BALTIMORE HARBOR
Watershed Assessment

April 2019

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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 –(WS) 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 Baltimore Harbor (BH) Watershed Assessment report is to identify and rank watershed conditions according to physical feasibility, social and health factors, and equity; and to identify best management practices (BMPs) for watershed restoration and Total Maximum Daily Load (TMDL) compliance to meet the requirements of the Baltimore City's Municipal Separate Storm Sewer System (MS4) permit while maximizing co-benefits provided to communities within the watershed. Specifically, the report addresses the following:

- Provides an update on current water quality conditions;

- Summarizes the results of a visual watershed inspection;

- Identifies and ranks water quality problems; and

- Prioritizes structural and nonstructural water quality improvement project types

The Watershed Assessment is a planning document that identifies priority areas and water quality improvement strategies specific to each of the priority areas. The assessment will be used to inform the development of future Watershed Implementation Plans, which will include identification of specific projects. Pollutant load reduction benchmarks and deadlines that demonstrate progress toward meeting all applicable stormwater waste load allocations (WLAs) for the BH Watershed can be found in the current "Baltimore City MS4 Restoration and TMDL Watershed Implementation Plan (WIP)" (August 2015), as well as in the City's MS4 Annual Reports.

In addition to serving as a guide for developing future watershed implementation plans by the City, this Watershed Assessment can also serve as a framework and resource for non-profits, environmental groups, and city agencies in targeting projects and programs.

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 related to water quality and physical conditions relevant for determining the feasibility of restoration activities 2) social, economic, and health factors relevant for prioritization of work, and 3) regulatory and planning documents relevant for aligning restoration efforts with the work of other stakeholders operating within the watershed.

Chapter 3 – Water Quality Assessment. Identifies and ranks 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 equity and potential co-benefits associated with restoration strategies, and prioritizing areas for potential projects, programs, and partnerships.

Chapter 5 – Stormwater Best Management Practices. Includes a description of various BMPs (Projects, Programs, and Partnerships) currently being employed by DPW, as well as BMP opportunities based on priority areas.

Chapter 6 – References and data sources. Includes 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 Gwynn's 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 drainage systems, catchment areas, 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 their 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 effectively 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 CSAs.

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 cannot be ignored. Watershed restoration activities used in Baltimore include a mix of constructed practices, programs, and partnership strategies that both directly treat and manage stormwater, and also aim to cultivate public acceptance, support, and stewardship of watershed restoration efforts by leveraging these activities as a tool to improve the health and safety of communities within the watershed.

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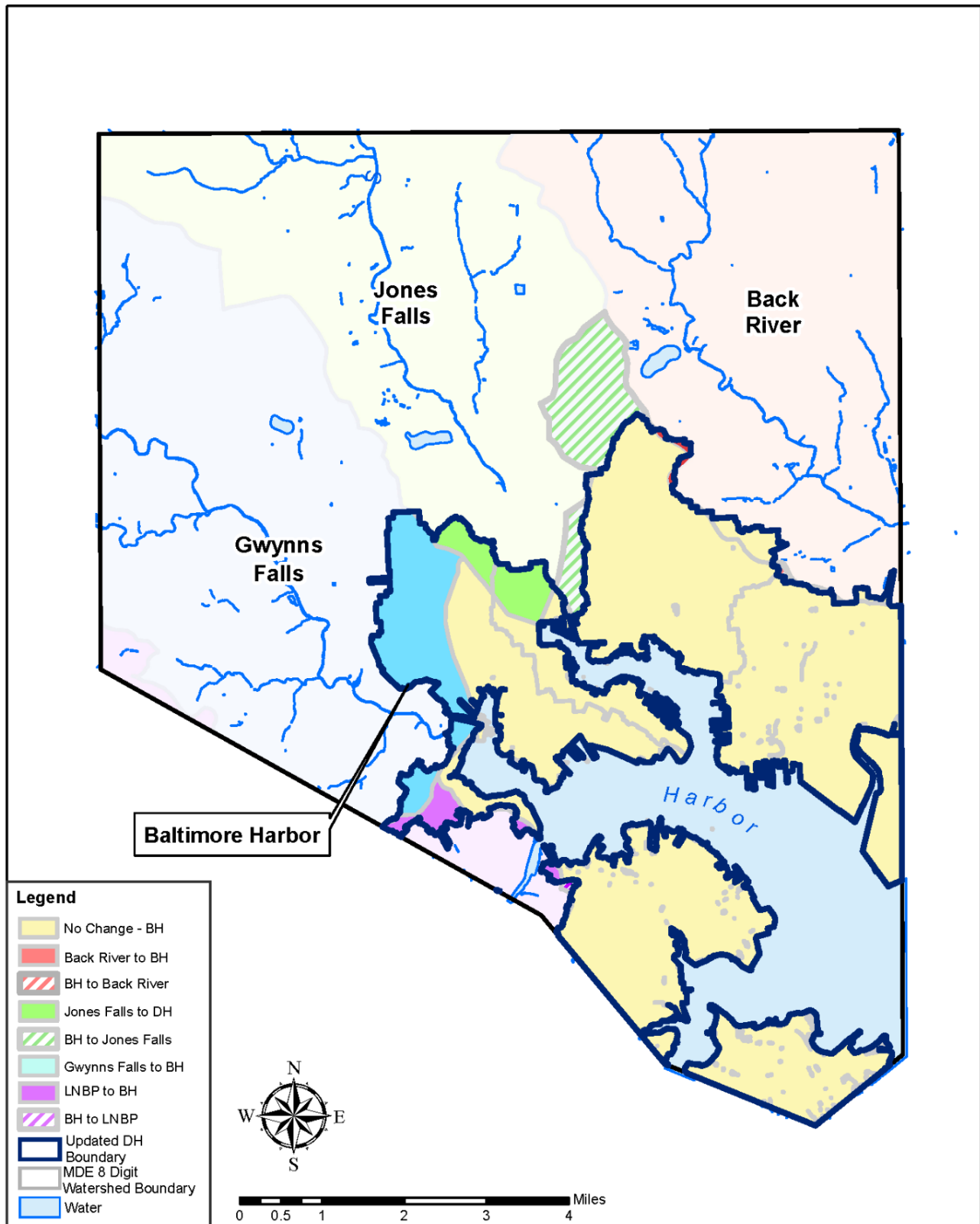
Figure 1-1 Updated Watershed Boundaries

