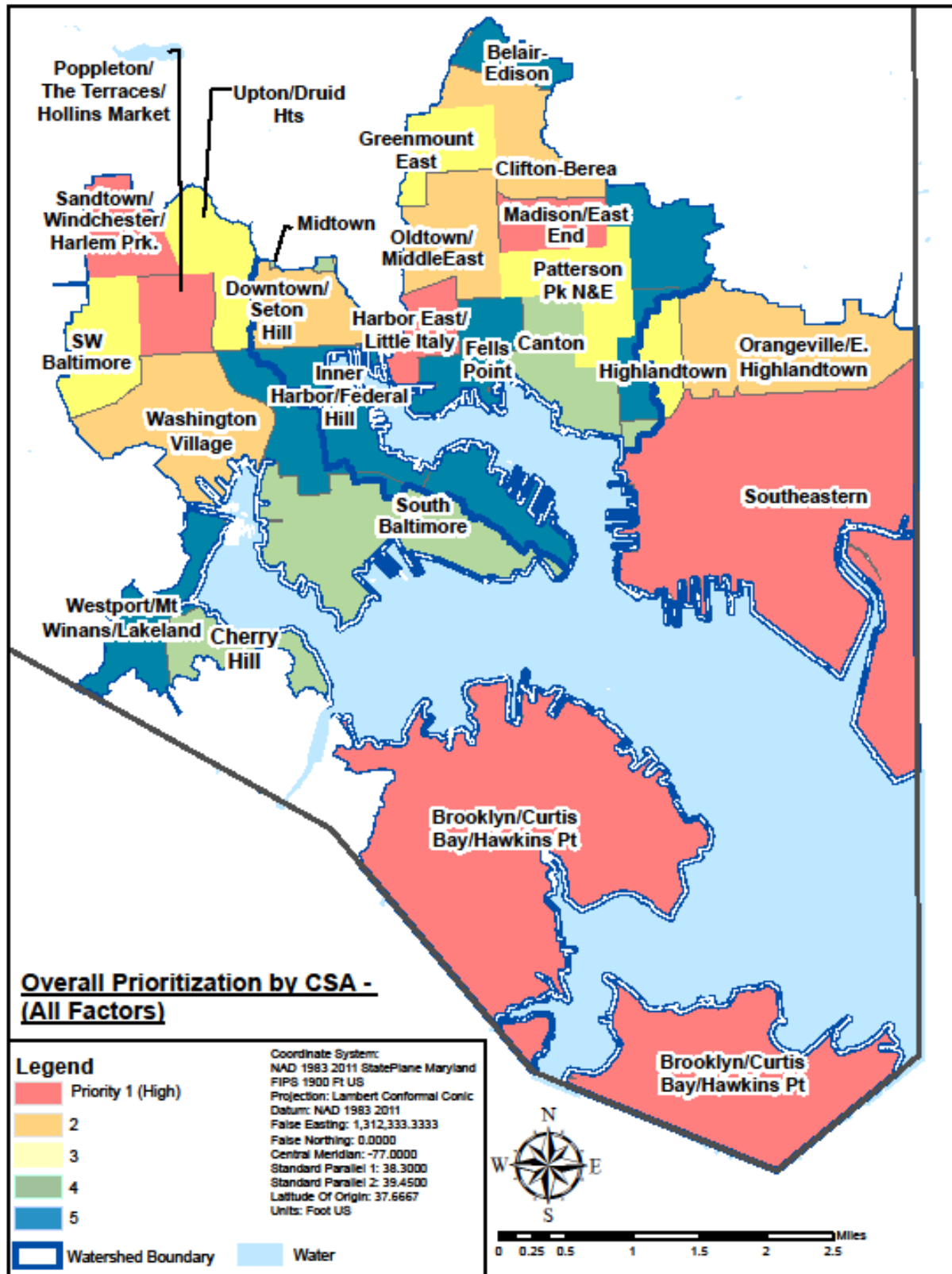
Figure 4-8 Overall Prioritization by CSA

4.2.3 Identification of Watershed Resources and Opportunities

Once the prioritization of Community Statistical Areas was complete, geographic locations of resources which represent potential opportunities for projects, programs, and partnerships were identified and mapped. For development of implementation plans, opportunities will be identified within the highest priority CSA's first (Figures 4-9 through 4-12).

This mapping of watershed opportunities and resources serves to identify potential innovative program and partnership opportunities that can be explored within these larger geographic areas. Table 4-4 lists the types of resources that were mapped and the types of opportunities that area associated with the mapped resources.

Table 4-4 Baltimore Harbor Watershed Resources / Opportunities

Resource/Opportunity Identified	Significance of Data
o Department of Transportation planned pedestrian "bump-outs". o Existing and Planned bicycle lanes	Areas to plan for outreach to Agencies Implementing Construction Projects in LNBP:
o Land Use – Commercial o Land Use – Residential by Density o Land Use – Institutional	Locations for Private Space Implementation Public Outreach and Programming
o Hospital Community Benefits and Service areas o Violence Reduction Initiative (VRI Zones) o ¼ Mile Buffers around schools o INSPIRE Schools o Intensive Learning Sites Schools o B'more Beautiful Neighborhoods o Green Network Plan work areas o Percent who walked to work by CSA	Geographic Focus Areas of initiatives aligned with ESD co-benefits including physical activity/access to nature – Potential related Programs and Partnerships
o Unemployment by CSA o Percent without a High School (HS) diploma by CSA o Percent with a HS diploma and some college by CSA o Percent without Access to a Vehicle by CSA o Violent Crime Rate by CSA o Percent Under 18 by CSA	Potential Focus Areas for Workforce Development Programs and Partnerships
o ¼ Mile Buffer around Schools o B'more Beautiful Neighborhoods	Potential Focus Areas for Stewardship, Engagement, Public Education, and Partnerships:
o Percent Under 18 by CSA o Percent Over 65 by CSA	Potential Consideration to Inform Development of Public Outreach and Engagement Strategies

Identification of Stakeholder Coordination Areas & Initiatives

Legend

Watershed Boundary	
Major Roads	
DOT Bumpouts	
Identified Potential BMP's	
DPW 2019 Planned BMP's	

Proposed Bicycle Network

- BIKE BOULEVARD
- BIKE CUT THRU
- BIKE LANE
- BUFFERED BIKE LANE
- CONTRAFLOW
- CYCLETRACK
- General
- SHARED BUS BIKE
- SHARROW
- SIDEPATH
- SIGNED ROUTE
- MULTI-USE TRAILS

CSA Boundary
Hydro Features
VRI_Zones
Bmore_Beautiful
Hospital Community Benefits Area
Hospital

Existing Bicycle Network

- BIKE BOULEVARD
- BIKE LANE
- CONTRAFLOW
- CYCLETRACK
- General
- SHARED BUS BIKE
- SHARROW
- SIDEPATH
- SIGNED ROUTE
- MULTI-USE TRAILS - Existing

High Ped. Crash Intersection

Public School Initiatives

- School
- Intensive Learning Site Literacy
- Intensive Learning Site Restorative Practices
- Intensive Learning Site Social-emotional learning
- INSPIRE School 1/4 Mile Radius
- School 1/4 Mile Radius

Green Network Plan

- Green Network Planned Lots 2018
- Community_Nodes
- Nature_Nodes
- Priority_Corridors
- Community_Corridors
- Nature_Corridors

Coordinate System: NAD 1983 StatePlane
Maryland FIPS 1900 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
False Easting: 1,312,333.3333
False Northing: 0.0000
Central Meridian: -77.0000
Standard Parallel 1: 38.3000
Standard Parallel 2: 39.4500
Latitude Of Origin: 37.6667
Units: Foot US

0   0.15 0.3   0.6   0.9   1.2
Miles

Figure 4-9 Stakeholder Coordination Areas and Initiatives - Inner Harbor Subwatershed

Identification of Stakeholder Coordination Areas & Initiatives

Legend

▭ Watershed Boundary	
— Major Roads	
▲ DOT Bumpouts	
✳ Identified Potential BMP's	
◆ DPW 2019 Planned BMP's	

Proposed Bicycle Network
- — BIKE BOULEVARD
- — BIKE CUT THRU
- — BIKE LANE
- — BUFFERED BIKE LANE
- — CONTRAFLOW
- — CYCLETRACK
- — General
- — SHARED BUS BIKE
- — SHARROW
- — SIDEPATH
- — SIGNED ROUTE
- — MULTI-USE TRAILS

▭ CSA Boundary
▭ Hydro Features
▨ VRI_Zones
▨ Bmore_Beautiful
▭ Hospital Community Benefits Area
⊙ Hospital

Existing Bicycle Network
- — BIKE BOULEVARD
- — BIKE LANE
- — CONTRAFLOW
- — CYCLETRACK
- — General
- — SHARED BUS BIKE
- — SHARROW
- — SIDEPATH
- — SIGNED ROUTE
- — MULTI-USE TRAILS - Existing

💧 High Ped. Crash Intersection

Public School Initiatives
- ◉ School
- ◉ Intensive Learning Site Literacy
- ◉ Intensive Learning Site Restorative Practices
- ◉ Intensive Learning Site Social-emotional learning
- ▭ INSPIRE School 1/4 Mile Radius
- ▭ School 1/4 Mile Radious

Green Network Plan
- ▨ Green Network Planned Lots 2018
- ◉ Community_Nodes
- ◉ Nature_Nodes
- — Priority_Corridors
- — Community_Corridors
- ▬ Nature_Corridors

Coordinate System: NAD 1983 StatePlane
Maryland FIPS 1900 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
False Easting: 1,312,333.3333
False Northing: 0.0000
Central Meridian: -77.0000
Standard Parallel 1: 38.3000
Standard Parallel 2: 39.4500
Latitude Of Origin: 37.6667
Units: Foot US

0   0.15 0.3   0.6   0.9   1.2
⊢—⊢—⊢———⊢———⊢———⊢ Miles

Figure 4-10 Stakeholder Coordination Areas and Initiatives - Middle Branch Subwatershed

Identification of Stakeholder Coordination Areas & Initiatives

Legend

Watershed Boundary
Major Roads
▲ DOT Bumpouts
✳ Identified Potential BMP's
◆ DPW 2019 Planned BMP's

Proposed Bicycle Network
BIKE BOULEVARD
BIKE CUT THRU
BIKE LANE
BUFFERED BIKE LANE
CONTRAFLOW
CYCLETRACK
General
SHARED BUS BIKE
SHARROW
SIDEPATH
SIGNED ROUTE
MULTI-USE TRAILS

CSA Boundary
Hydro Features
VRI_Zones
Bmore_Beautiful
Hospital Community Benefits Area
⊙ Hospital

Existing Bicycle Network
BIKE BOULEVARD
BIKE LANE
CONTRAFLOW
CYCLETRACK
General
SHARED BUS BIKE
SHARROW
SIDEPATH
SIGNED ROUTE
MULTI-USE TRAILS - Existing

💧 High Ped. Crash Intersection

Public School Initiatives
◉ School
◉ Intensive Learning Site Literacy
◉ Intensive Learning Site Restorative Practices
◉ Intensive Learning Site Social-emotional learning
INSPIRE School 1/4 Mile Radius
School 1/4 Mile Radious

Green Network Plan
Green Network Planned Lots 2018
◉ Community_Nodes
◉ Nature_Nodes
Priority_Corridors
Community_Corridors
Nature_Corridors

Coordinate System: NAD 1983 StatePlane
Maryland FIPS 1900 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
False Easting: 1,312,333.3333
False Northing: 0.0000
Central Meridian: -77.0000
Standard Parallel 1: 38.3000
Standard Parallel 2: 39.4500
Latitude Of Origin: 37.6667
Units: Foot US

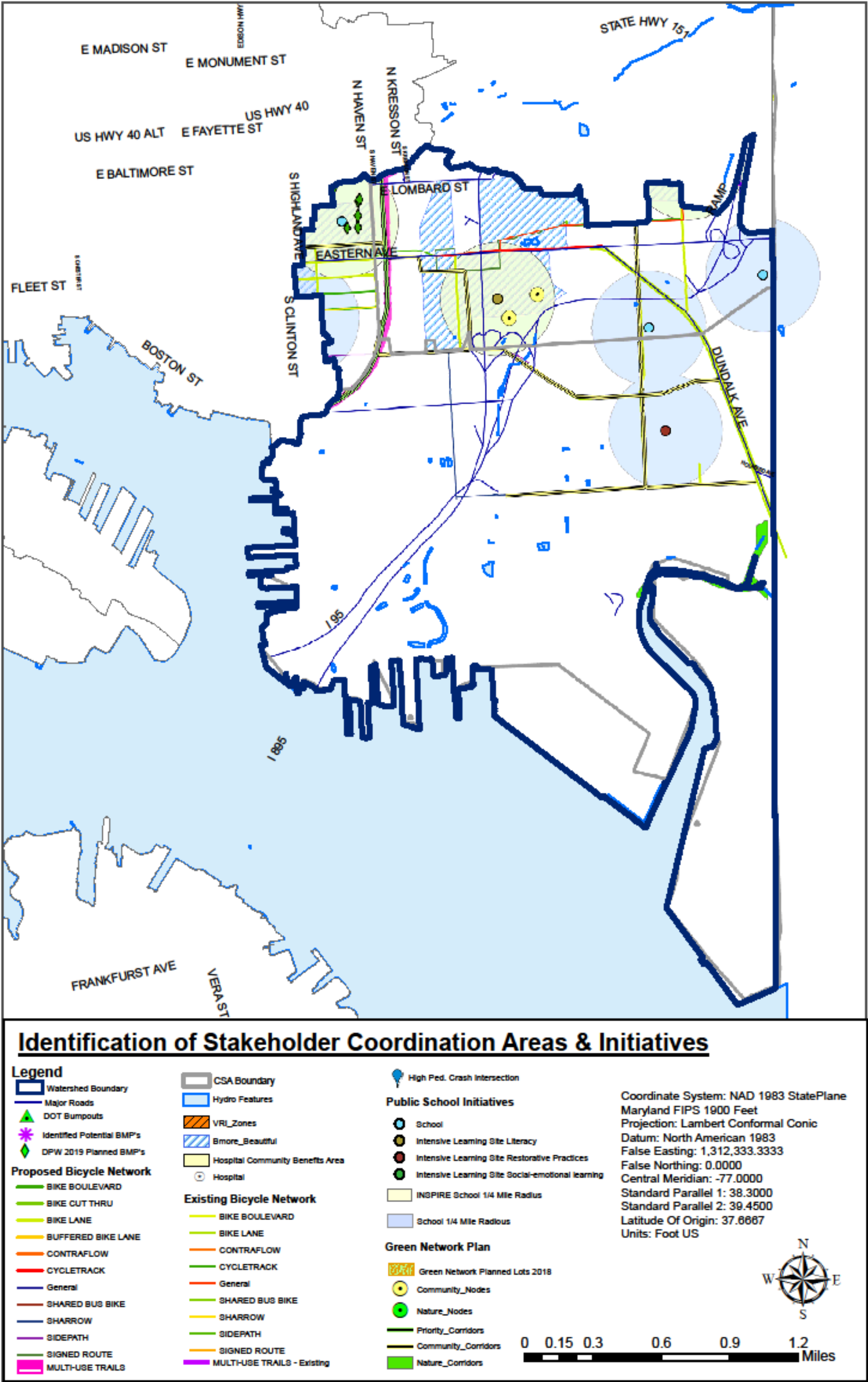0   0.15 0.3   0.6   0.9   1.2
Miles

Figure 4-11 Stakeholder Coordination Areas and Initiatives - Patapsco Subwatershed

Identification of Stakeholder Coordination Areas & Initiatives

Legend

☐	Watershed Boundary
—	Major Roads
▲	DOT Bumpouts
✳	Identified Potential BMP's
◆	DPW 2019 Planned BMP's

Proposed Bicycle Network

—	BIKE BOULEVARD
—	BIKE CUT THRU
—	BIKE LANE
—	BUFFERED BIKE LANE
—	CONTRAFLOW
—	CYCLETRACK
—	General
—	SHARED BUS BIKE
—	SHARROW
—	SIDEPATH
—	SIGNED ROUTE
—	MULTI-USE TRAILS

☐	CSA Boundary
☐	Hydro Features
▨	VRI_Zones
▨	Bmore_Beautiful
☐	Hospital Community Benefits Area
◎	Hospital

Existing Bicycle Network

—	BIKE BOULEVARD
—	BIKE LANE
—	CONTRAFLOW
—	CYCLETRACK
—	General
—	SHARED BUS BIKE
—	SHARROW
—	SIDEPATH
—	SIGNED ROUTE
—	MULTI-USE TRAILS - Existing

💧	High Ped. Crash Intersection

Public School Initiatives

⊙	School
⊙	Intensive Learning Site Literacy
⊙	Intensive Learning Site Restorative Practices
⊙	Intensive Learning Site Social-emotional learning
☐	INSPIRE School 1/4 Mile Radius
☐	School 1/4 Mile Radius

Green Network Plan

▨	Green Network Planned Lots 2018
⊙	Community_Nodes
⊙	Nature_Nodes
—	Priority_Corridors
—	Community_Corridors
▨	Nature_Corridors

Coordinate System: NAD 1983 StatePlane
Maryland FIPS 1900 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
False Easting: 1,312,333.3333
False Northing: 0.0000
Central Meridian: -77.0000
Standard Parallel 1: 38.3000
Standard Parallel 2: 39.4500
Latitude Of Origin: 37.6667
Units: Foot US

0   0.2   0.4   0.8   1.2   1.6
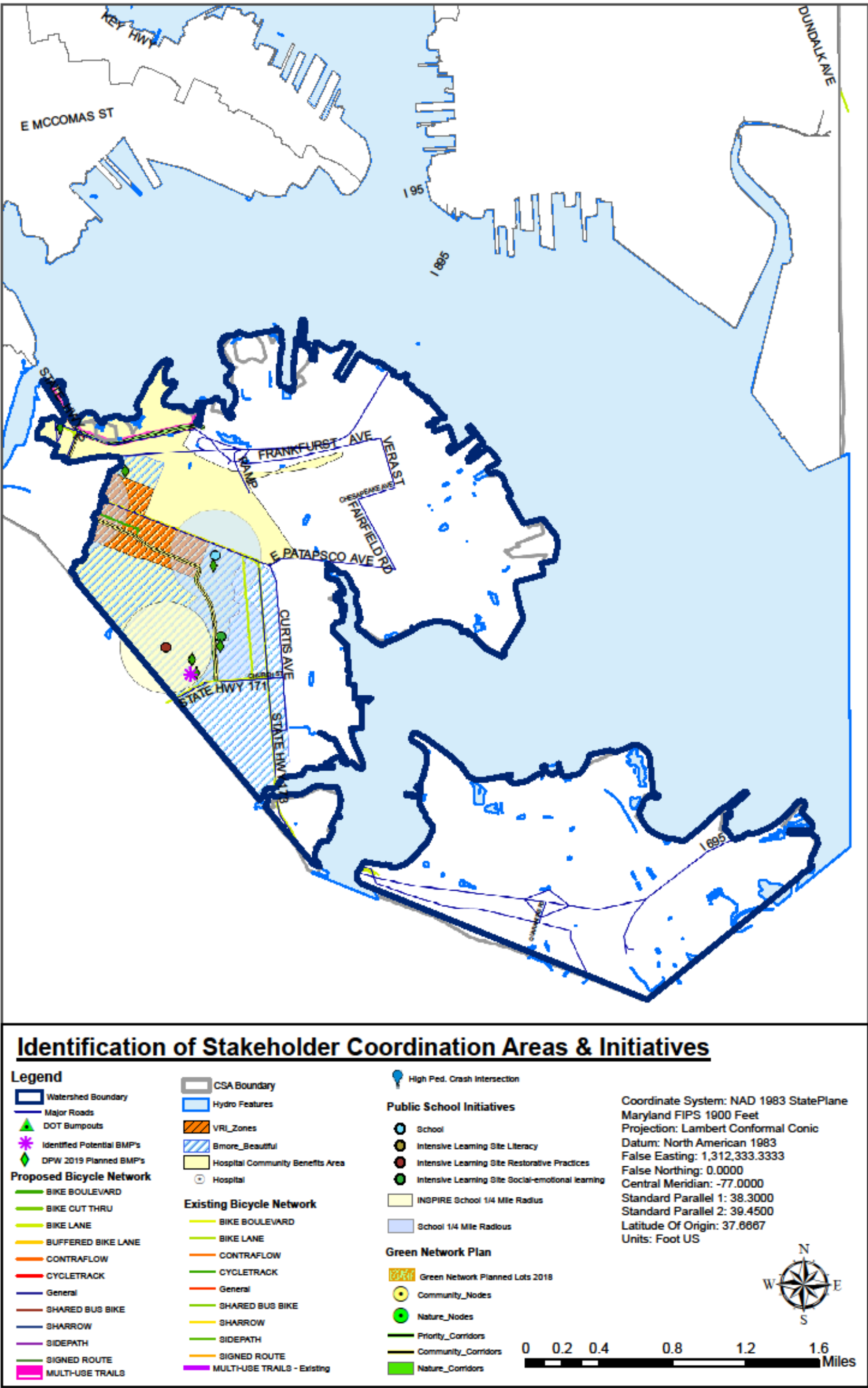Miles

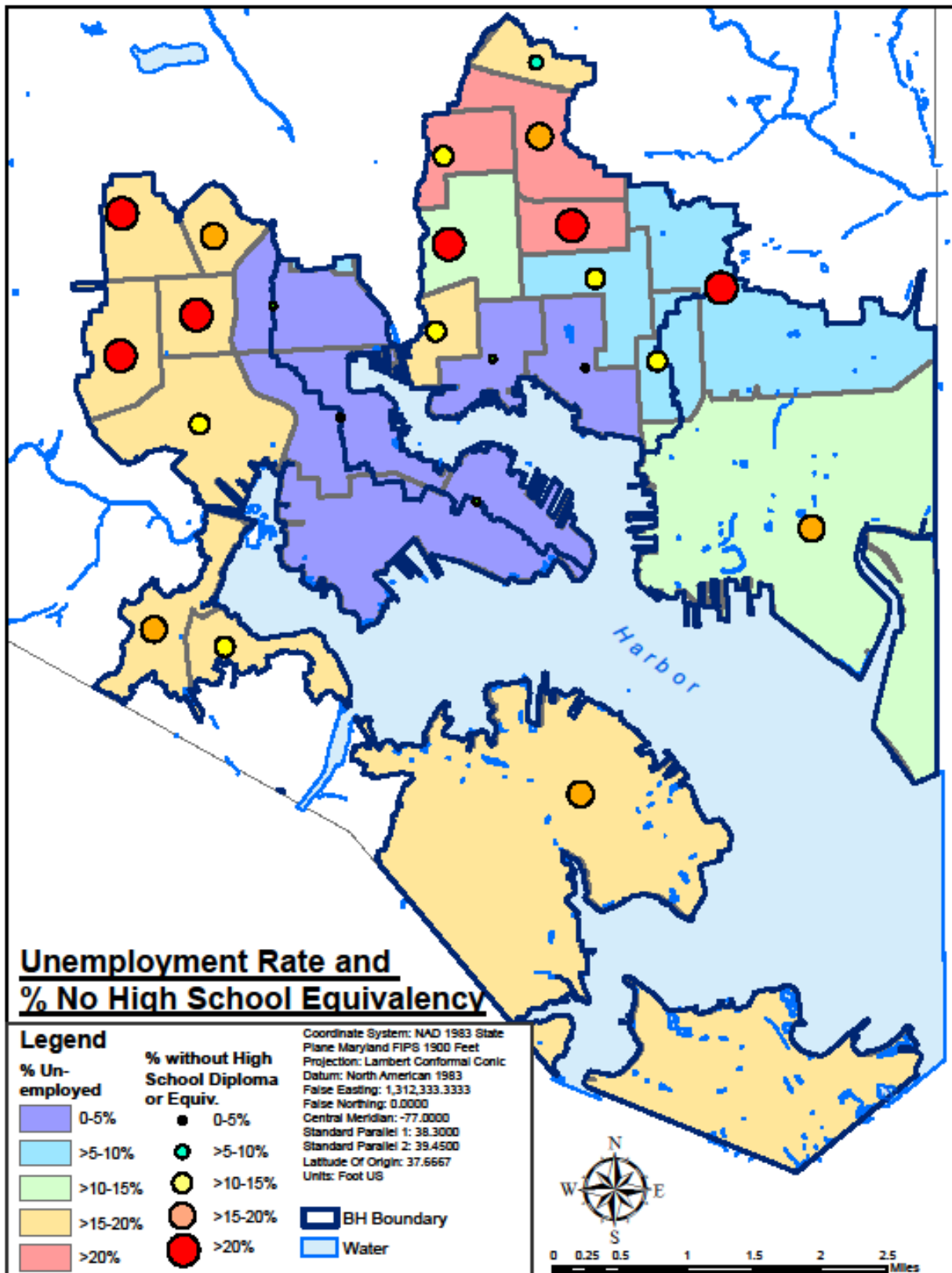*Figure 4-12 Stakeholder Coordination Areas and Initiatives - SW Harbor Subwatershed*