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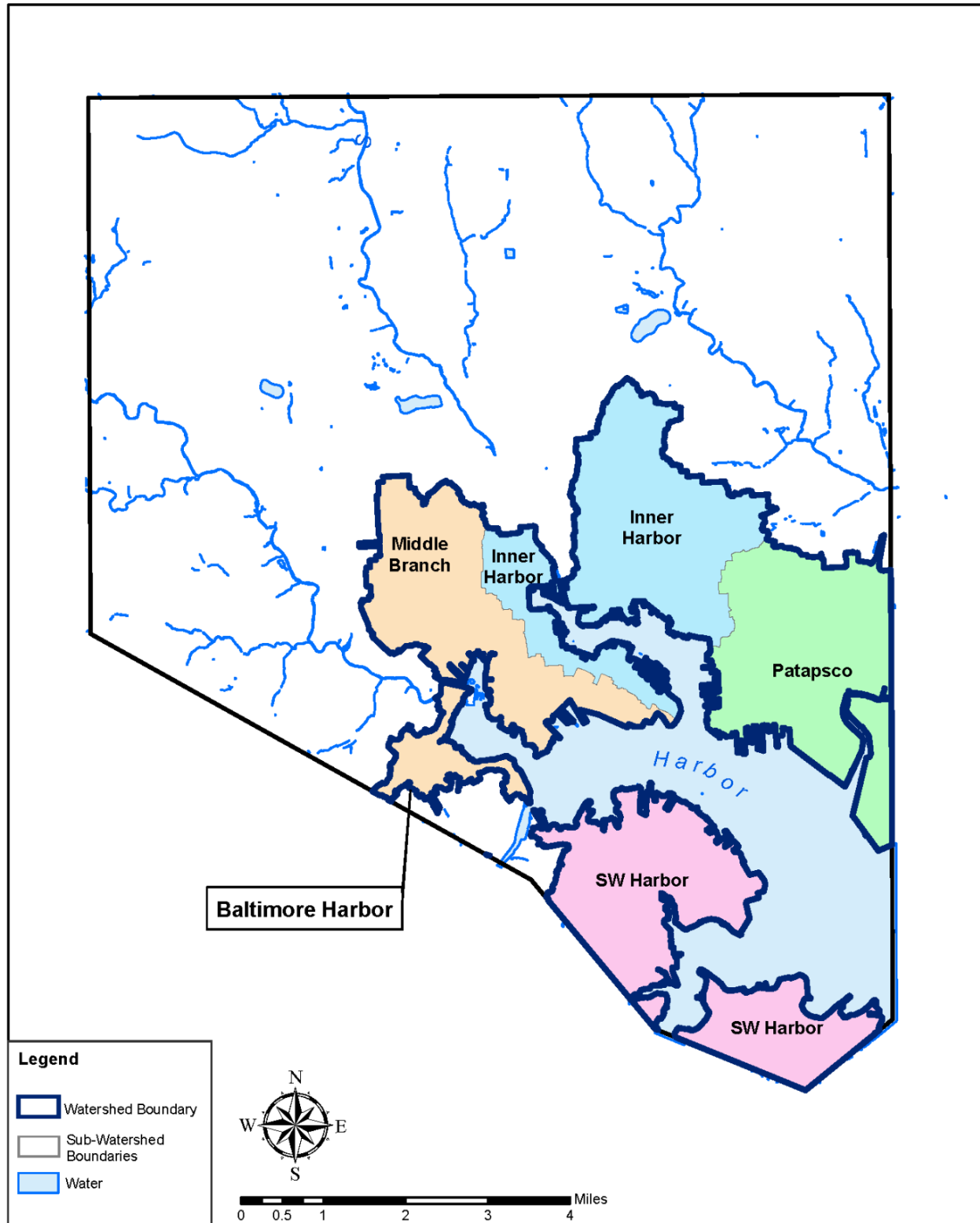
Figure 1-2 Baltimore Harbor Subwatersheds
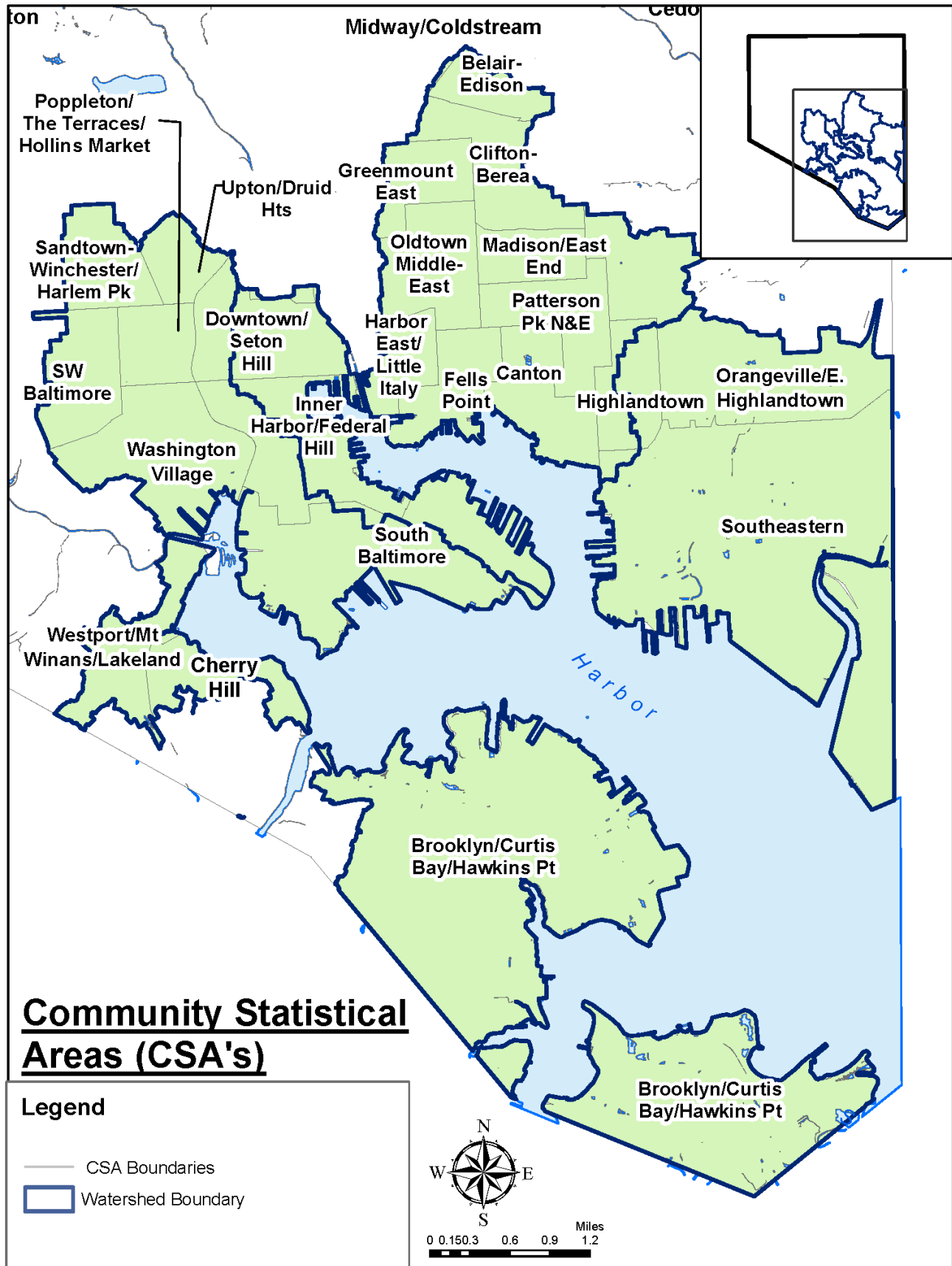
Figure 1-3 Baltimore Harbor CSAs
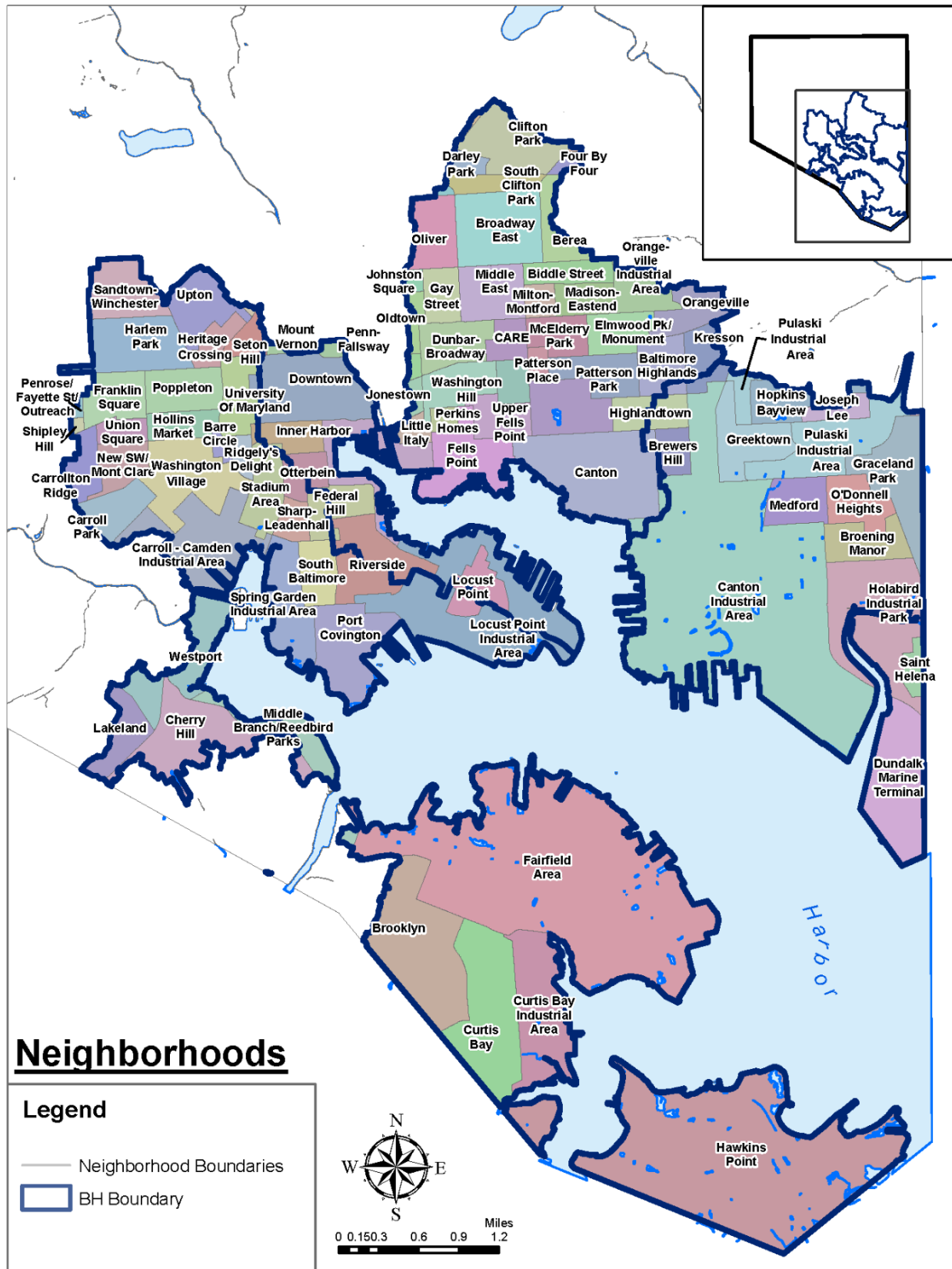
Figure 1-4 Baltimore Harbor Neighborhoods

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.

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

1) **Projects:** Capital projects like stormwater ponds, environmental site design (ESD) (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.

a.   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) and suitability and prioritization analyses (in Section 4 of this report).

- Land Use
  - Zoning
  - Land Use
  - Property Ownership
- Regulatory Conditions
  - Projected Development Trends
  - Critical Area
  - NPDES Discharge Permits
- Assessment of Physical Conditions
  - Slope
  - Hydrologic Soil Classification
  - Stream/Shoreline Systems
  - Stream Riparian Buffers
  - Tidal Waters
  - Shoreline Riparian Buffers
  - Floodplain
  - Impervious Surfaces
  - Surface Temperature

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

- - o Urban Tree Canopy Prioritization
    - o Wet Utility Networks
      - ▪ Storm Drain System
      - ▪ Sanitary Sewer System)
      - ▪ Capital Improvement Projects
      - ▪ Sanitary Sewer Overflows (SSOs)
      - ▪ Dirty Streets and Alleys / Clogged Storm Drains
- Visual Watershed Inspection Results
- Socio-Economic Conditions
  - o Demographics
  - o Age Distribution
  - o Hardship Index
- Planning Initiatives / City-wide Initiatives
  - o Community Plans
  - o Small Watershed Action Plans and Harbor Plans
  - o Other Plans
  - o City Wide Initiatives

b. Water Quality Assessment

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

c. Suitability Analysis and Prioritization

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

- Physical Feasibility

- Equity (social / economic/racial)

- Health Supportive Community

Each of the three Prioritization categories was defined by analyzing data based on several factors. These factors and the prioritization methodology are described in greater detail within Section 4 of this report.

Watershed opportunities and other stakeholder initiatives were also 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.

d. Identification of Best Management Practices

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, based on the opportunities identified within this report (Section 5).

It is recognized that changes in weather patterns resulting from climate change will require adaptations in terms of the extent of the floodplain, facility design, and facility placement going forward. Additional considerations may become necessary as implementation plans are developed, and adaptations will be made as needed.

e. Recommendations

Each of the potential types of projects, programs, and partnerships that were identified was then linked to conditions that would indicate particular strategies that would be appropriate and beneficial. 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. (Section 5.4)

2   WATERSHED CHARACTERIZATION

The following section includes an inventory of the physical and socio-economic conditions, and health related in the watershed, which will be used to determine where various stormwater BMPs most appropriate. Recent infrastructure projects and planning initiatives in the watershed area are also noted to inform planning for future water quality improvement work.

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. Zoning reflects what exists 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 subwatersheds. Industrial land is typically regulated under separate NPDES permits. Where this is not the case, (industrial permits for City of Baltimore property), industrial use lands are generally limited in the types of BMP's that can be installed. For example, depending on the current and past use of the land, contaminants may be present in soils below the surface that would preclude installation of BMP's that encourage infiltration of surface waters through native soils for groundwater recharge.

Residential, office, and commercial zoned 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-uses 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 (with 41.9% of the subwatershed as high density residential), 39.0% of the Middle Branch (with 32.9% of the subwatershed as high density), 17.2% of the Patapsco (with 4.2% of the subwatershed as high density), and 11.3% of the Southwest Harbor subwatershed (with <1% of the subwatershed as 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 overall 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 to participate in water quality improvement efforts.

Open space zoned areas represent good opportunities for ESD practices, as they typically are publicly owned and have 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. The "Special Districts" category includes Port Covington Zoning District, Transit Oriented Development zones, and Bio-Science Campus Districts.