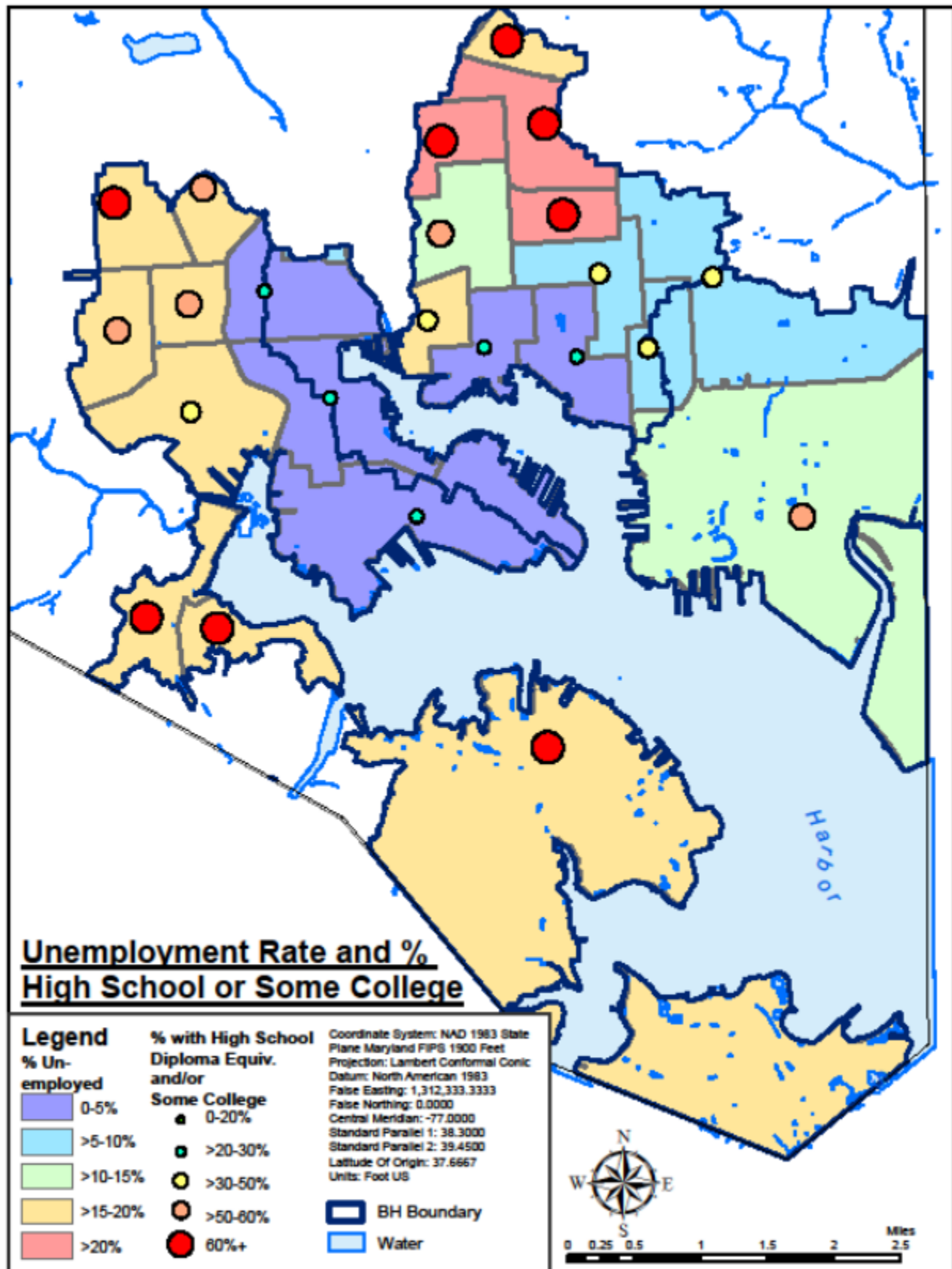*Figure 4-13 Unemployment Rate no HS Equivalency*

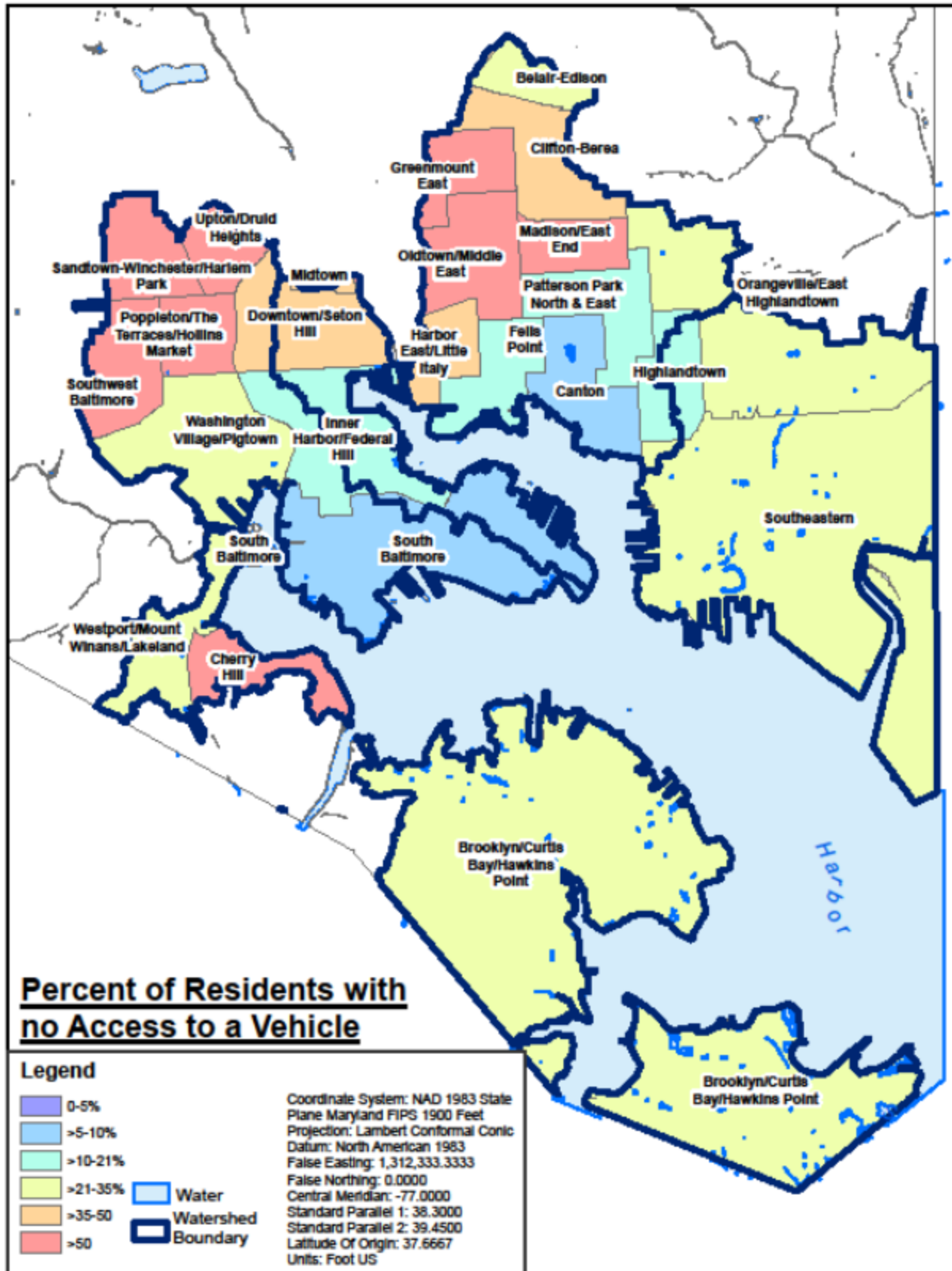*Figure 4-14 Unemployment Rate HS and some College*

Figure 4-15 Percent of Residents with No Access to a Vehicle

Table 4-5 contains a summary of the watershed resources and stakeholder coordination initiatives identified in Figures 4-9 through 4-14. Resources that represent discrete point locations were summarized using a number. Large zones or linear resources are indicated by an "X" when present. Land use and impervious area are indicated by a percentage of the CSA or acres as indicated. This table was used to inform the opportunities identified in Section 5 of this report.

Table 4-5 Watershed Resources and Opportunities Summary Table-Inner Harbor – Priority CSA's

Criteria	P1 - Madison East End	P1 - Harbor East / Little Italy	P2 - Clifton/Berea	P2 – Oldtown / Middle East	P2 – Midway / Coldstream [6]	P2 – Downtown / Seton Hill
			Inner Harbor			
Green Network Community Corridor	X	X	X	X		
Green Network Nature Corridor						
Green Network Priority Corridors	X	X	X	X		
Green Network Community Nodes			1			1
Green Network Nature Nodes						
Green Network Planned 2019						
School (or 1/4 mile radius)	5	6	6	7	1	1
Inspire School (or 1/4 mile radius)	1		1	1		
School ILS Restorative Practices (or 1/4 mile radius)						
School ILS Social Emotional Learning (or 1/4 mile radius)		1	1	1		
School ILS Literacy (or 1/4 mile radius)	1			1		
School - Green Healthy Schools 2017/2018 (or 1/4 mile radius)	2					
School GHG Multiple Years (or 1/4 mile radius)						
School - GHG - TMDL directly related (or 1/4 mile radius)	1					
School GHG - TMDL Tangentially Related (or 1/4 mile radius)						
VRI Zone	X		X			
B'more Beautiful	X		X	X		
Hospital				1	1	1
Planned 2018 DPW BMP's	6					
DOT Bumpouts						
Planned Bike Lane (more than sharrow/sidepath)	X	X	X	X	X	X
Planned multi-use trail						
Planned Bikelane (sharrow/sidepath)	X	X	X	X	X	X
Existing Bike Lane (more than sharrow/sidepath)	X	X	X	X	X	X
Existing multi-use trail						
Existing Bikelane (sharrow/sidepath)	X	X	X	X	X	X
High crash intersections						5
Major Redevelopment Area (DCHD)	X			X		
Neighborhood Subcabinet Area (DCHD)			X	X		

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[6] Very small total land area, will be addressed as part of the Downtown/Seton Hill restoration efforts.

Criteria	P1 - Madison East End	P1 - Harbor East / Little Italy	P2 - Clifton/Berea	P2 – Oldtown / Middle East	P2 – Midway / Coldstream [7]	P2 - Downtown/ Seton Hill
Commercial District	10.2%	49.7%	8%	10.6%	57.4%	99.9%
High Density Residential	70.7%	28.1%	58.6%	42.3%		0.02%
Low Density Residential		11%	4%		30.8%	
Institutional	5%			25.1%		
Mixed Use			3.8%			
Office				3.9%		
Industrial	4.6%	3.9%	10.4%	1.7%		
Open Space	9.4%	2.3%	9.9%	1%	11.8%	
Home Ownership >50%						
Home Ownership <50%	23.1%	37.3%	30.6%	37.9%	34.5%	39.5%
Elig. Imperv on Public Property (Ac)	7.5	22	21.7	26.8	0.02	6.6
Elig. Imperv on Private Property (Ac)	65.9	77	116.5	122.8	2.4	21.8
Elig. Imperv on Right of Way (Ac)	52.4	65	78.2	68.5	3.8	39

Table 4-6 Watershed Resources and Opportunities Summary Table - Middle Branch, Patapsco, and SW Harbor Priority CSA's

Criteria	P1 - Sandtown Winchester / Harlem Park	P1 – Poppleton / Hollins Market	P2 - Washington Village	P1 Southeastern	P2 - Orangeville	P1 –Brooklyn / Curtis Bay / Hawkins Point
	Middle Branch			Patapsco		SW Harbor
Green Network Community Corridor	X	X	X	X	X	X
Green Network Nature Corridor				X		
Green Network Priority Corridors	X	X	X	X	X	X
Green Network Community Nodes	4		1		2	
Green Network Nature Nodes			1			
Green Network Planned 2019	1					
School (or 1/4 mile radius)	3	4	4	3	3	4
Inspire School (or 1/4 mile radius)				1	1	1
School ILS Restorative Practices (or 1/4 mile radius)				1		1
School ILS Social Emotional Learning (or 1/4 mile radius)		1				1
School ILS Literacy (or 1/4 mile radius)	2				1	
School - Green Healthy Schools 2017/2018 (or 1/4 mile radius)	3	1	3	1	2	1
School GHG Multiple Years (or 1/4 mile radius)		1	1			
School - GHG - TMDL directly related (or 1/4 mile radius)	1	1	1	1	2	1
School GHG - TMDL Tangentially Related (or 1/4 mile radius)						

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[7] Very small total land area, will be addressed as part of the Downtown/Seton Hill restoration efforts.

Criteria	P1 - Sandtown Winchester / Harlem Park	P1 – Poppleton / Hollins Market	P2 - Washington Village	P1 - Southeastern	P2 - Orangeville	P1 -Brooklyn/ Curtis Bay /Hawkins Point
	Middle Branch			**Patapsco**	**SW Harbor**	
VRI Zone	X					X
B'more Beautiful	X	X	X		X	X
Hospital						X
Planned 2018 DPW BMP's	8	1	3			5
DOT Bumpouts						
Planned Bike Lane (more than sharrow/sidepath)	X	X	X	X	X	X
Planned multi-use trail	X	X	X	X	X	X
Planned Bikelane (sharrow/sidepath)	X	X	X			
Existing Bike Lane (more than sharrow/sidepath)	X	X				X
Existing multi-use trail						
Existing Bikelane (sharrow/sidepath)	X					X
High crash intersections						
Major Redevelopment Area (DCHD)		X		X		
Neighborhood Subcabinet Area (DCHD)		X	X			
Commercial District	0.0	0.1	0.3	0.1	0.1	0.0
High Density Residential	0.9	0.8	0.2		10.7	0.0
Low Density Residential	0.0	0.0		0.1	0.1	0.1
Institutional					0.1	
Mixed Use			0.0	0.0	0.1	0.0
Office		0.0		0.0	0.0	0.0
Industrial	0.0	0.0	0.4	0.7	0.4	0.8
Criteria	0.0	0.0	0.1	0.0	0.1	0.0
Open Space				0.6		0.5
Home Ownership >50%	0.3	0.3	0.4			0.4
Home Ownership <50%	33.6	15.2	25.4	24.8	11.8	60.0
Elig. Imperv on Public Property (Ac)	62.9	47.7	164.5	315.4	199.4	430.0
Elig. Imperv on Private Property (Ac)	61.0	51.2	93.6	219.5	142.4	271.6
Elig. Imperv on Right of Way (Ac)	X	X	X	X	X	X

5   Stormwater Best Management Practices

Best Management Practices (BMPs) are defined as the practice or combination of practices that are determined to be the most effective, practicable means of preventing or reducing the amount of pollution generated by point and nonpoint sources to a level compatible with water quality goals. In this assessment BMPs also include those practices that meet the Secondary Goals (co-benefits) identified in Section 2.9.

To best organize this diverse suite of practices, we have divided stormwater BMPs into three categories:

1. **Projects** – capital projects like stormwater ponds, bio-swales, rain gardens, impervious surface removal, and reforestation resulting in a definable asset. DPW will either be the lead for the installation of these projects and/or work in collaboration with other city agencies and the school system to provide capital funding.

2. **Programs** – DPW support services and operations, including street and proactive inlet cleaning, inspections, and public outreach and education.

3. **Partnerships** –BMPs that are installed by the public, private and non-profit sectors, whether as a requirement for development, projects by environmental non-profits or stormwater fee credits. Partnerships can also include public education, engagement, and initiatives that address co-benefits such as health and equity..

5.1   Projects
Projects consist of two types: Environmental Site Design (ESD) Practices, and Alternative BMPs. While restoration projects can also include stream restoration and Traditional BMPs like ponds, they are not included in this assessment because there are few to no opportunities for these types of practices in the watershed.

5.1.1   Environmental Site Design (ESD)
ESD Practices, sometimes called green stormwater infrastructure (GSI), are small stormwater facilities that typically treat 1/2 acre or less, including micro-bioretention, rain gardens, downspout disconnects, and green roofs.   Given the small size of these practices, they fit well into Baltimore's urban environment of streets, parking lots, small parks, and school grounds. There are opportunities for incorporating ESD practices into complete and green street projects and on school grounds where they can be used for environmental education. Smaller practices like rain gardens and downspout disconnect are applicable on residential and institutional property. Unfortunately, these practices can be expensive to install, limited by existing conduits, utilities, and soil conditions, and conflict with right-of-way needs like on-street parking or community acceptance.

5.1.2   Alternative BMPs
Alternative BMPs, as outlined in MDE's "Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated" guidance document, include impervious surface removal and greening, and reforestation. Impervious surface removal and greening projects have been undertaken at several schools and parks throughout Baltimore. There are opportunities for removing impervious surfaces and installing stormwater BMPs as part of the Baltimore City Public Schools' 10-Year Plan.

Reforestation and tree planting efforts coincide with the City's TreeBaltimore Program. The Department of Recreation and Parks manages this program to meet the City's goal of 40 percent tree canopy cover. This effort in turn supports Baltimore's plans for increasing sustainability, improving surface water quality, and minimizing stormwater runoff. Locations will target TreeBaltimore's Priority Planting Areas, which were identified as neighborhoods with minimal tree canopy, high heat island index, high asthma rates, and large amounts of impervious surfaces.

5.1.3   Existing / Proposed Stormwater Management Facilities
Per Title 4, Subtitle 3, of the Environment Article of Annotated Code of Maryland, management of

stormwater runoff is required to reduce erosion, sedimentation, pollution, and flooding (MDE, 2010). Increased importance of water quality and water resource protection has led to the development of the Maryland Stormwater Design Manual to provide Best Management Practice (BMP) design standards that promote a general shift toward low-impact SWM practices that mimic natural hydrologic processes and achieve pre-development conditions. The latter is evident by the Maryland Stormwater Management Act of 2007 which requires that Environmental Site Design (ESD) be implemented to the MEP via nonstructural BMPs and/or other innovative design techniques.

Table 5-1 summarizes the number of various types of SWM facilities in each SUBWATERSHED. The SWM facilities are categorized by those constructed pre 2010, post 2010, and proposed (MS4 projects). Figure 5-1 shows the distribution of these SWM facilities within the planning area. The MS4 projects consist of various micro-bioretention practices located in the ROW and bio-retention facilities on public housing property and on school property. Construction is scheduled for 2019.

Table 5-1 Existing and Proposed BMPs (ESD and Alternative)

Facilities	Inner Harbor	Middle Branch	Patapsco	Southwest Harbor
Pre 2010	12	15	35	30
Post 2010	60	19	19	15
Proposed MS4	14	21	4	6

One of the strategies of the City's MS4 WIP was to "identify more projects than are needed", recognizing that field conditions and property ownership might impact the feasibility of projects. Figure 5-2 illustrates projects that were determined to be "Not Feasible" due to either a conflict (such as utilities) or they did not receive approval by the agency responsible for the property. Additionally, there were a number of projects that were listed in the WIP but were determined to be not cost-effective for DPW to install during this Permit period (typically <0.2 IA treated)or had no feasibility study prepared. These are listed as "Identified". These projects offer opportunities to revisit them in the future, as well as be installed by an entity other than DPW.
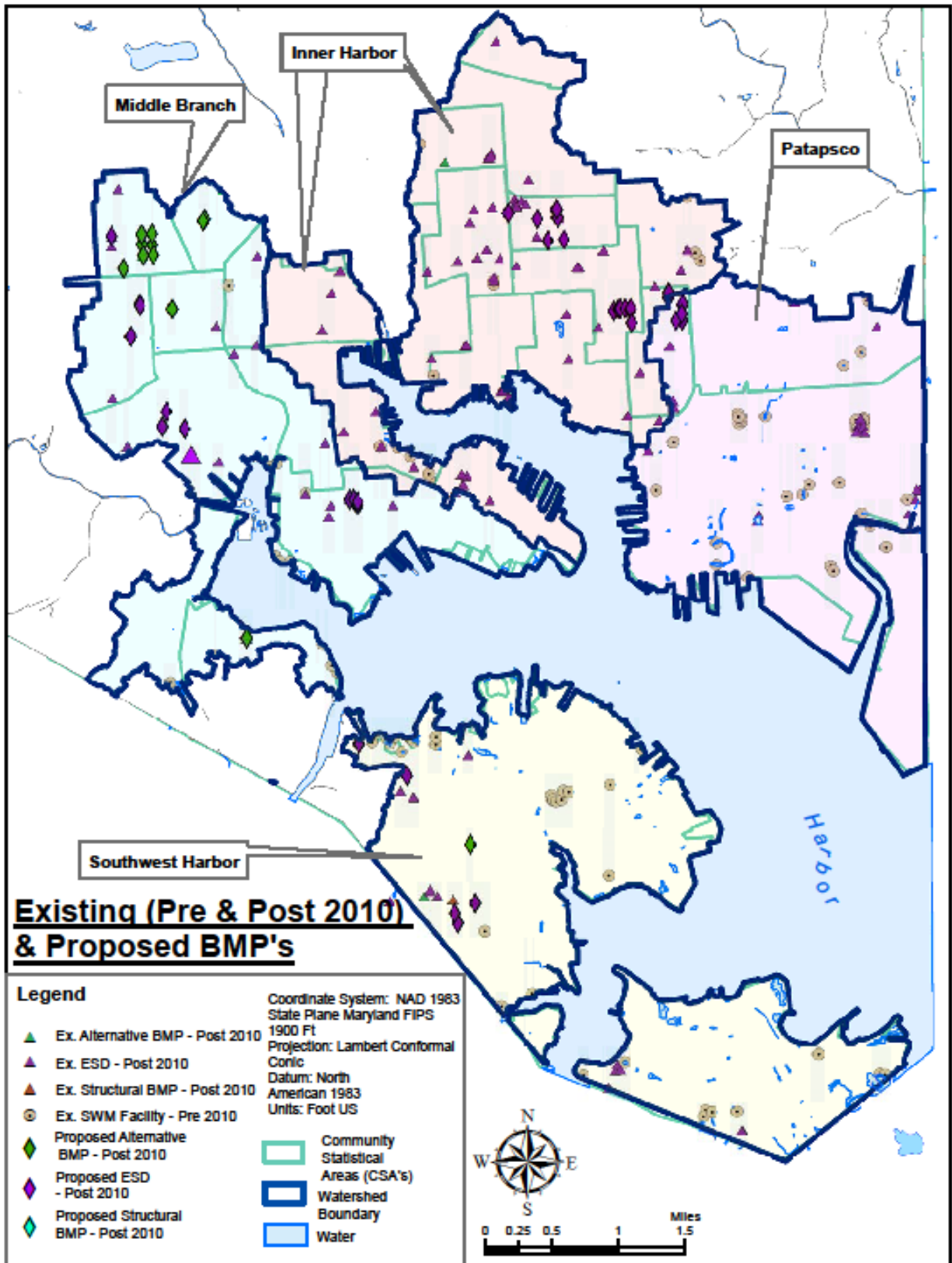
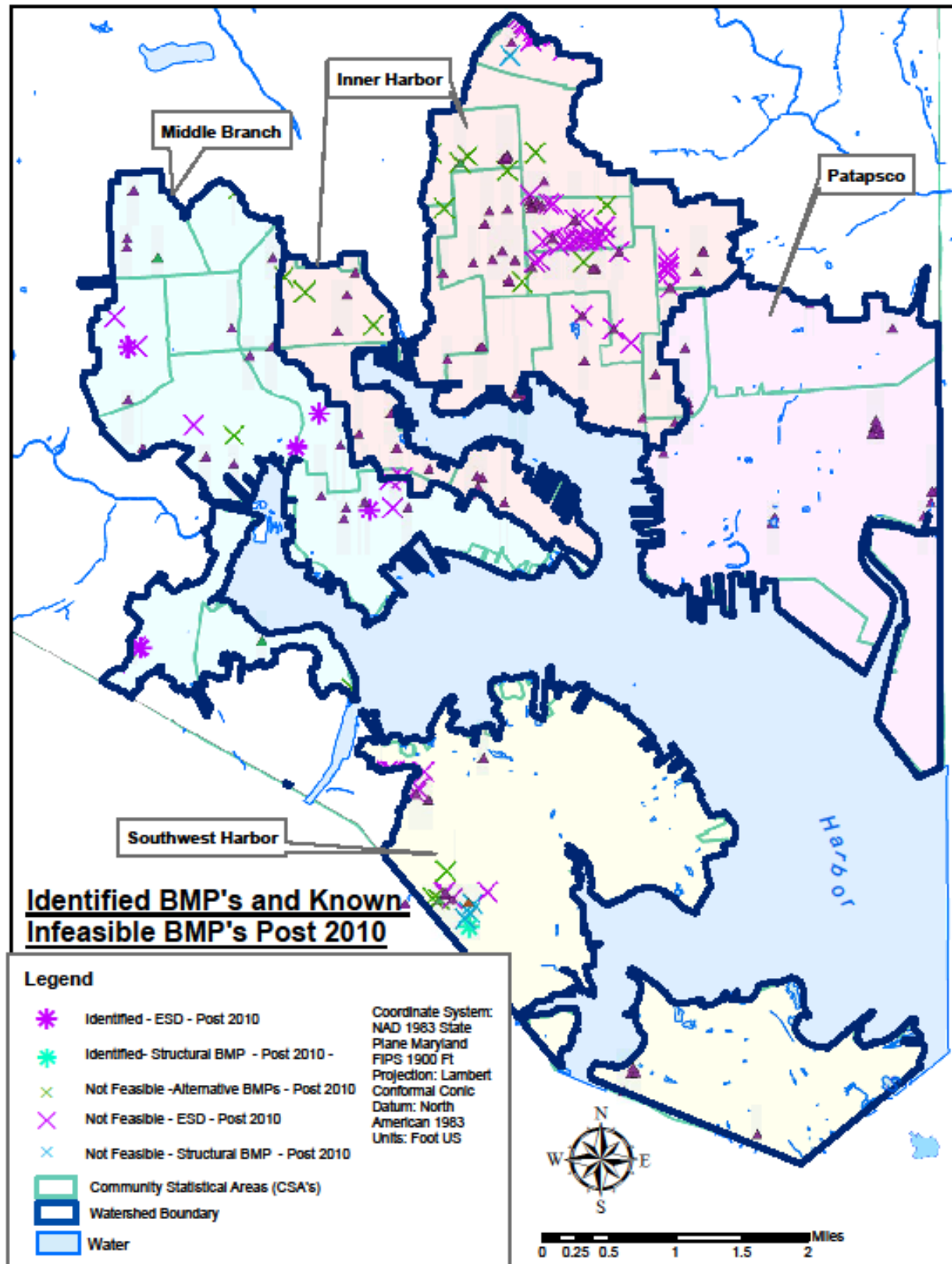*Figure 5-1 Existing and Currently Proposed BMP's*