Table 2-1 Zoning Type within Watershed

Zoning Type	Acres	% Watershed Area
Special Districts	435.3	3.0%
Commercial	1,847.5	12.7%
Educational	0.4	0.0%
Hospital	190.7	1.3%
Industrial	6,665.7	45.8%
Office	187.1	1.3%
Open Space	1,082.3	7.4%
Residential Detached	232.4	1.6%
Residential High Density Rowhouse	2,924.3	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

Subwatershed	Type	AREA (Ac.)	% of SWS	% of Zoning Type within WS
Inner Harbor	Special Districts	35.6	0.9	8.2
	Commercial	1004.3	25.5	54.4
	Educational	14.7	0.4	99.9
	Hospital	83.0	2.1	43.5
	Industrial	521.2	13.2	7.8
	Office	66.5	1.7	35.6
	Open Space	449.8	11.4	41.6
	Residential Detached	48.8	1.2	21.0
	Residential High Density Rowhouse	1650.9	41.9	56.5
	Residential Mixed Use	40.6	1.0	16.8
	Residential Multifamily	0.0	0.0	0.0
	Residential Rowhouse Low D	22.5	0.6	4.2
	Residential Transitional	0.0	0.0	0
Middle Branch	Special Districts	399.2	11.6	91.7
	Commercial	492.8	14.4	26.7
	Educational	0.0	0.0	0.0
	Hospital	33.3	1.0	17.5
	Industrial	849.7	24.8	12.7
	Office	6.8	0.2	3.6
	Open Space	309.7	9.0	28.6
	Residential Detached	1.3	0.0	0.5
	Residential High Density Rowhouse	1129.8	32.9	38.6
	Residential Mixed Use	34.8	1.0	14.4
	Residential Multifamily	32.8	1.0	100.0
	Residential Rowhouse Low D	141.7	4.1	26.7
	Residential Transitional	0.0	0	0
Patapsco	Special Districts	0.4	0.0	0.1
	Commercial	302.4	8.8	16.4
	Educational	0.0	0.0	0.0
	Hospital	74.5	2.2	39.1
	Industrial	2194.4	64.1	32.9
	Office	106.2	3.1	56.8
	Open Space	155.1	4.5	14.3
	Residential Detached	148.6	4.3	63.9
	Residential High Density Rowhouse	142.8	4.2	4.9
	Residential Mixed Use	117.4	3.4	48.6
	Residential Multifamily	0.0	0.0	0.0
	Residential Rowhouse Low D	131.2	3.8	24.7
	Residential Transitional	50.3	1.5	32.6
SW Harbor	Special Districts	0.0	0.0	0.0
	Commercial	48.0	1.3	2.6
	Educational	0.0	0.0	0.0
	Hospital	0.0	0.0	0.0
	Industrial	3100.4	82.6	46.5
	Office	7.6	0.2	4.1
	Open Space	167.7	4.5	15.5
	Residential Detached	33.7	0.9	14.5
	Residential High Density Rowhouse	0.8	0.0	0.0

Subwatershed	Type	AREA (Ac.)	% of SWS	% of Zoning Type within WS
	Residential Mixed Use	48.8	1.3	20.2
	Residential Multifamily	0.0	0.0	0.0
	Residential Rowhouse Low D	236.3	6.3	44.4
	Residential Transitional	103.9	2.8	67.4

Zoning
(Condensed Categories based on Use)

Legend

▭	Watershed Boundary
▮	Specialized Districts
▨	Commercial
▮	Educational
▮	Hospital
▮	Industrial
▮	Office
▮	Open Space
▮	Residential Transitional
▮	Residential Detatched
▮	Residential High Density Rowhouse
▮	Residential Mixed Use
▮	Residential Multi-Family
▨	Residential Rowhouse Low Density
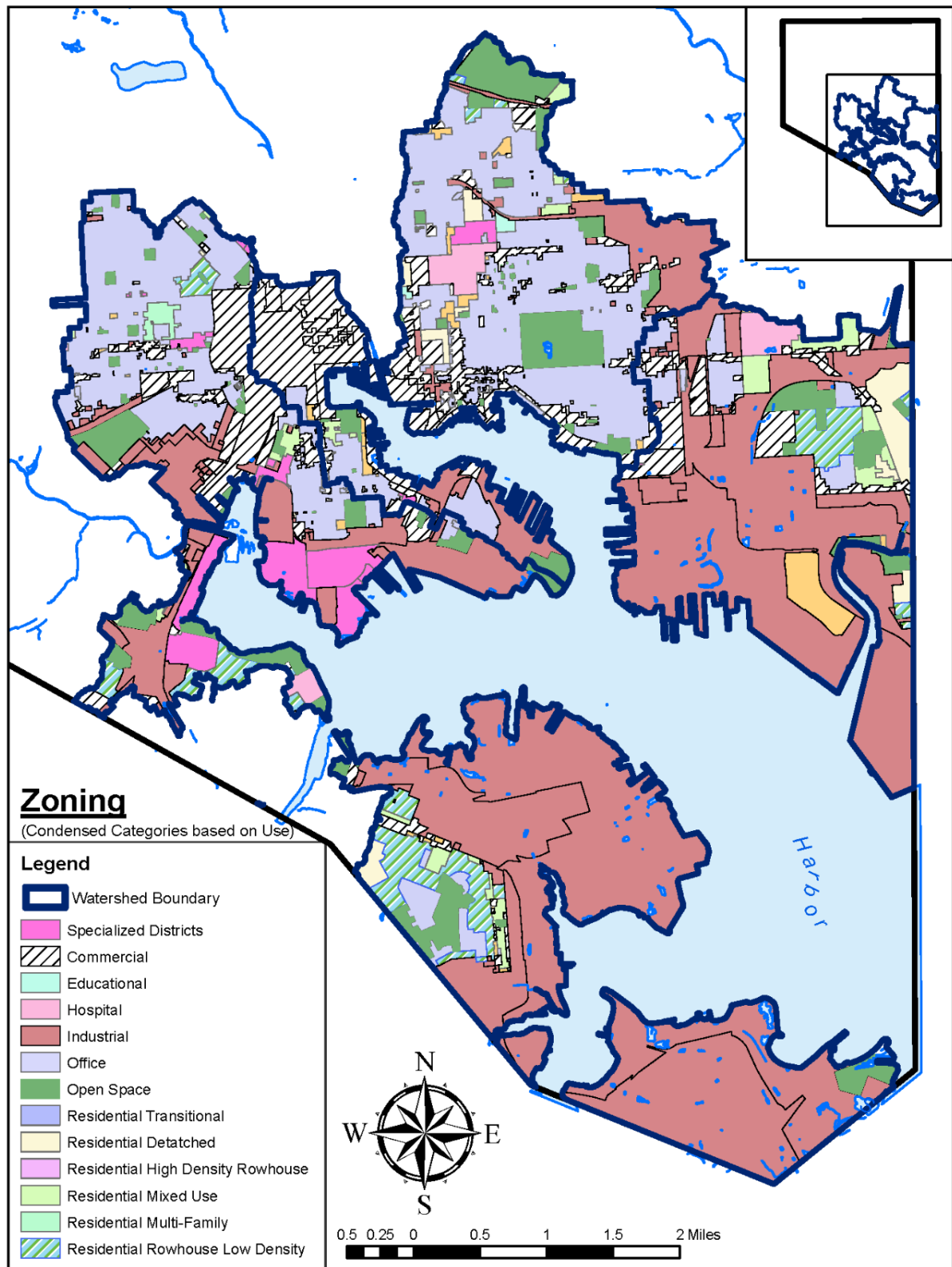
Figure 2-1 Zoning Type within Watershed

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.

The predominant land use types present within the Baltimore Harbor watershed 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 comprise 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 7% 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%
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%
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%
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%

Land Use Land Cover

County Land Use Land Cover 2010 -
Maryland GIS Data Catalog

Legend

- ▢ Watershed Boundary
- ▢ Other Developed Lands
- ▢ Transportation
- ▢ Water
- ▨ Wetlands
- ▢ Medium Density Residential
- ▨ Industrial
- ▢ Institutional
- ▢ Low Density Residential
- ▢ Barren Land
- ▢ Commercial
- ▢ Forest
- ▢ High Density Residential
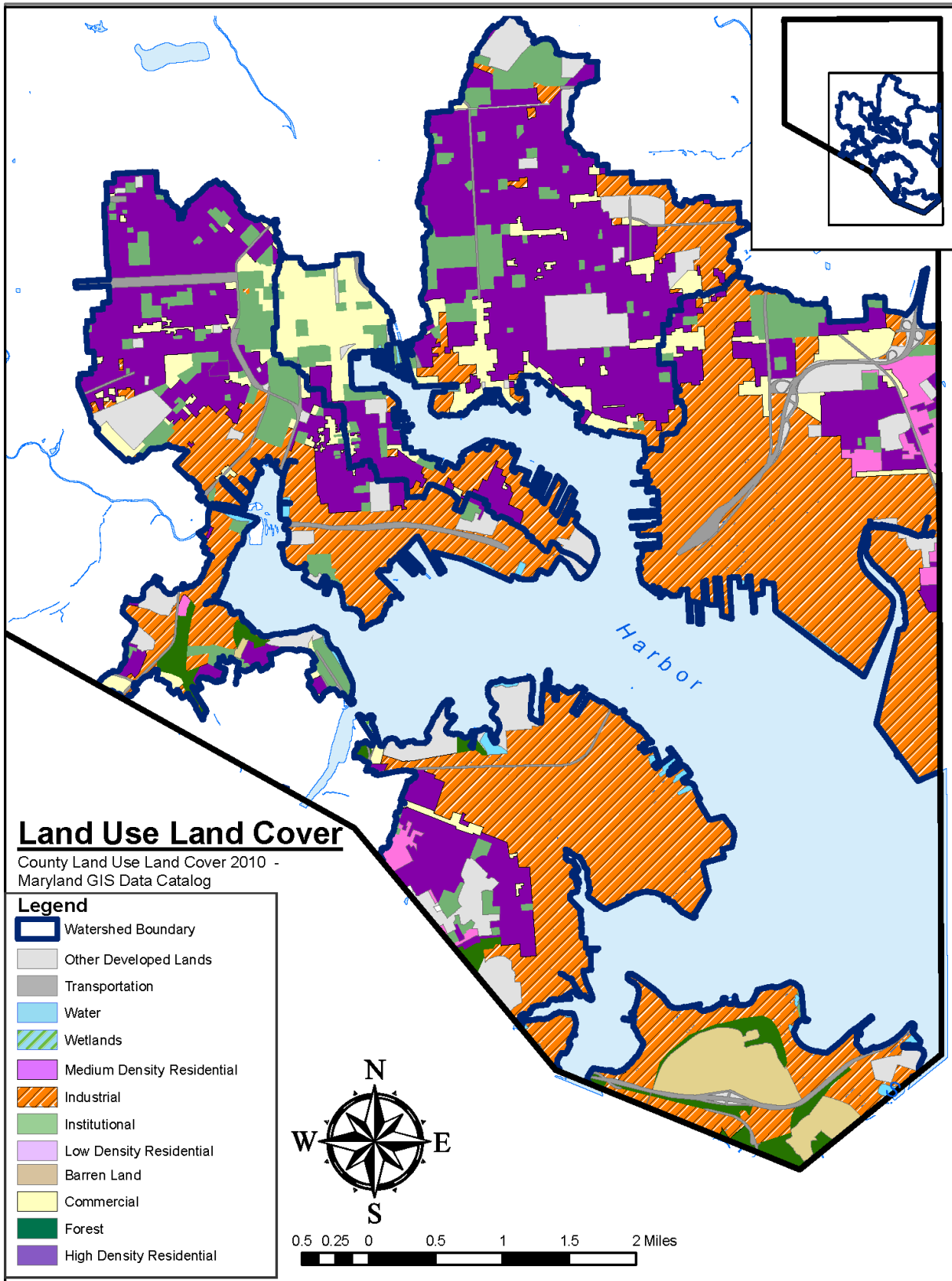
Figure 2-2 Land Use within Watershed

2.1.3 Property Ownership

Property ownership is a critical consideration for determining the magnitude of available space for restoration activities, the potential partnerships necessary for implementation, and the barriers that may be encountered. Currently, it is the policy of DPW to only install stormwater management projects on publicly owned property, such as City owned land or within right's-of-ways[2]. Public land is limited, and often contains physical constraints or barriers such as utilities. Installing projects on federal, state, or private land would require additional tailored agreements, easements, or memorandums of understanding in order to protect 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. Railway corridors have been identified as particularly limiting for restoration projects based on prior experience, therefore parcels with above and below ground rail were identified. While railway corridors may not impact the entire parcel, the presence of railways indicates an additional stakeholder requiring coordination for activities on those parcels.

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 identifying land area within the City limits that was not a parcel. For the rail crossings in the ROW, a 20 ft. buffer was assumed on either side of rail lines crossing the estimated right of way area to determine the area of ROW impacted by railways. This area was combined with the area of the parcels impacted by rail to determine the properties impacted by rail (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 landowners 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 Sub WS	AREA (Ac.)	% of Sub WS	AREA (Ac.)	% of Sub WS	AREA (Ac.)	% of WS
City Owned	619.3	15.7%	438.3	12.8%	99.0	2.9%	472.2	12.6%	1628.8	11.2%
Private	1737.1	44.1%	1424.1	41.5%	1176.5	34.4%	1178.7	31.4%	5516.4	37.9%
Right of Way (ROW)*	1187.0	30.1%	819.7	23.9%	439.7	12.8%	479.3	12.8%	2925.6	20.1%
State ROW*	0.0	0.0%	69.7	2.0%	200.7	5.9%	77.7	2.1%	348.1	2.4%
Parcel/ROW w/Rail*	295.0	7.5%	545.1	15.9%	1240.4	36.2%	1400.4	37.3%	3480.9	23.9%
State Owned	19.0	0.5%	87.6	2.6%	180.7	5.3%	87.2	2.3%	374.5	2.6%
Federal Owned	93.8	2.4%	78.4	2.3%	60.3	1.8%	32.4	0.9%	265.0	1.8%

*Area of right-of-way and parcels with rail were estimated as described above

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[2] Stream restoration projects can be installed on private property utilizing a property easement.

Property Ownership

Legend

■ City Owned			■ State ROW Estimated	
■ Federal Owned			▨ Parcel with Rail	
■ Private			■ Water	
■ ROW Estimated			▭ Watershed Boundary	
■ State Owned				
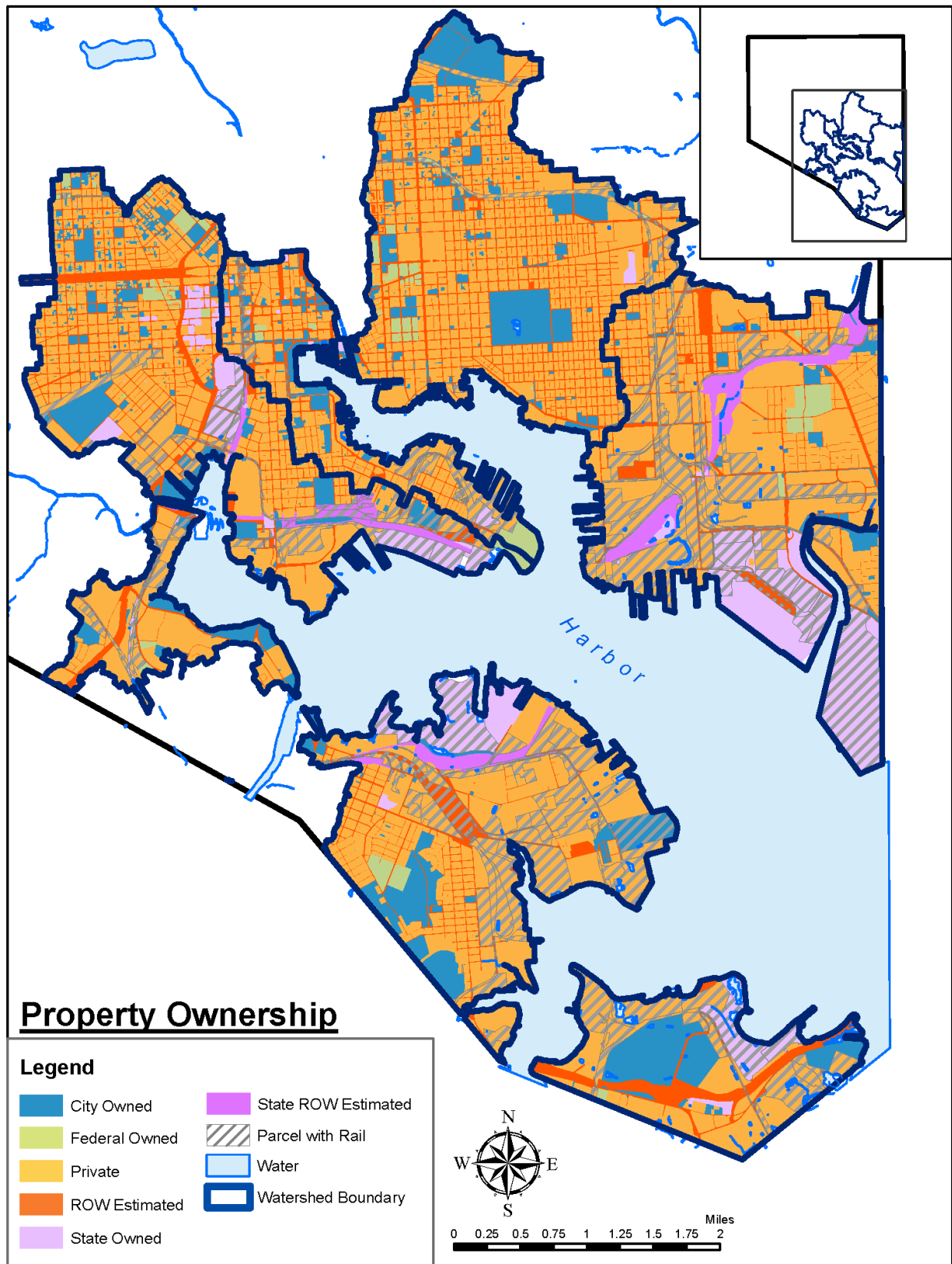
Figure 2-3 Property Ownership

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 Sub-Cabinet 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).
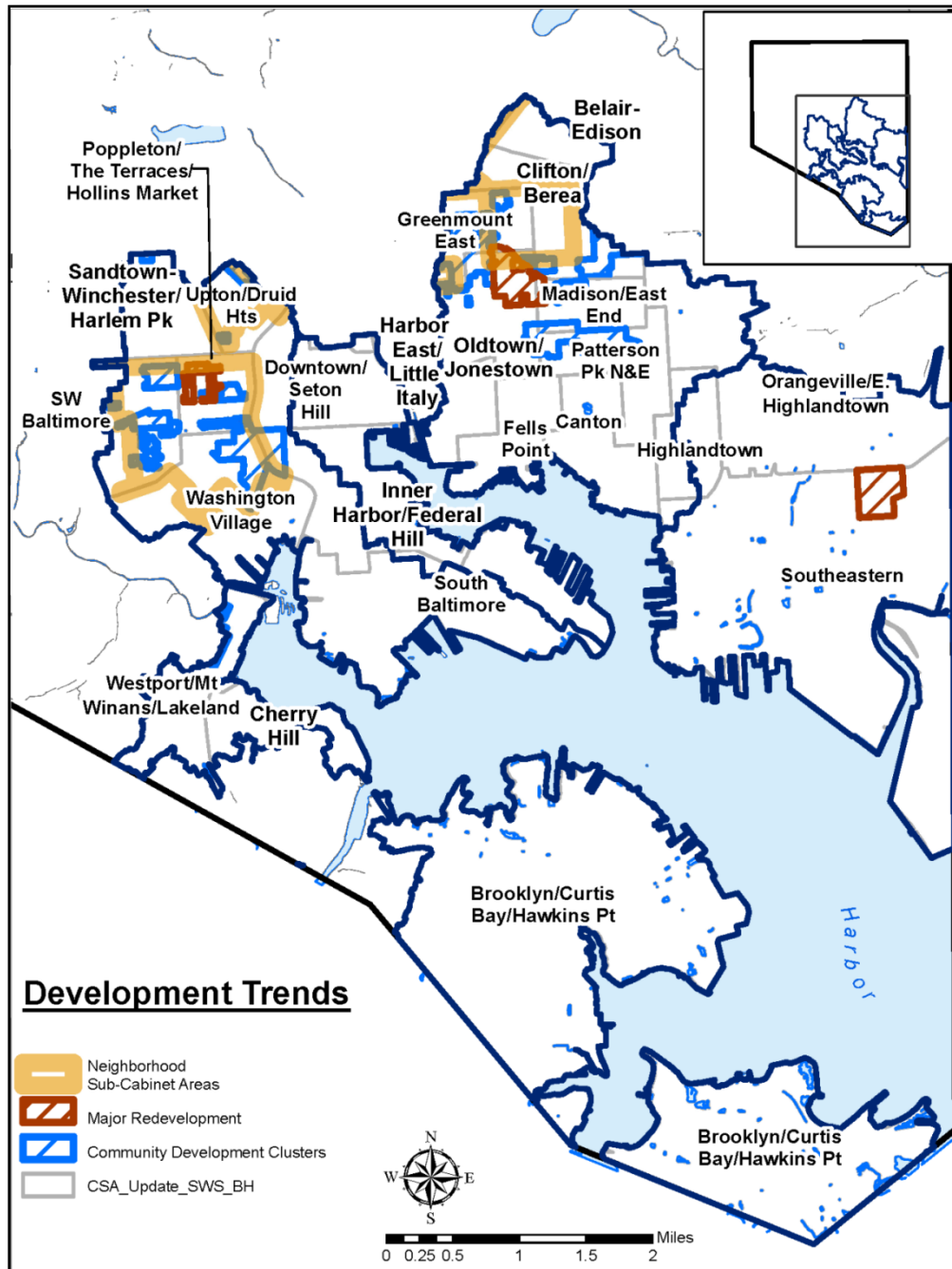
Figure 2-4 Development Trends

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

Point source discharges of wastewater, stormwater, or water from industrial uses into waters of the United States are required to obtain a National Pollutant Discharge Elimination System (NPDES) permit, which includes requirements to protect water quality. Large municipalities, like Baltimore, manage Municipal Separate Storm Sewer System (MS4) permits under the NPDES umbrella. Federal and state landowners, even within the city boundary, often have their own separate NPDES permits with separate requirements. Facilities that discharge industrial wastewater or conduct activities that can contribute a higher level of pollutants than typical may exist within the city boundaries, but often require separate industrial discharge permits with special requirements. This watershed assessment specifically aims to inform strategies to address water quality to satisfy the requirements of Baltimore City's MS4 permit. Therefore, it is important to identify properties within the city boundary that are regulated by separate permits and managed by others.