Figure 5-2 Previously Identified but Infeasible BMP's

5.2 Programs

Programs represent those practices that are municipal services undertaken by the Department of Public Works or in partnership with other agencies.

5.2.1 Street Sweeping

In April of 2014, DPW launched a citywide mechanical street sweeping program, covering neighborhoods which previously had no service or scattered, inefficient service. Instead of sweeping only the Central areas of the City and some of our main commuter routes, all neighborhoods are now being reached using a fleet of 36 vehicles. Those additional neighborhoods are divided into a quadrant system; the LNBP is located in the Southwest Quadrant. The quadrant areas of the city are swept monthly. These routes do not have posted parking restrictions; residents are asked to cooperate in the street sweeping effort by following the schedule when parking and move their cars on the designated sweeping days.

5.2.2 Trash Collection

In addition to the City's Municipal Can and Single Stream recycling programs, two additional collection programs have been initiated in the watershed. In June of 2018, fifteen new all-terrain litter vehicles (ATLVs) were added to DPW's street cleaning fleet. These collection vehicles will allow DPW to expand cleaning operations in nineteen Business Districts and traffic gateways business districts throughout Baltimore, including Patapsco and Hanover Streets in Brooklyn.

In September 2018, several "Smart Cans" were installed at the Cherry Hill Town Center. Smart Cans have numerous advantages over the simple round bins seen on many street corners. Their enclosed construction confines litter better, and helps keep rodents away. Additionally, the cans compact the trash to keep litter from overflowing. Sensors in the cans transmit data to let DPW's Bureau of Solid Waste know they are getting full, and supervisors can schedule pickups as they are needed. This first phase of the Smart Can rollout is a pilot that will be used to confirm the best ways to operate the program in other neighborhoods, business districts and, ultimately, bus stops.

5.2.3 Preventive cleaning of catch basins and debris collectors

In 2015, approximately 760 storm drain inlet screens and inserts were installed in five neighborhoods – McElderry Park, Baltimore-Linwood, Oliver, Franklin Square, and Carrollton Ridge. All of the neighborhoods, except for Carrollton Ridge, are located in the Baltimore Harbor watershed. The purpose of these screens is to allow stormwater to pass through while keeping trash out, which will also reduce the number of clogged storm drains (for storm events of greater than 1" rain, the screens are designed to open so as to prevent flooding). If the pilot is successful, then additional neighborhoods will be added to the CIP program.

In conjunction with the installation of the storm drain inlet screens, DPW initiated a proactive catch basin and debris collector cleaning program. Using 3-1-1 "hot spot" information, DPW will also target problematic storm drains and catch basins and clean these on a regular schedule.

5.2.4 Illicit Discharge Detection and Elimination (IDDE) program[8]

DPW's Office of Compliance and Laboratories (OCAL) is responsible for monitoring the quality of the streams and Harbor in the City of Baltimore. It uses ammonia screening (AS) as a water quality monitoring program designed to rapidly identify potential pollutants with the intent to initiate pollution source tracking (PST).[9] There are seven stream impact sampling (SIS) stations within the watershed:

- Linwood & Elliott
- Lakewood & Hudson

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[8] The Chesapeake Bay Program and MDE have not quantified the benefit in relation to impervious restoration at this time.
[9] The AS program is an alternative methodology to the prescribed sampling listed in the City's NPDES MS4 permit for Illicit Discharge Detection and Elimination (IDDE).

- Central & Lancaster
- Light St.*
- Warner & Alluvion*
- Waterview Ave.*
- Janey Run*

All of the stations sample for various pollutants, including Nitrogen, Phosphorus, Metals, Enterococci, and Total Suspended Solids. Four of the stations (with asterisk) also sample for ammonia, which is used to identify sanitary discharges, drinking water system leaks, and chemical spills.

5.2.5   Erosion and sediment control practices[10]

In 2013, Baltimore City adopted new legislation for erosion and sediment control (Baltimore City Code, Article 7). The legislation updates the City's erosion and sediment control law, provides clear guidance to developers and property

Figure 28: Stream Impact Sampling (Source: Van Sturtevant)

owners, and provides additional authority to enforce violations. Also, the City has a 3-1-1 Service Request category allows citizens to report any erosion problems, whether construction sites, street work, or from private properties.

5.2.6   Public Education and Engagement [11]

DPW recognizes that meeting the City's MS4 and TMDL requirements cannot be done solely by government – residents, faith organizations, schools, and businesses each play a role. DPW provides various types of educational material at public events, community meetings, through social media, and on its website (https://publicworks.baltimorecity.gov/). Information ranges from how to properly dispose of household hazardous waste, reducing pesticide and herbicide use, installing stormwater Best Management Practices, recycling tipsheets, and various stormwater fee credit programs. Specifically, DPW's Community Liaison program provides information to communities within the area on DPW initiatives, attends community meetings, and serves as a conduit for citizen complaints and concerns. While covering the breadth of DPW services, the Community Liaisons also work with DPW's Watershed Planning + Partnership Section and the Office of Engineering and Construction to schedule community meetings regarding MS4 and TMDL projects.

5.3   PARTNERSHIPS

Improving both water quality and quality of life in the LNBP watershed will require a collaborative effort among multiple stakeholders, including city agencies, non-profit organizations, community partners, and the private sector. The following is a summary of key stakeholders, both city-wide and within the LNBP watershed, and the role that they play.

5.3.1   Baltimore City Government Stakeholders

Department of Public Works (DPW)

The Department of Public Works (DPW) is primarily responsible for the planning, implementing, maintaining, monitoring, and reporting of projects and programs related to meeting Bay and local TMDLs. Further descriptions of the DPW divisions are as follows:

Office of Compliance and Laboratories (OCAL)

The OCAL is responsible for planning, coordination, monitoring, and reporting for the MS4 permit including TMDL's. This includes maintenance of GIS information related to planned and completed Stormwater

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[10] See footnote 30.
[11] See footnote 30.

management facilities, overseeing stormwater management and erosion and sediment control for all developments, surface water quality monitoring, Illicit discharge detection and elimination (IDDE) program, and hot spot investigations. OCAL develops Watershed Assessments and Watershed implementation plans for submittal to MDE and coordinates partnership development and community engagement activities.

Office of Engineering and Construction (OEC)
OEC is responsible for the implementation of the capital projects planned by OCAL, including the design and construction of stormwater management facilities and the coordination of Baltimore City and other utility capital improvement projects.

Office of Asset Management (OAM)
The OAM is responsible for inventory, condition assessment, and maintenance of all DPW assets, including green stormwater infrastructure, preventative maintenance of stormwater facilities and inlet cleaning. OAM also maintains GIS information related to the storm drain system.

Bureau of Water and Wastewater / Wastewater Facilities Division
The Bureau of Water and Wastewater - Wastewater Facilities Division is responsible for inspection and enforcement to ensure compliance with water quality discharge standards for NPDES industrial permits in Baltimore City. They provide operation of ENR upgrades at wastewater treatment plant, and manage the fats, oil, and grease (FOG) inspection and abatement program.

Bureau of Solid Waste
The Bureau of Solid waste is responsible for trash pick-up and disposal, mechanical street and alley sweeping, vacant land management, rat abatement, recycling education and outreach, and the operation of solid waste facilities under NPDES industrial permit.

Community Liaison program
Provides information to communities within the area on DPW initiatives, attends community meetings, and serves as a conduit for citizen complaints and concerns. See Section xx-xx.

Other City Agencies
Various city agencies do work that intersects with watershed management and stewardship, and are important to engage during the planning, outreach and engagement, implementation, and assessment of stormwater projects and programs. The following are some of the city agencies doing aligned work, and a description of how their work relates to watershed restoration.

Department of Planning (includes the Office of Sustainability)
The Department of Planning develops plans to guide redevelopment within Baltimore City. It includes the Office of Sustainability, Comprehensive Planning Land Use and Urban Design, and Research and Strategic Planning. They manage regulated sensitive environmental areas including the Critical Area Management Program and the Floodplain management program and disaster preparation related to climate change. They also have developed long term development plans for Baltimore including the Green Network Plan.

The Department of Planning has recently taken steps to increase its focus on equity and equitable and meaningful community engagement related to planning for Baltimore's future development. This has included engaging residents across Baltimore in visioning sessions, which have resulted in plans that can be used to prioritize areas for implementation of green stormwater infrastructure and other restoration efforts.

Environmental Control Board
Coordinates the Bmore Beautiful program in the Cherry Hill and Brooklyn neighborhoods.

Baltimore City Public School System
The school system is responsible for facility planning, building renovations, and new construction (21st Century School Initiative). They also coordinate with the Planning Department on the INSPIRE Schools program.

Additionally, BCPSS works with schools to integrate the Maryland Environmental Literacy Curriculum into classrooms.

Health Department
The mission of the Health Department is to protect health, eliminate disparities, and ensure the well-being of every Baltimorean through education, advocacy, and direct service delivery. Many of the Health Department's programs and priority areas also align with co-benefits offered by green stormwater infrastructure, including mosquito control/ponding water, outreach and partnerships around healthy environments, heat related illness, and office of youth violence.

Department of Recreation and Parks
Recreation and parks is responsible for all public parks in Baltimore City. The Department also coordinates waterway recreation programs and education & outreach for nature and environmental initiatives. Additionally, the Forestry Division coordinates TreeBaltimore, a collaboration of city agencies, non-profit organizations, and community groups with the goal to increase the City's tree canopy.

Baltimore Department of Housing Community Development
Baltimore Housing is responsible for most of the city-owned vacant properties in Baltimore, and manages its acquisition and disposition through the Vacants to Value program. The department also works in partnership with the MD Department of Housing and Community Development and the Maryland Stadium Authority to demolish thousands of vacant buildings to serve as a catalyst for redevelopment and reinvestment.

Department of Transportation
The department is responsible for the City's road ways, footways, and alley ways as well as transportation planning. This includes Complete Streets program and planning, the Bike Baltimore program, and coordination with MTA and public transit programs.

Department of General Services
The Department of General Services manages and maintains many City owned properties, including fire stations, police stations, and libraries. They are also responsible for the design and construction of new facilities and existing building renovations.

Mayor's Office of Employment Development
The Mayor's Office of Employment Development (MOED) coordinates and directs workforce development initiatives responsive to the needs of Baltimore City employers and job seekers in order to enhance and promote the local economy. MOED is a potential partner for workforce development programs. MOED is currently a partner with DPW on the YH2O internship program, and potentially a partner for other workforce development programs.