Tables 2-5 and 2-6 list the distribution of land area covered by various NPDES permit sectors. The subwatershed with the most land area (Acres and Percentage of Subwatershed) regulated by NPDES permits by others is Southwest Harbor. These permits are primarily for State properties (Maryland Port Administration) and industrial permit holders. The Patapsco subwatershed has the second most land area (Acres and Percentage of Subwatershed) for NPDES permits managed by others; primarily resulting from industrial permits and state property (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	3646.2	2792.0	2066.8	2443.1	10948.1
Federal	108.7	81.3	60.3	32.4	282.8
State	32.8	344.6	820.5	440.8	1638.8
Industrial	168.6	249.9	462.2	859.4	1679.9

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	92.6%	81.3%	60.4%	65.1%	75.2%
Federal	2.8%	2.4%	1.8%	0.9%	1.9%
State	0.8%	10.0%	24.0%	11.7%	11.3%
Industrial	4.3%	7.3%	13.5%	22.9%	11.5%
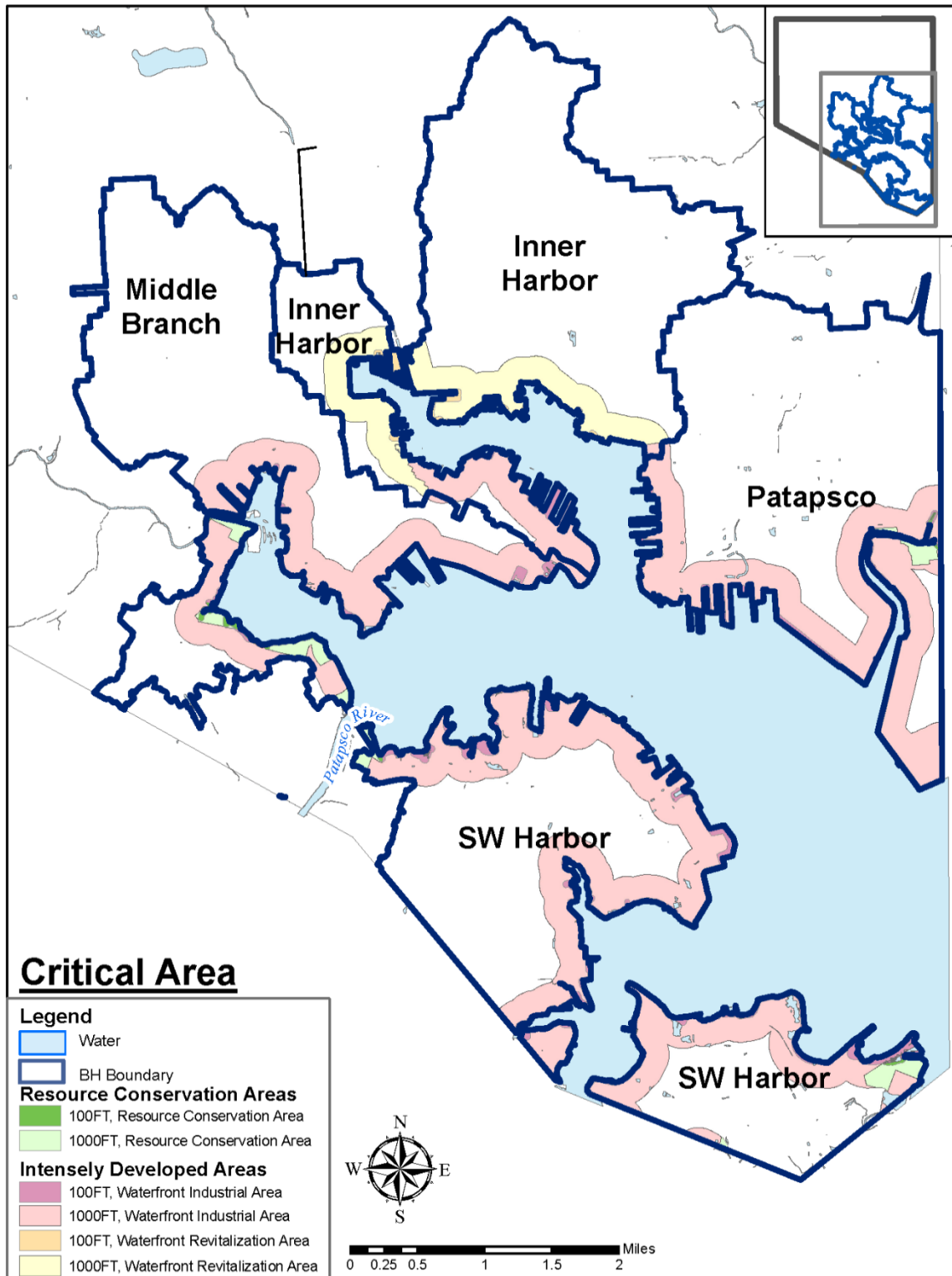
Figure 2-5 Critical Area
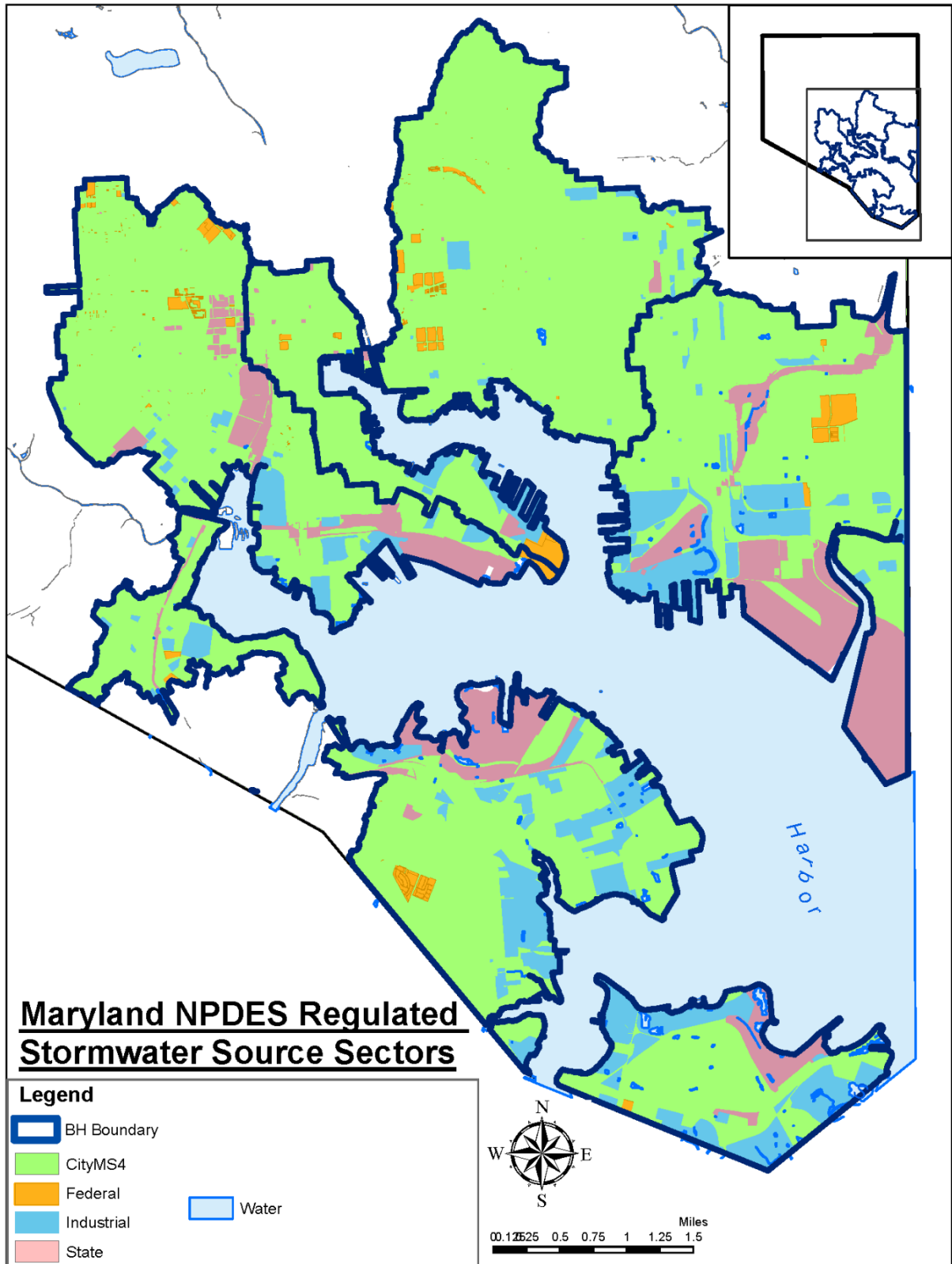
Figure 2-6 NPDES by Sector within Watershed

2.3 Assessment of Physical Conditions

2.3.1 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 Baltimore Harbor 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 ESD practices like bioretention is 0-5%, with restrictions on some types of practices above 10 to 15%. The acreage and percent of these slopes was therefore calculated for slope ranges 0-5% and 5-10% for each subwatershed (see Table 2-8). Although 0-10% slopes are optimal for specific ESD practices, this does not preclude other ESD practices, like regenerative conveyance systems, from being installed on steeper slopes or alternative practices such as tree planting or street sweeping from being deployed in those areas.

The percentage of land with 0-5% slopes in the watershed is relatively evenly distributed between the subwatersheds (23.4-27.3%), with the greatest land area in the Patapsco subwatershed. The Inner Harbor subwatershed has the most total acreage that falls within the 0-10% range, followed by the Patapsco. Notably, within the Patapsco and Southwest Harbor subwatersheds, a substantial part of the 0-5% slope area coincides with land managed through Industrial or State NPDES permits

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 Subwatershed with 0-5% slopes	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	833.0
% of Subwatershed with 5-10% Slopes	32.4%	27.9%	21.2%	22.1%
% of 5-10% Slopes within the Watershed	33.7%	25.3%	19.1%	22.0%
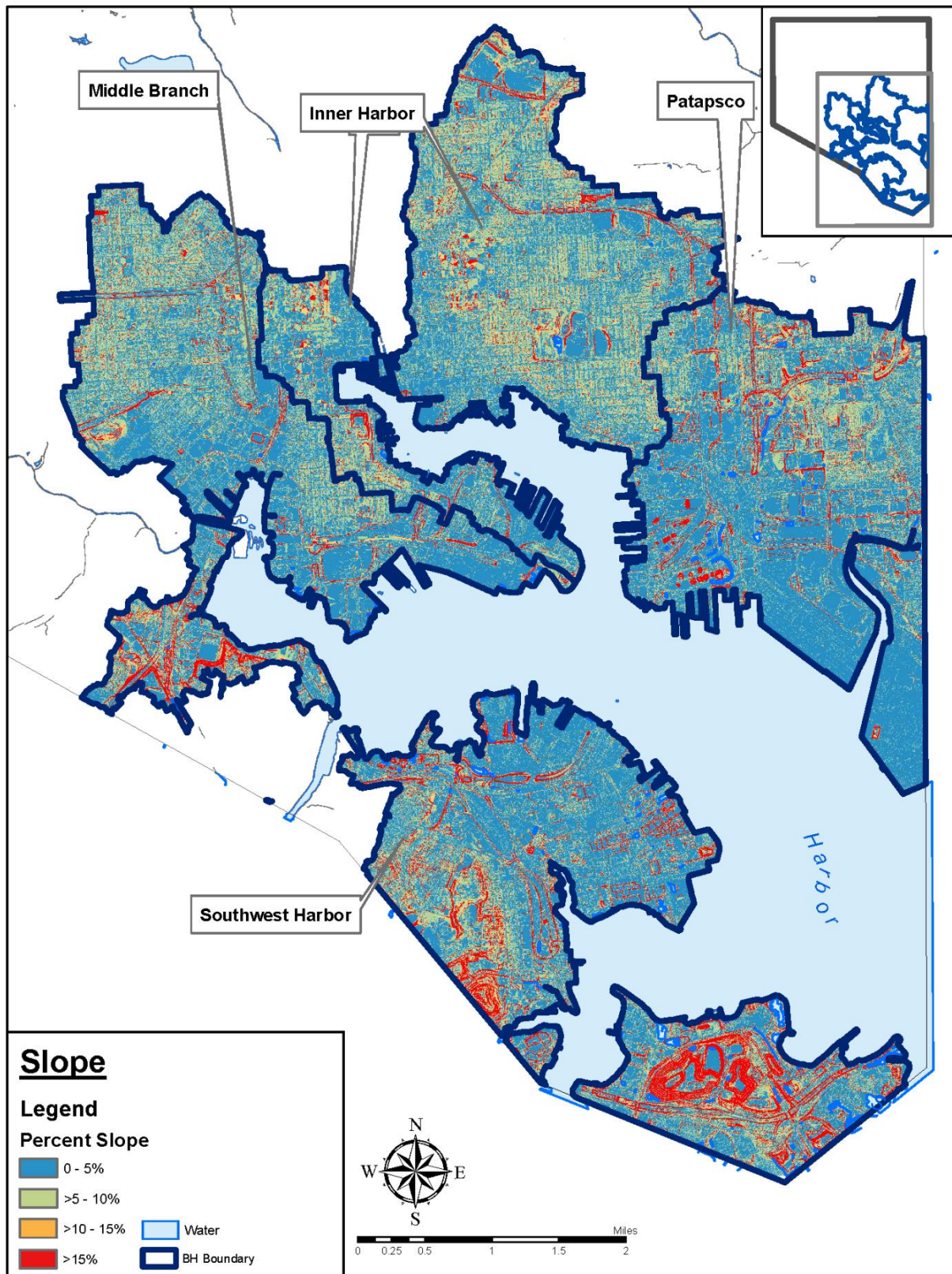
Figure 2-7 Slope Ranges within Watershed

2.3.2   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 plant health. The Natural Resources Conservation Services (NRCS) classifies soils into four hydrologic soil groups (HSG) based on 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[3]. Soils with high runoff potential have low infiltration capacity, resulting in runoff, or overland flow. Soil composition, compaction, and infiltration rate are influenced by disturbances to the soil profile such as land development activities, and 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 an 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 areas are unlikely to have good infiltration rates and therefore stormwater management practices such as bioretention facilities or bioswales would require an underdrain and a viable connection to the storm drain system, increasing cost and decreasing pollutant removal efficiency.

Table 2-9 Hydrologic Soil Groups within Watershed

Soil Groups	Group A	Group B	Group C	Group C/D	Group D	Unknown
Acres	689.4	405.6	2875.0	12.8	10,077.6	477.5
% of Watershed	4.7%	2.8%	19.8%	0.1%	69.3%	3.3%

Tables 2-10 shows that the Southwest Harbor SWS has the greatest acreage with A and B group soils. These areas where good infiltration can be expected are less prevalent within the Patapsco, 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 area 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, some areas were identified for all subwatersheds where opportunities for infiltration-based practices may exist. Where soils preclude use of infiltration-based practices, underdrained facilities may be installed and opportunities for non-infiltration based practices, such as tree planting, rainwater harvesting, and street sweeping, remain viable in these areas.

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[3] 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	4.8
D	3,324.6	2,470.2	2,621.7	1,660.9
Unknown	60.7	63.3	17.4	336.1
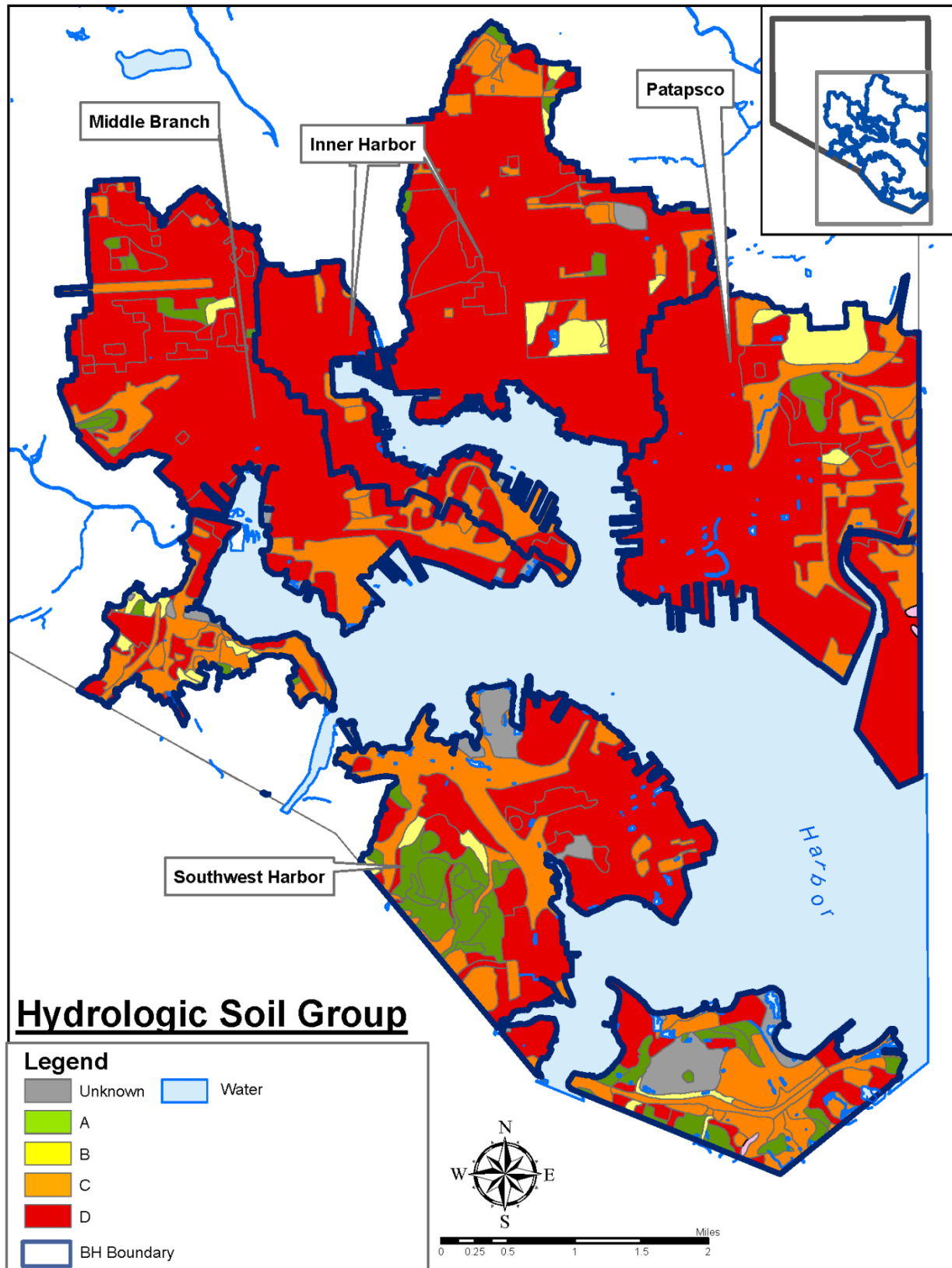
Figure 2-8 Hydrologic Soil Groups within Watershed

2.3.3 Stream / Shoreline Systems

There are 6.3 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 (Table 1-22; Figure 2-9).

Table 2-11 Stream Miles by Subwatershed

Subwatershed	Stream Miles
Inner Harbor	0.5
Middle Branch	1.3
Patapsco	2.0
Southwest Harbor	2.5
Total	*6.3*

2.3.4 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 seven categories: impervious, barren, shrubland, low vegetation, tree canopy, wetlands, and water. Land cover was derived from the Chesapeake Conservancy High Resolution Land Cover Dataset. 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	Stream Buff. Total (Ac.)	Water (Ac.)	Water (%)*	Wetlands (Ac.)	Wetlands (%)*	Tree Canopy (Ac.)	Tree Canopy (%)*	Shrubland (Ac.)	Shrubland (%)*	Low Vegetation (Ac.)	Low Vegetation (%)*	Barren (Ac.)	Barren (%)*	Impervious (Ac.)	Impervious (%)*
SW Harbor	81.1	3.4	4.2%	0.4	0.4%	39.8	49.0%	0.4	0.5%	20.9	25.8%	2.4	3.0%	13.8	17.0%
Middle Branch	45.7	1.3	2.9%	0.6	1.4%	10.3	22.5%	0.4	0.9%	9.7	21.3%	0.1	0.1%	23.3	50.9%
Patapsco	61.4	3.3	5.3%	0.1	0.1%	17.1	27.8%	0.0	0.0%	7.9	12.9%	1.4	2.3%	31.7	51.6%
Inner Harbor	15.8	1.8	11.4%	0.0	0.0%	3.9	24.8%	0.0	0.0%	1.7	10.9%	0.0	0.0%	8.3	52.9%
Total	204.0	9.8		1.0		71.0		0.9		40.3		3.9		77.1	
% (WS)**	100%		4.8%		0.5%		34.8%		0.4%		19.8%		1.9%		37.8%

* Percent of stream buffer in respective subwatershed
**Percent of stream buffer in watershed

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 22% comprised of shrubland, low vegetation, or barren (unforested or open pervious). The Inner Harbor and Patapsco followed by

the Middle Branch subwatersheds have the highest percentages of impervious area in the buffer zone, all over 50%. The subwatershed with the highest percentage of tree canopy in the buffer is Southwest Harbor (49%).