Baltimore Development Corporation
The Baltimore Development Corporation (BDC) is a non-profit organization, which serves as the economic development agency for the City of Baltimore. Its mission is to retain and expand existing businesses, support cultural resources, and attract new opportunities that spur economic growth and help create jobs. BDC is a potential partner for incentive programs with businesses and commercial properties.

5.3.2   Non-government Organizations (NGOs) - City Wide
Baltimore is fortunate to have a number NGOs that have been active in addressing stormwater issues, providing education, advocacy, and project implementation.

Baltimore Tree Trust
The mission of the non-profit Baltimore Tree Trust (BTT) is to make Baltimore a greener and healthier place to live by restoring Baltimore's urban forest through increased tree planting, community engagement, and advocacy. BTT has been worked and is currently working in three neighborhoods within the watershed – McElderry Park, Berea, and Broadway East.

Blue Water Baltimore
Blue Water Baltimore's (BWB) mission is to restore the quality of Baltimore's rivers, streams and harbor to foster a healthy environment, a strong economy, and thriving communities. BWB runs several programs, including the Water Audit program (installation of residential stormwater practices), Blue Water Congregations (faith-based communities), Baltimore Harbor WaterKeeper, and Storm Drain Art program. BWB recently worked with the Cherry Hill community to create a Deep Blue Plan that identified opportunities for green stormwater infrastructure projects on private property. BWB is also working with MedStar Harbor Hospital to install green infrastructure on the hospital property and educate staff about various green and sustainable practices.

Chesapeake Bay Trust
Chesapeake Bay Trust (CBT) is a funding organization that supports various types of education, outreach, and restoration projects. DPW provides funding to CBT for its Outreach and Restoration grant program to support NGOs providing environmental education and installing green infrastructure in Baltimore.

Civic Works / Baltimore Center for Green Careers
Civic Works' mission is to strengthen Baltimore's communities through education, skills development, and community service. One of their programs is the Baltimore Center for Green Careers. The Center is dedicated to the creation of business and employment development initiatives that contribute to environmental sustainability and are open to all Baltimore job seekers. One of its workforce development programs provides green stormwater infrastructure installation and maintenance training to residnets located in underserved communities like many located within the watershed.

Interfaith Partners for the Chesapeake
Interfaith Partners for the Chesapeake (IPC) educates, supports, and inspires people and communities of faith to advocate for the waters of the Chesapeake through policies and practices that promote a healthier environment and healthier people. IPC provides outreach, educational information, and training, and works in partnership with Blue Water Baltimore to help congregations conduct water audits and develop green stormwater infrastructure projects.

National Aquarium
National Aquarium is a nonprofit aquatic education and conservation organization whose mission is to inspire conservation of the world's aquatic treasures. The National Aquarium provides education, school programs, and community engagement. The National Aquarium is located along the Inner Harbor.

Parks & People Foundation
The Parks & People Foundation (PPF) works to unite Baltimore by ensuring that everyone is connected to nature, their community and each other through vibrant parks and green spaces. They provide community greening grants, environmental education programming, and workforce development through Branches, a year-round green careers internship and summer jobs program for Baltimore City high school youth. PPF also installs green stormwater infrastructure projects as part of its park restoration projects. PPF is also leading the effort to create a masterplan for the Middle Branch, which will include goals for environmental restoration and improved water quality.

Trash Free Maryland
Trash Free Maryland is a nonprofit organization focused on lasting change to prevent trash pollution. They bring together organizations, businesses, government agencies and decision makers, and individuals committed to reducing trash in Maryland's environment. Trash Free Maryland also works to prevent litter from happening in the first place by supporting various anti-litter policies and programs. Trash Free Maryland has been coordinating a "Trash Free Baltimore Coalition" whose goal is to coordinate and support efforts with social marketing, community clean-ups, and letter research.

5.3.3   NGOs - Watershed Specific

Baltimore Casino Local Development Council (BCLDC)
BCLDC is comprised of business owners, residents and community leaders, and major institutional representatives in the communities surrounding the Casino, including Cherry Hill. The Council has three primary roles consultation on the expenditures of the local impact funds, review of the Casino licensee's master plan for the development of the Casino, and consultation on transportation planning.

Baltimore Industrial Group
The Baltimore Industrial Group (BIG) was established by public and private business organizations in the Baltimore metropolitan region to advocate for industry and maritime operations. The group represents an array of businesses involved in manufacturing, transportation, maritime, shipping and warehousing, including many located in the Patapsco and Southwest Harbor subwatersheds.

Downtown Partnership of Baltimore
The mission of the Downtown Partnership is to promote the downtown as a place to work, live, shop, and eat. The Partnership oversees the Downtown Management Authority (DMA), a business improvement district. Programs include managing several parks, providing trash and litter programs, and beautification efforts.

MedStar Harbor Hospital
Medstar Harbor Hospital is located in the Baltimore Harbor Watershed, but its service area overlaps mostly with the LNBP. As a non-profit hospital, it conducts community health needs assessments and invests in community benefits initiatives. Understanding their goals and planned projects will be critical for aligning efforts in a way that supports community benefits.

6th Branch
The non-profit 6th Branch builds community by bringing together service-minded veterans and civilians. They work with neighborhood leaders to transform vacant lots in east Baltimore, primarily in the Oliver and Johnston Square neighborhoods.

Southeast CDC
Southeast CDC is a community development corporation that promotes healthy, vibrant and diverse communities in Southeast Baltimore. Programs include community revitalization inbitiatives, real estate acquisition, community organizing, housing counseling, and beautification and greening activities, in particular around the Library Square area.

Southwest Partnership
The Southwest Partnership is a coalition of seven neighborhood associations and six anchor institutions in Southwest Baltimore, including Barre Circle, Franklin Square, Hollins Roundhouse, Mount Clare, Pigtown, Poppleton, and Union Square.

Various Community Associations
There are several dozen community associations in the Baltimore Harbor watershed. These groups are important for education and outreach activities, planning neighborhood-scaled implementation projects, and programs such as trash reduction and workforce development.

Waterfront Partnership
The Waterfront Partnership is a coalition of businesses dedicated to improve maintenance, beautification, and visitor services for the Waterfront. A key program of the Waterfront Partnership is the Healthy Harbor Initiative, which includes installing and managing two Water Wheel Trash Interceptors, coordinating the Greater Baltimore Oyster Partnership, planting floating wetlands, conducting water quality monitoring, and providing community engagement support for neighborhoods in the Harris Creek watershed in east Baltimore.

5.4 Opportunities - General

Given the ultra-urban nature of Baltimore, a diverse and comprehensive approach for meeting the various TMDL requirements and watershed management goals is needed. These strategies are based on the watershed characterization mapping, the suitability analysis, and opportunity areas, and are not listed in order of priority. Since there isn't one strategy for all watershed restoration, it is important that implementation of strategies needs to occur in tandem with each other.

1. Implement bioretention projects and tree planting in the ROW to create "green streets".

2. Implement ESD restoration projects at schools and parks, including impervious surface removal and tree planting.

3. Engage stakeholders in the planning process for public green stormwater infrastructure projects.

4. Develop a neighborhood restoration program targeted at homeowners that includes downspout disconnection, tree planting, storm drain stenciling, and proper lawn care.

5. Engage non-profits, faith organizations, and businesses to implement stormwater retrofits, pollution prevention practices, and public outreach and engagement.

6. Support educational, community health, and workforce development initiatives.

7. Strengthen stakeholder connections to watershed restoration efforts (Watershed Connections) through exploring traditional and non-traditional programs and partnerships aimed at increasing awareness of and amplifying human health co-benefits resulting restoration activities.

8. Expand existing trash reduction programs and partnerships.

Recommendations are provided for the Priority 1 and Priority 2 CSAs within each subwatershed. Opportunities within these subwatersheds will be explored first. If additional areas are needed in the next permit cycle, the next highest priority CSA's will be explored following the same methodology demonstrated in this document.

5.4.1 Projects / Programs / Partnerships

Table 5-2 contains a list of suitable project types, programs, and partnerships for use within the Baltimore Harbor watershed, the criteria for where these are considered most suitable, and the potential partnerships to be engaged. The plus signs (+) are positive criteria, while the negative sign (-) represent limitations.

Table 5-2 Criteria for identifying Projects / Programs / Partnerships

PROJECTS		
BMPs	**Criteria for priority locations**	**Partner**
Bioretention / Rain Gardens – General Conditions	+ Impervious surface / adjacent + A and B soils + Slopes <5% + Near a storm drain + Baltimore Green Network + Community Benefits areas	See Below
ESD practices - Right of Way (ROW)	+ Complete Streets plan + DOT CIP project - Bus stop - Fire hydrant	• DPW • DOT • Local community groups

BMPs	Criteria for priority locations	Partner
ESD practices - Schools	+ ¼ miles of an INSPIRE school + Existing Green Team + CASEL	• DPW • BCPSS • Office of Sustainability • Planning
ESD practices - Parks / city-owned property	+ Adjacent to impervious surface + Near a storm drain - Active recreation field - Recent tree planting	• DPW • BCRP • Baltimore Housing • Planning / BOS • Parks & People Foundation • DGS
Alternative BMPs – General Conditions	+ Impervious surface + ¼ miles of INSPIRE school	See Below
Impervious removal	+ Impervious surface + Schools / parks	• DPW • BCPSS • BCRP
Tree planting	+ UTC Priority Planting Map + Open tree pits + Available space (new pits)	• DPW • BCRP Forestry • TreeBaltimore
PROGRAMS		
SMART Cans	+ Commercial areas + Bus stops	• DPW • Main Street / business associations • MTA • LDC
Street Sweeping (expansion)	+ Clogged drain SRs + Dirty streets and alleys SRs	• DPW
Proactive Inlet Cleaning	+ Clogged storm drains	• DPW
IDDE	+ Monitoring locations + SR complaints	• DPW • Environmental NGOs
PARTNERSHIPS		
Watershed Connections (Public Education, engagement, and programs aimed at strengthening stakeholder connections to watershed restoration efforts)	+ Hospital Community Benefits areas + Schools + Faith Organizations + Community-based groups with environmental focus + Areas focused on violence reduction + CASEL schools	• MedStar Hospital • BCPSS • IPC • BWB • National Aquarium • Health Department

BMPs	Criteria for priority locations	Partner
Incentive Programs - BMPs - Programs	+ Commercial land use + NSFP + Low / Medium Density Housing	• IPC • BWB • BDC • Catholic Charities
Workforce Development	+ High unemployment	• MOED • BCGC • NGICP • Parks & People Foundation • Blue Water Baltimore
Anti-Litter Campaign	+ Commercial areas (concentration of take-out food establishments) + Dirty street / alley SRs + Clogged drain SRs	• Envir. Control Board • Trash Free Maryland • National Aquarium
Pet Waste Campaign	+ Dog Parks (formal and informal)	• Health Department • Envir. Control Board • Parks & People Foundation • Blue Water Baltimore

5.5 Opportunities by Priority Areas

5.5.1 Sub-Watershed Priority Area #1: Inner Harbor subwatershed

5.5.1.1 CSA Priority Area 1 - Madison East End

Madison East End scored in the highest priority based on health supportive communities and equity considerations, and was mid-priority in terms of physical feasibility. High levels of unemployment (>20%) and percentage of residents with no access to a vehicle (>50%) demonstrate that residents could benefit from workforce development opportunities associated with restoration activities, and prioritization of ESD near residential areas. Multiple opportunities for implementation and stakeholder engagement were identified including Green Network corridors, schools (including INSPIRE schools, and a school with a green team related to stormwater management), designation as an area focused violence reduction, and designation as a B'more beautiful neighborhood area. The CSA also contains several proposed and existing bike lanes, and has been identified as a potential area for private re-development. Most of the eligible impervious is on private property or the right of way, with very little on public property. The area is characterized mostly by renter-occupied high density residential uses, with some open and commercial spaces.

Recommendations include:

- Explore opportunities for bioretention projects and tree planting in the ROW to create "green streets", including within ¼ mile buffers of INSPIRE schools and associated pedestrian safety improvements.

- Explore opportunities for ESD installation and watershed connection programming at and around school areas, including INSPIRE schools and schools with green teams

- Explore opportunities for retrofit at areas schools

- Coordinate with schools on environmental education programs, in particular where ESD practices have been installed.

- Engage with B'more Beautiful on watershed connection based engagement and litter reduction efforts.

- Coordinate with the Planning Department on opportunities for ESD, alternative practices, and watershed connections outreach and engagement within and around Green Network corridors.

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, and potential bumpout locations.

- Explore Alternative BMPs like street tree planting.

- Provide education and outreach to homeowners and renters, including litter prevention, proper disposal of oils and grease, pet waste, downspout disconnect, and rainwater harvesting, as well as watershed connections outreach and engagement.

- Explore opportunities to cluster ESD and alternative practices like tree planting in areas where private developers are installing similar practices.
  Connect residents with existing green infrastructure workforce development programs, like YH2O and the Baltimore Center for Green Careers.

- Explore workforce development / green jobs for maintenance of ESD practices installed in the area.

- Provide education and outreach to homeowners and renters, in particular on watershed health activities they can do on private property (i.e. litter prevention, proper disposal of oils and grease, pet waste, downspout disconnect, rainwater harvesting, lot greening etc.) and watershed connections outreach and engagement.

- Promote to homeowners/property owners incentive programs like ESD installation, and for homeowners and renters rain barrels, tree planting, and community clean-ups.

- Implement Phase 3 of the SMART Can program at local bus stops.

5.5.1.2   CSA Priority Area 1 - Harbor East / Little Italy

Harbor East/Little Italy also includes Jonestown and Perkins Homes public housing. It scored Priority 2 in equity and health supportive community analyses, and Priority 3 in the physical feasibility analysis. With an unemployment rate of 15-20% and 35-50% of residents with no access to a vehicle, residents could benefit from workforce development opportunities associated with restoration activities, and the prioritization of ESD near residential areas. Opportunities for implementation and stakeholder engagement include Green Network corridors, Schools (including schools participating in CASEL – social emotional learning curriculum). The CSA also contains several proposed and existing bike lanes. Most of the eligible impervious is on private property and ROW, with very little on non-ROW, City-owned property. The area is characterized mostly by commercial properties, followed by renter-occupied high density residential uses, with very little open space. Alternative BMP's and working with commercial property owners will be important in this area.

Recommendations include:

- Explore the feasibility of potential ESD practices in this area that have been identified in the MS4 WIP

- Explore Alternative BMPs like street tree planting.

- Explore opportunities for ESD installation and watershed connection programming at and around school areas, including schools participating in CASEL social and emotional learning.

- Coordinate with schools on environmental education programs, in particular where ESD practices have been installed.

- Coordinate with Baltimore City Housing and Community Development regarding opportunities for ESD , alternative practices, and watershed connections related outreach and engagement associated with the planned redevelopment of Perkins Homes.

- Connect residents with existing green infrastructure workforce development programs, like YH2O and the Baltimore Center for Green Careers

- Explore workforce development / green jobs for maintenance of ESD practices installed in the area. Coordinate with the Planning Department on opportunities for ESD, alternative practices, and watershed connections outreach and engagement within and around Green Network corridors.

- Explore outreach and incentive programs for commercial property owners.

- Implement Phase 3 of the SMART Can program at local bus stops.

5.5.1.3   *CSA Priority Area 2 - Clifton / Berea*

Clifton / Berea scored as a top priority CSA for physical feasibility and second for the equity and for health supportive communities analyses. Unemployment levels and access to a vehicle is consistent with Oldtown/Middle East, and similarly, residents could benefit from workforce development opportunities associated with restoration activities and the prioritization of ESD near residential areas.   Stakeholder engagement and implementation opportunities identified include Green Network corridors, schools (including two INSPIRE schools and one CASEL social emotional learning focused school). The area has been identified as a VRI zone and a Bmore beautiful neighborhood, so there are current efforts to engage neighbors around greening, trash clean-up, and violence reductions that create opportunities for aligning with restoration efforts. DHCD identified the CSA as a location where concentrated private development is projected to occur, and therefore achieving restoration goals in this CSA will be assisted in part by private re-development projects. The CSA also contains several proposed and existing bike lanes. The CSA is primarily high density residential. Although home ownership is under 50%, clusters of owner occupied homes are present. Most of the eligible impervious exists on private property, followed by within the public right of way, so residential and commercial partnerships will be important.

Recommendations include:

- Explore opportunities for ESD projects and tree planting in the ROW to create "green streets", including within ¼ mile buffers of INSPIRE schools aligning with the associated pedestrian safety and streetscape improvements.

- Explore opportunities for ESD installation and watershed connection programming at and around school areas, including INSPIRE schools and the CASEL school focused on social emotional learning.

- Explore opportunities for retrofits at area schools
  Provide education and outreach to homeowners and renters, in particular on watershed health activities they can do on private property (i.e. litter prevention, proper disposal of oils and grease, pet waste, downspout disconnect, rainwater harvesting, lot greening etc.) and watershed connections outreach and engagement.

- Promote to homeowners incentive programs like ESD installation; and to renters and home-owners rain barrels, tree planting, and community clean-ups.

- Explore opportunities to cluster ESD and alternative practices like tree planting in areas where private developers are installing similar practices.

- Coordinate with the Planning Department on opportunities for ESD, alternative practices, and watershed connections outreach and engagement within and around Green Network corridors.

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, and potential bumpout locations.

- Implement Phase 3 of the SMART Can program at local bus stops.

- Connect residents with existing green infrastructure workforce development programs, like YH2O and the Baltimore Center for Green Careers.

- Explore workforce development / green jobs for maintenance of ESD practices installed in the area.

- Engage with B'more Beautiful on watershed connection engagement and litter reduction efforts.

5.5.1.4   *CSA Priority Area 2 - Oldtown / Middle East*

Oldtown/Middle East scored Priority 2 in the health supportive community analysis, Priority 1 in the equity analysis, and Priority 3 in the physical feasibility analysis. With an unemployment rate of 10-15% and >50% of residents with no access to a vehicle, prioritization of ESD near residential areas and any associated potential workforce development programs could benefit this community.   Multiple opportunities for implementation and stakeholder engagement were identified including Green Network corridors, schools (including an INSPIRE school and another participating in CASEL – social emotional learning curriculum). The CSA also contains several proposed and existing bike lanes. Twice as much eligible impervious exists on private property as exists in the right of way, with very little on non-ROW public property; therefore engaging with private property owners is an important part of the restoration strategy. The area has been identified by DHCD as a location where concentrated private development is projected to occur, thus achieving restoration goals in this CSA will be assisted in part by private re-development. Much of the area is characterized by high density residential, with some institutional (Johns Hopkins Medical) and a small amount of commercial, with very little open space.

Recommendations include:

- Explore opportunities for ESD projects and tree planting in the ROW to create "green streets", including within ¼ mile buffers of INSPIRE schools aligning with the associated pedestrian safety and streetscape improvements.

- Explore opportunities for ESD installation and watershed connection programming at and around school areas, including INSPIRE schools and the CASEL school focused on social & emotional learning.

- Coordinate with schools on environmental education programs, in particular where ESD practices have been installed.

- Coordinate with the Planning Department on opportunities for ESD, alternative practices, and watershed connections outreach and engagement within and around Green Network corridors.

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, and potential bumpout locations.

- Explore Alternative BMPs like street tree planting.

- Provide education and outreach to homeowners and renters, in particular on watershed health activities they can do on private property (i.e. litter prevention, proper disposal of oils and grease, pet waste, downspout disconnect, rainwater harvesting, lot greening etc.) and watershed connections outreach and engagement.

- Explore opportunities to cluster ESD and alternative practices like tree planting in areas where private developers are installing similar practices.

- Connect residents with existing green infrastructure workforce development programs, like YH2O and the Baltimore Center for Green Careers.

- Explore workforce development / green jobs for maintenance of ESD practices installed in the area.

- Promote to homeowners/property owners incentive programs like ESD installation, and for homeowners and renters rain barrels, tree planting, and community clean-ups.

- Coordinate with the BHCD office regarding potential opportunities for ESD, alternative BMP's, and watershed engagement opportunities related to the Oldtown Redevelopment Plan.

- Explore opportunities for innovative Watershed Connections programming to promote and increase awareness of health-related co-benefits of restoration activities within the Johns Hopkins Hospital's Community Benefit Area.

- Implement Phase 3 of the SMART Can program at local bus stops.

5.5.1.5   CSA Priority Area 2- Midway Coldstream

The geographic area associated with Midway Coldstream within the Baltimore Harbor Watershed is only a few blocks. Most of this small area is within a commercial district. Restoration efforts in this CSA will be addressed as part of the restoration efforts for Downtown / Seton Hill (see below).

Recommendations include:

- Explore outreach and incentive programs for commercial property owners.

- Those opportunities identified within Downtown/Seton Hill

5.5.1.6   CSA Priority Area 2 - Downtown / Seton Hill

Downtown/Seton Hill scored as Priority 2 for physical feasibility, Priority 1 for the health supportive communities' analysis, and Priority 4 for the equity analysis. Unemployment levels are very low, so there is less of a need to prioritize siting of ESD and workforce development related outreach and engagement in this area as compared to others. Stakeholder engagement and opportunities include a Green Network community node, a school, and designation as a violence reduction focus area and a B'more beautiful neighborhood. There is an opportunity to engage neighbors around greening, trash clean-up, and violence reductions that align with restoration efforts. Five high pedestrian-involved crash intersections were identified in this CSA, where DOT will likely be doing work focused on pedestrian safety. The CSA also contains several proposed and existing bike lanes. Most of this CSA is commercial, with most eligible impervious within the right of way, followed by private, commercial property, and very little on open space. Due to the dense, urban nature of this area of the sub-watershed, opportunities for traditional BMP's in the right-of way may be constrained, so alternative practices and private land owner engagement will be important.

Recommendations include:

- Explore opportunities for ESD projects and tree planting in the ROW to create "green streets", within ¼ mile buffers the school.

- Explore Alternative BMPs like street tree planting.

- Implement Phase 3 of the SMART Can program at local bus stops.

- Coordinate with the Planning Department on opportunities for ESD, alternative practices, and watershed connections outreach and engagement within and around Green Network community node.

- Explore outreach and incentive programs for commercial property owners.

- Explore opportunities for ESD and alternative practices associated with the Downtown Open Space Plan, in coordination with Downtown Partnership.

- Explore opportunities for innovative Watershed Connections programming to promote and increase awareness of health related co-benefits of restoration activities within the Mercy Hospital's Community Benefit Area.

- Engage with B'more Beautiful on watershed connection based engagement and litter reduction efforts.

- Provide education and outreach to homeowners and renters, in particular on watershed health activities

they can do on private property (i.e. litter prevention, proper disposal of oils and grease, pet waste, downspout disconnect, rainwater harvesting, lot greening etc.) and watershed connections outreach and engagement.

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, and potential bumpout locations.

- Explore opportunities to work with Downtown Partnership to promote greening and engagement of property owners in restoration related activities.

5.5.2 Subwatershed Priority Area #2: Middle Branch subwatershed

5.5.2.1 *CSA Priority Area 1 - Sandtown Winchester / Harlem Park*

Sandtown Winchester / Harlem Park scored as Priority 1 for physical feasibility, Priority 3 for the health supportive communities' analysis, and Priority 2 for the equity analysis. High levels of unemployment (15-20%) and many residents with no access to a vehicle (>50%) demonstrate that residents could benefit from workforce development opportunities associated with restoration activities, and prioritization of ESD near residential areas. Extensive stakeholder engagement and other opportunities were identified including Green Network corridors and community nodes, three schools (all with green teams, one focused on a stormwater management related issue), and designation both as a violence reduction focus area and a B'more beautiful neighborhood. There is therefore an opportunity to engage neighbors around greening, trash clean-up, and violence reductions that align with restoration efforts. The CSA also contains several proposed and existing bike lanes and a multi-use trail. Most of this CSA is high density renter occupied residential, with equal amounts (Ac.) of eligible impervious within the right of way (61) and on private property (63), and 33 acres on city owned property.

Recommendations include:

- Implement impervious removal projects planned within the Harlem Park inner blocks, in coordination with the Green Network Plan.

- Engage with B'more beautiful around watershed connection based engagement and litter reduction efforts.

- Explore opportunities for ESD within the right of way, on vacant lots, and other city owned property.

- Provide education and outreach to homeowners and renters, in particular on watershed health activities they can do on private property (i.e. litter prevention, proper disposal of oils and grease, pet waste, downspout disconnect, rainwater harvesting, lot greening etc.) and watershed connections outreach and engagement.

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, multi-use trail, and potential bumpout locations.

- Coordinate with the Planning Department on opportunities for ESD, alternative practices, and watershed connections outreach and engagement within and around Green Network community nodes.

- Explore opportunities for ESD projects and tree planting in the ROW to create "green streets", within ¼ mile of schools

- Coordinate with schools on environmental education programs, in particular where ESD practices have been installed.