Areas of low vegetation, barren areas, and shrubland 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 land uses including densely populated residential, commercial, and industrial land.
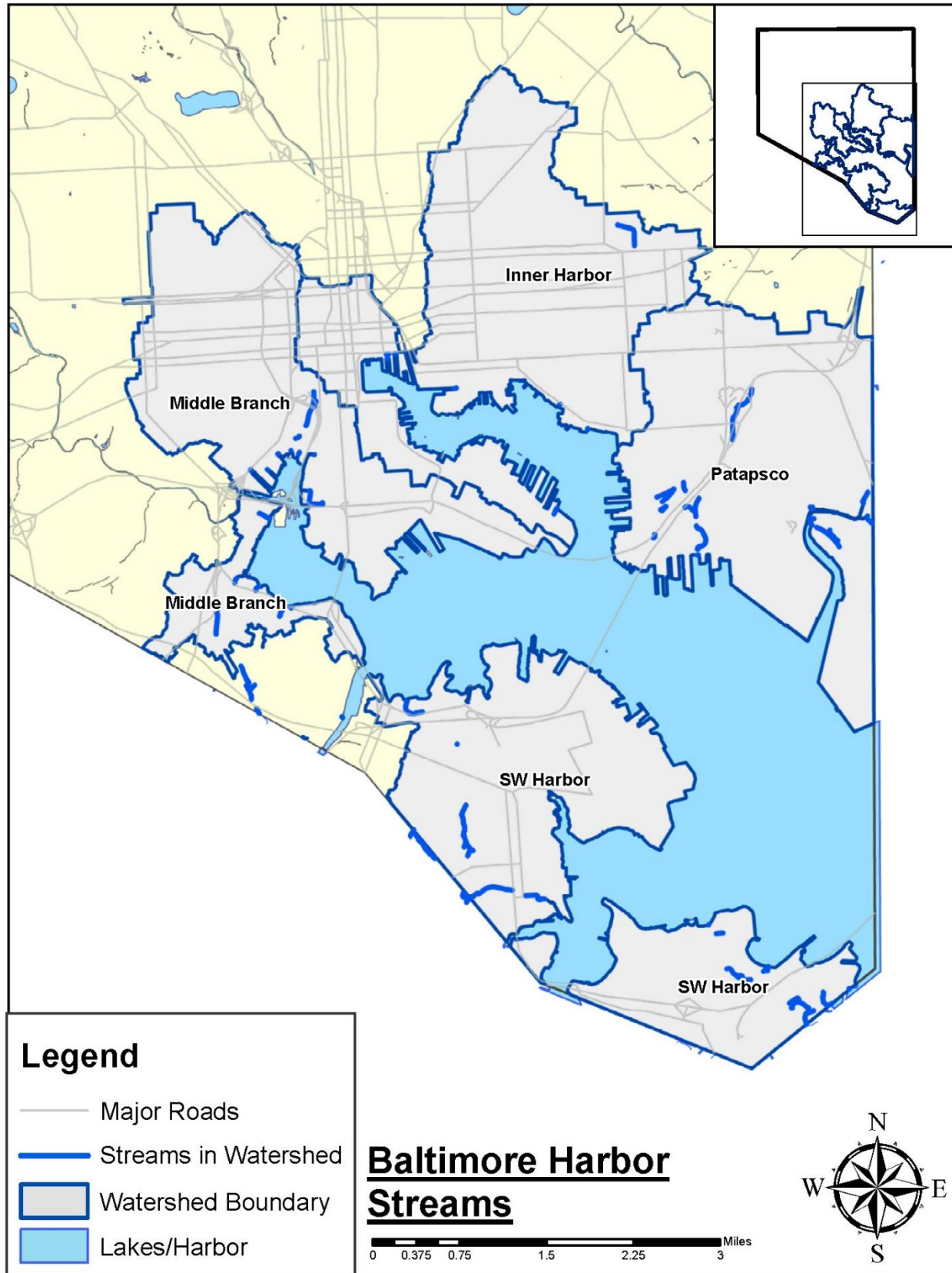
Figure 2-9 Stream System within Watershed

Legend

— Major Roads

▢ Watershed Boundary

▢ Lakes/Harbor

▢ Barren

▢ Impervious Surfaces

▢ Low Vegetation

▢ Shrubland

▢ Tree Canopy

▢ Water

▢ Wetlands

Baltimore Harbor 100'
Stream Buffer Condition

Miles
0   0.375   0.75   1.5   2.25   3
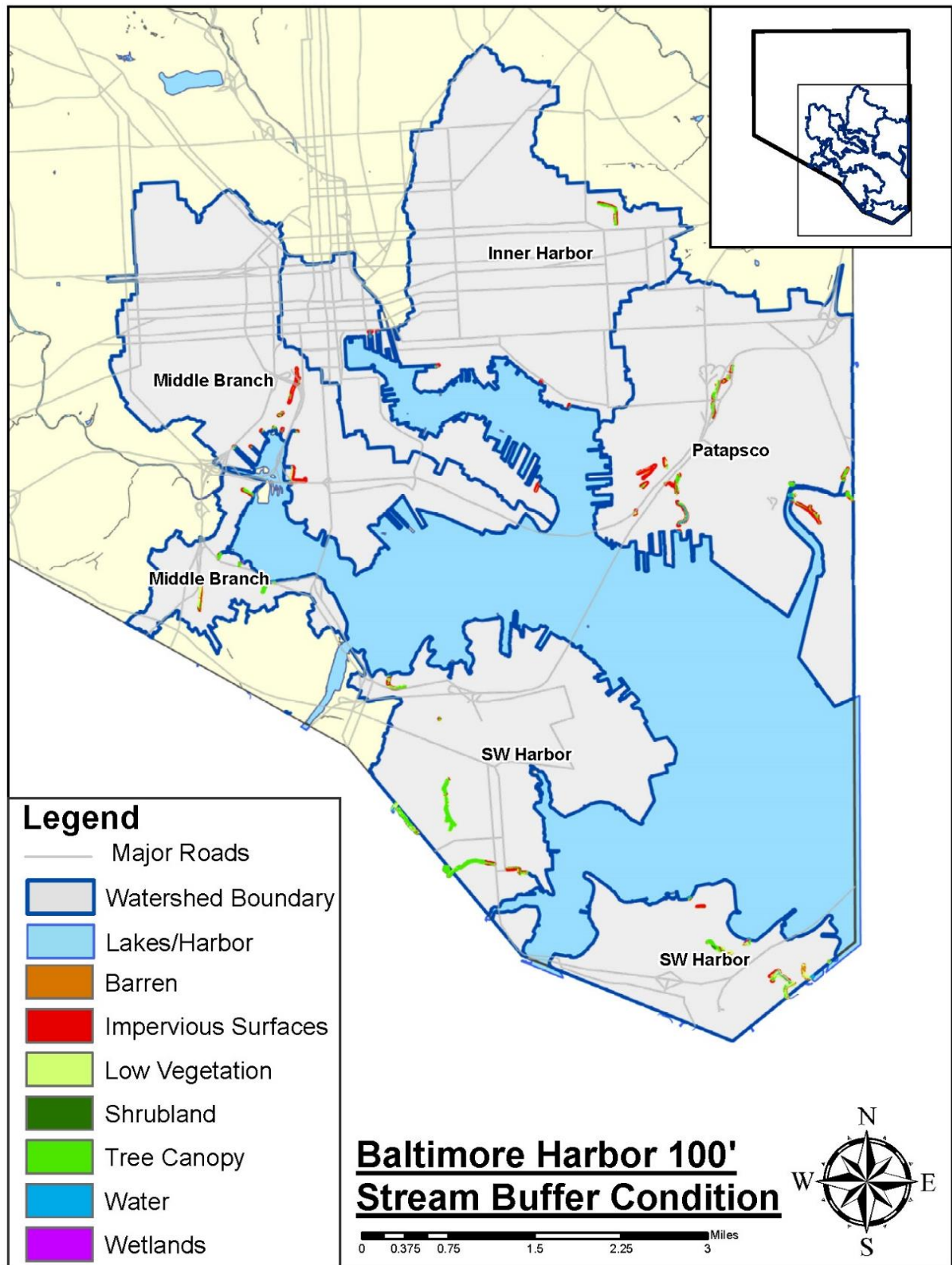
Figure 2-10 100 FT Stream Buffers

2.3.5 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).

2.3.6 Shoreline Riparian Buffers

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

Table 2-13 Baltimore Harbor Shoreline Mileage

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

A shoreline riparian buffer analysis similar to the stream riparian buffer study was conducted to characterize the vegetative condition of shoreline buffers in the Baltimore Harbor planning area. Shoreline 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 shoreline riparian buffer conditions by subwatershed, and the distribution is shown in Figure 2-11.

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

	Impervious		**Open Pervious**		**Forest**		**Wetland**		**Total Acres**	**Total % of Watershed**
Subwatershed	**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 shoreline in the planning area, approximately 55%, is designated as open pervious. Open pervious areas present potential opportunities for re-forestation. The amount of shoreline 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 2%) of the shoreline 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 shoreline buffer zone at approximately 38%. The subwatersheds with the most acres of impervious area in the shoreline 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.
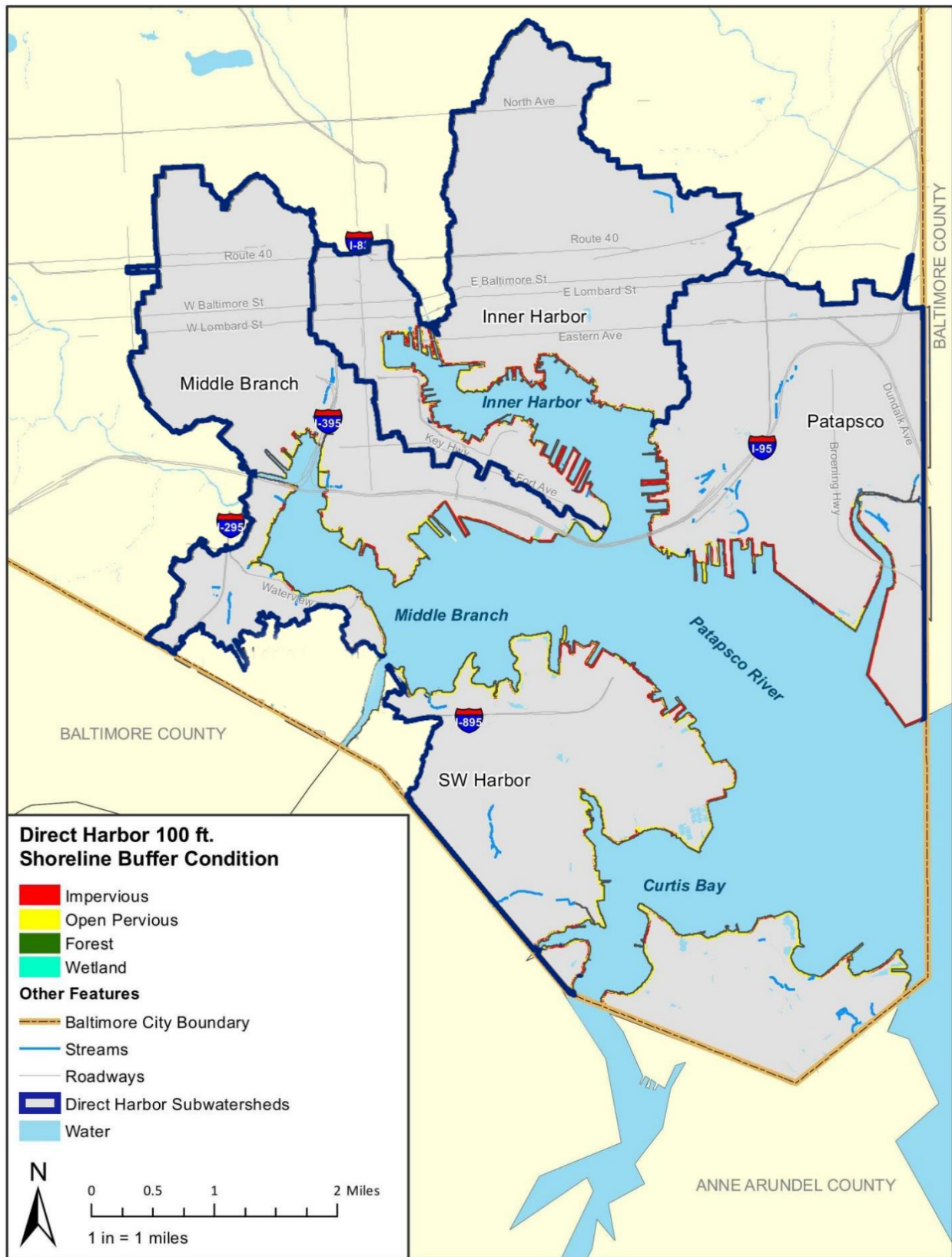
Figure 2-11 100 ft Shoreline Buffer

2.3.7 Floodplain

The Baltimore Harbor watershed contains approximately 612 Acres of 100 Year Floodplain and 567 Acres of 500 Year Floodplain across all subwatersheds, and 5 Acres of Floodway, exclusively in the Middle Branch (Table 2-15).