- Connect residents with existing green infrastructure workforce development programs, like YH2O and the Baltimore Center for Green Careers.

- Explore workforce development / green jobs for maintenance of ESD practices installed in the area.

- Provide education and outreach to homeowners and renters, in particular on watershed health activities they can do on private property (i.e. litter prevention, proper disposal of oils and grease, pet waste, downspout disconnect, rainwater harvesting, lot greening etc.) and watershed connections related outreach and engagement.

- Implement Phase 3 of the SMART Can program at local bus stops.

5.5.2.2 CSA Priority Area 1 - Poppleton / Hollins Market

Poppleton/Hollins Market scored as Priority 3 for physical feasibility, Priority 1 for the health supportive communities' analysis, and Priority 2 for the equity analysis.   High levels of unemployment (15-20%) and many residents with no access to a vehicle (>50%) demonstrate that residents could benefit from workforce development opportunities associated with restoration activities, and prioritization of ESD near residential areas. Extensive stakeholder engagement and other opportunities were identified including Green Network corridors, four schools (one with a green team focused on a stormwater management related issue, and one participating in CASEL social emotional learning curriculum), and designation as a B'more beautiful neighborhood. These factors provide an opportunity to engage neighbors around greening and trash clean-up in partnership with aligned initiatives. The CSA also contains several proposed and existing bike lanes and a multi-use trail. The area has been identified by DHCD as a location where concentrated private development is projected to occur, thus, achieving restoration goals in this CSA will be assisted in part by private re-development. Most of this CSA is high density renter occupied residential, with slightly more acres of eligible impervious within the right of way (51 Ac.) compared to on private property (48 Ac.). City owned, non-ROW property is 15 acres.

Recommendations include:

- Explore the feasibility of potential ESD practices that have been identified in the MS4 WIP

- Coordinate with BHCD to identify opportunities for ESD and alternative BMP's associated with the Choice Neighborhoods Action Plan

- Coordinate with the Planning Department on opportunities for ESD, alternative practices, and watershed connections outreach and engagement within and around Green Network corridors.

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, multi-use trail, and potential bumpout locations.

- Explore opportunities for ESD projects and tree planting in the ROW to create "green streets", within ¼ mile of schools

- Explore opportunities for ESD installation and watershed connection programming at and around school areas, including the green team and CASEL participating school

- Coordinate with schools on environmental education programs, in particular where ESD practices have been installed.

- Explore opportunities for retrofit at area schools

- Explore opportunities to cluster ESD and alternative practices like tree planting in areas where private developers are installing similar practices

- Explore Alternative BMPs like street tree planting.

- Engage with B'more beautiful around watershed connection based engagement and litter reduction efforts.

- Provide education and outreach to homeowners and renters, in particular on watershed health activities they can do on private property (i.e. litter prevention, proper disposal of oils and grease, pet waste,

downspout disconnect, rainwater harvesting, lot greening etc.) and watershed connections related outreach and engagement.

- Implement Phase 3 of the SMART Can program at local bus stops.

- Connect residents with existing green infrastructure workforce development programs, like YH2O and the Baltimore Center for Green Careers.

- Explore workforce development / green jobs for maintenance of ESD practices installed in the area.

5.5.2.3   CSA Priority Area 2 - Washington Village

Washington Village scored as Priority 1 for physical feasibility, Priority 2 for the health supportive communities' analysis and for the equity analysis. High levels of unemployment (15-20%) and residents with no access to a vehicle (21-35%) demonstrate that residents could benefit from workforce development opportunities associated with restoration activities and prioritization of ESD near residential areas. Extensive stakeholder engagement and other opportunities were identified including Green Network (corridors, community nodes, and nature nodes) four schools (three with green teams, one of which focused on a stormwater management related issue), and designation as a B'more beautiful neighborhood. These factors provide an opportunity to engage neighbors around greening and trash clean-up in partnership with aligned initiatives. The CSA also contains several proposed bike lanes and a multi-use trail. The area has been identified by DHCD as a location where concentrated private development is projected to occur. Thus, achieving restoration goals in this CSA will be assisted in part by private re-development. Most of this CSA is commercial (28%) and industrial (36%), with some (21%) high density residential (41% owner occupied). Most eligible impervious (165 Ac.) is on private property, with 25 Ac. on city owned non-ROW property. Identifying opportunities in the ROW and opportunities to incentivize restoration on private property will be important toward achieving restoration goals.

Recommendations include:

- Explore the feasibility of potential ESD practices that have been in the MS4 WIP

- Explore opportunities for ESD and alternative BMP's in coordination with the Middle Branch Master Plan near the Casino.

- Explore opportunities for retrofits at area schools

- Explore opportunities for ESD installation and watershed connection programming at and around school areas

- Explore opportunities to cluster ESD and alternative practices like tree planting in areas where private developers are installing similar practices

- Coordinate with schools on environmental education programs, in particular where ESD practices have been installed.

- Coordinate with the Planning Department on opportunities for ESD, alternative practices, and watershed connections outreach and engagement within and around Green Network corridors.

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, multi-use trail, and potential bumpout locations.

- Explore outreach and incentive opportunities for commercial and industrial property owners.

- Provide education and outreach to homeowners and renters, in particular on watershed health activities they can do on private property (i.e. litter prevention, proper disposal of oils and grease, pet waste, downspout disconnect, rainwater harvesting, lot greening etc.) and watershed connections related outreach and engagement.

- Explore opportunities for ESD and alternative BMP's in and around Carroll Park, in coordination with BCRP

5.5.3   Subwatershed Priority Area #3: Southwest Harbor subwatershed

5.5.3.1   *CSA Priority Area 1 - Brooklyn / Curtis Bay/ Hawkins Point*

Brooklyn/Curtis Bay/Hawkins Point is a relatively large CSA, and represents the entire Southwest Harbor Watershed. Conditions are challenging for installation of ESD practices due to the extent of industrial property and steep slopes. Because of these constraints, alternative BMP's including tree planting and street sweeping will be critical to treating stormwater in areas where constraints for ESD exist. High levels of unemployment (15-20%) and residents with no access to a vehicle (21-35%) demonstrate that residents could benefit from workforce development opportunities associated with restoration activities, and prioritization of ESD near residential areas. Stakeholder engagement and other opportunities include Green Network corridors, four schools (one with a green team focused on a stormwater management related issue, and one each participating in CASEL social & emotional learning and restorative practices), Medstar Hospital community benefits area, and designation as an area focused on violence reduction and a B'more beautiful neighborhood. These factors present opportunities for engaging neighbors around greening, trash clean-up, and violence reduction in partnership with aligned initiatives. Most of this CSA is industrial (82%), with some (7%) low density residential (41% owner occupied). The majority of eligible impervious exists on private property (430 Ac.), with substantial eligible impervious exists within the right of way (272 Ac.). Non-ROW city owned property is 60 acres. The CSA also contains several proposed and existing bike lanes. Identifying feasible opportunities in the right of way and on city owned property, and identifying opportunities to incentivize restoration activities on private property, will be important toward achieving restoration goals.

Recommendations include:

- Explore alternative BMP's like street tree planting

- Coordinate with schools on environmental education programs, in particular where ESD practices have been installed.

- Explore opportunities for retrofit at area schools

- Coordinate with the Planning Department on opportunities for ESD, alternative practices, and watershed connections outreach and engagement within and around Green Network corridors.

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, and potential bumpout locations

- Implement Phase 3 of the SMART Can program at local bus stops.

- Provide education and outreach to homeowners and renters, in particular on watershed health activities they can do on private property (i.e. litter prevention, proper disposal of oils and grease, pet waste, downspout disconnect, rainwater harvesting, lot greening etc.) and watershed connections related outreach and engagement.

- Explore outreach and incentive opportunities for commercial and industrial property owners.

- Promote to homeowners/property owners incentive programs like ESD installation, and for homeowners and renters rain barrels, tree planting, and community clean-ups.

- Connect residents with existing green infrastructure workforce development programs, like YH2O and the Baltimore Center for Green Careers.

- Explore workforce development / green jobs for maintenance of ESD practices installed in the area.

- Explore opportunities for innovative Watershed Connections programming to promote and increase

awareness of health-related co-benefits of restoration activities within the Medstart Harbor Hospital's Community Benefit Area.

5.5.4 Subwatershed Priority Area #4 - Patapsco subwatershed

5.5.4.1 CSA Priority Area 1 - Southeastern

Southeastern scored as Priority 1 of the three CSA's within the Patapsco watershed for all prioritization analyses considered. At moderately high levels of unemployment (10-15%) and 21-35% of residents with no access to a vehicle, workforce development opportunities associated with restoration activities, and prioritization of ESD near residential areas, would be beneficial. Stakeholder engagement and other opportunities that were identified include Green Network (corridors and community nodes) and three schools (one INSPIRE school, one focusing on CASEL restorative practices curriculum, and one with a green team focusing on a stormwater management related issue). Southeastern is an identified BCHCD major development area, so private development will likely account for a portion of future restoration activities. Most of this CSA is industrial (71%) followed by low density residential (12%) with a high rate of home ownership (59%), and 7 % commercial. Most eligible impervious (315 Ac.) is on private property, followed by 219 Ac. In the ROW and 25 Ac. on non-ROW, city owned property. Identifying opportunities in the right of way and city owned land alongside opportunities to incentivize restoration on private property will be important toward achieving restoration goals. The CSA also contains several small streams, proposed bike lanes, and a proposed multi-use trail.

Recommendations include:

- Coordinate with the Planning Department on opportunities for ESD, alternative practices, and watershed connections outreach and engagement within and around Green Network corridors.

- Evaluate streams for potential restoration opportunities

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, multi-use trails, and potential bumpout locations

- Explore opportunities for ESD projects and tree planting in the ROW to create "green streets", including within ¼ mile buffers of INSPIRE schools aligning with the associated pedestrian safety and streetscape improvements.

- Explore opportunities for ESD installation and watershed connection programming at and around school areas, including INSPIRE schools , schools with green teams, and the CASEL participating school focused on restorative practices.

- Explore opportunities to cluster ESD and alternative practices like tree planting in areas where private developers are installing similar practices.

- Connect residents with existing green infrastructure workforce development programs, like YH2O and the Baltimore Center for Green Careers.

- Explore workforce development / green jobs for maintenance of ESD practices installed in the area.

- Work with the Baltimore Industrial Group (BIG) to identify opportunities for ESD practices or alternative BMP's

- Promote to homeowners/property owners incentive programs like ESD installation, and for homeowners and renters rain barrels, tree planting, and community clean-ups.

- Implement Phase 3 of the SMART Can program at local bus stops.

5.5.4.2 CSA Priority Area 2 – Orangeville

Orangeville scored Priority 2 of the three CSAs within the Patapsco watershed for all prioritization analyses considered. Extensive stakeholder engagement and other opportunities were identified including Green

Network (corridors and community nodes) and three schools (one INSPIRE school and one with a green team focusing on a stormwater management related issue). The CSA also contains proposed bike lanes and a proposed multi-use trail. Most of this CSA is industrial (40%) followed by commercial (12%) and low density residential (7%). It also includes a mix of open space, office, and mixed use. Home ownership is relatively high for the watershed at 41%. Most eligible impervious (199 Ac.) is on private property, followed by 142 Ac. (ROW) and 25 Ac. non-ROW, city owned property. Identifying opportunities in the right of way and on city owned land, as well as incentivizing restoration on private property, will be important toward achieving restoration goals.

Recommendations include:

- Explore the feasibility of potential ESD practices that have been identified in the MS4 WIP

- Coordinate with the Planning Department on opportunities for ESD, alternative practices, and watershed connections outreach and engagement within and around Green Network corridors.

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, multi-use trails, and potential bumpout locations

- Explore opportunities for ESD projects and tree planting in the ROW to create "green streets", including within ¼ mile buffers of INSPIRE schools aligning with the associated pedestrian safety and streetscape improvements.

- Explore opportunities for ESD installation and watershed connection programming at and around school areas, including INSPIRE schools , and schools with green teams

- Provide education and outreach to homeowners and renters, in particular on watershed health activities they can do on private property (i.e. litter prevention, proper disposal of oils and grease, pet waste, downspout disconnect, rainwater harvesting, lot greening etc.) and watershed connections related outreach and engagement.

- Explore outreach and incentive opportunities for commercial property owners.

- Promote to homeowners/property owners incentive programs like ESD installation, and for homeowners and renters rain barrels, tree planting, and community clean-ups.

- Implement Phase 3 of the SMART Can program at local bus stops.

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