According to the MDE Stormwater Design Manual, construction of BMP practices is not recommended in the floodplain. In areas of regulated floodplain, alternative practices or specialized designs may be required.

Table 2-15 Floodplain

	Inner Harbor	Middle Branch	Patapsco	SW Harbor	Total
Floodplain 100 year	200.8 Ac (5.1%)	179.6 Ac. (5.3%)	81.9 Ac. (2.4%)	150.0 Ac. (4.0%)	612.3 Ac. (4.2%)
Floodplain 500 Year	134.4 Ac. (3.4%)	154.7 Ac (4.5%)	88.8 Ac. (2.6%)	189.5 Ac. (5.0 %)	567.4 Ac.(3.9%)
Floodway	0 Ac, (0%)	5.0 Ac (0.1%)	0 Ac, (0%)	0 Ac, (0%)	5.0 Ac (0.0%)
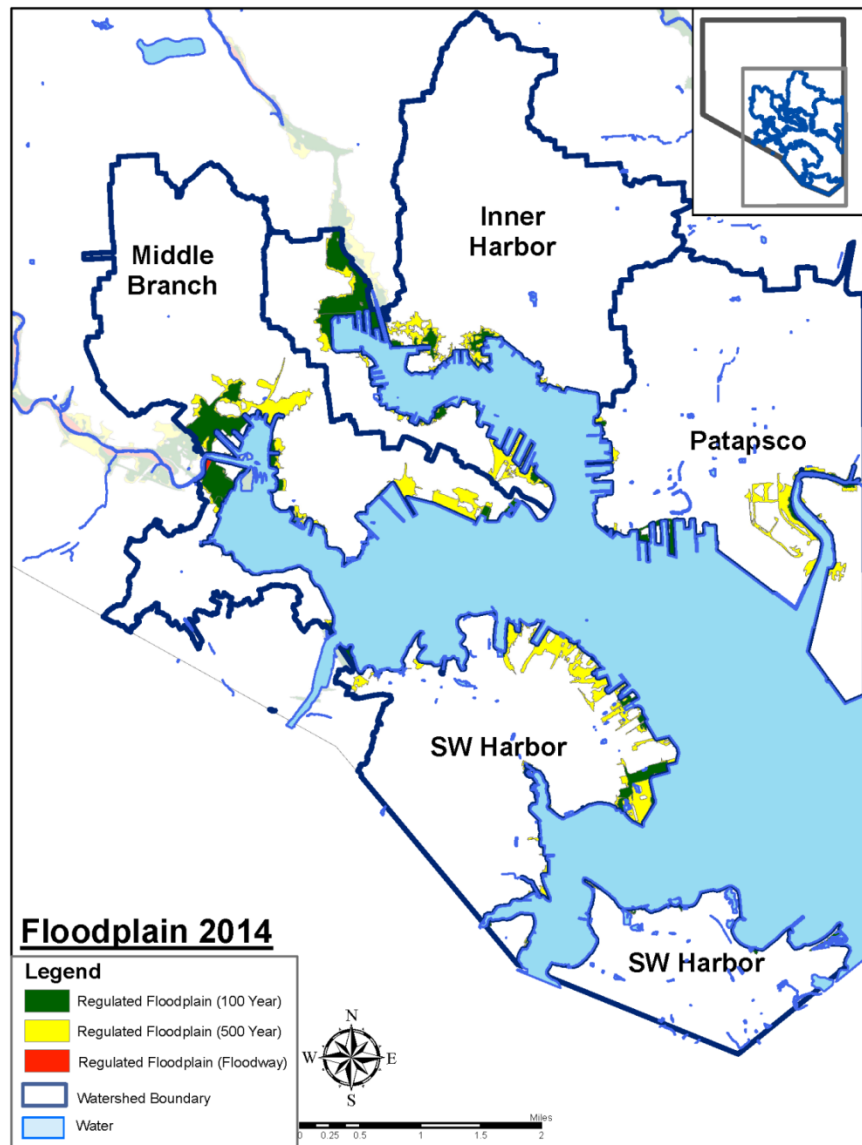
Figure 2-12 Floodplain

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 2-16 includes Eligible MS4 Impervious, which is defined as 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[4].

All of the subwatersheds within the Baltimore Harbor watershed are 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 2-16 Eligible MS4 Impervious by Subwatershed within Watershed

Subwatershed	Inner Harbor	Middle Branch	Patapsco	Southwest Harbor
Acres of Eligible MS4 Impervious	2,389.4	1,552.6	1,148.4	983.2
% of subwatershed	60.7%	45.2%	33.6%	26.2%

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 2-17 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 (Table 2-17 and Figure 2-13). For areas with higher slopes, alternative practices can be used for restoration.

Table 2-17 Eligible Impervious in Watershed and Percent Slope

Slope %	0-5%	5-10%	10-15%	15%+
Acres of Eligible MS4 Impervious	3741.5	1,705.1	403.1	223.0
% of the Eligible Impervious in the Watershed	61.6%	28.1%	6.6%	3.7%

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[4] 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.
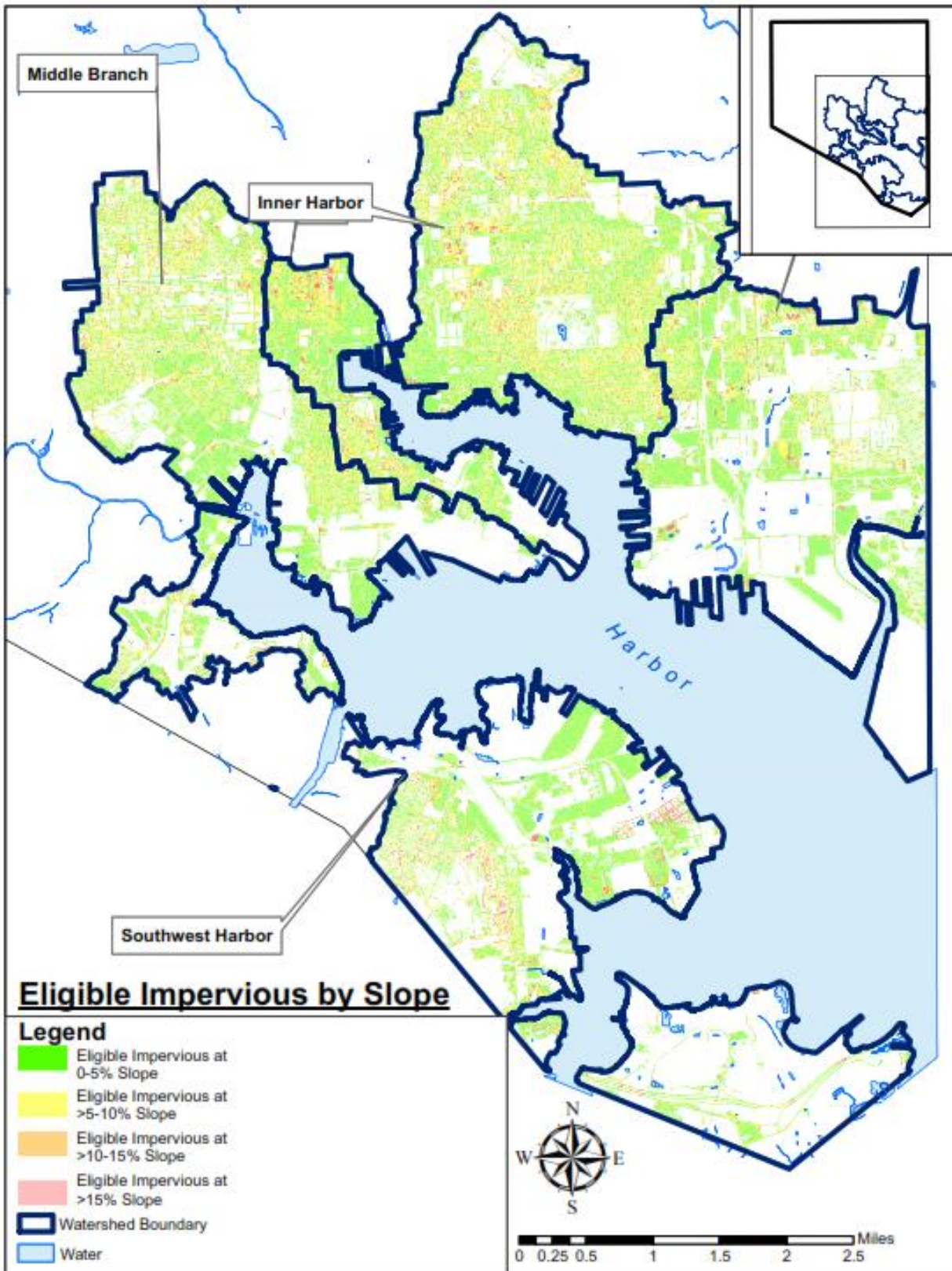
Figure 2-13 Eligible Impervious by Slope within Watershed

Table 2-18 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 within the watershed is found in the Inner Harbor subwatershed, followed by the Middle Branch, Patapsco, and the Southwest Harbor.

Table 2-18 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	1333.4	953.8	778.3	676.0
	As % of Eligible Impervious in Sub Watershed	55.8%	61.4%	67.8%	68.8%
	As % of 0-5% Sloped Eligible Impervious in Watershed	35.6%	25.5%	20.8%	18.1%
>5-10% Slope	Acres >5-10% slope	780.7	446.3	271.2	206.9
	As % of Eligible Impervious in Sub Watershed	32.6%	28.5%	23.6%	21.0%
	As % of >5-10% Sloped Eligible Impervious in Watershed	45.8%	26.2%	15.9%	12.1%

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 2-19). 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 2-19 Eligible Impervious by Property Ownership Type

Type	Area (Ac.) of Eligible Impervious	As % of Total Eligible Impervious
City Owned (non-ROW)	483.5	8.0%
Private	3020.4	49.7%
City Right of Way (ROW)	1842.0	30.3%
Parcel/ROW with Rail	727.8	12.0%

Table 2-20 shows the distribution of impervious surfaces on various land ownership types across sub watersheds with parcels/right-of way with rail accounted for separately. The majority of impervious surfaces on city-owned property within the watershed are contained within the Inner Harbor subwatershed (50.8%), but this represents only 10.3% of the eligible impervious within that subwatershed. Most of the eligible impervious in the Inner Harbor is on private property (53.2%). Most of the eligible impervious in the right-of-way within the watershed is in the Inner Harbor SWS (43.1%), followed by the Middle branch (28%), with less in the Patapsco and Southwest Harbor watersheds (16.4% and 12.6% respectively). For all subwatersheds, the percentage of eligible impervious within the right-of-way is similar (23.6-33.2%). Most properties impacted by rail are found in the Southwest harbor subwatershed, where 38.2% of the eligible impervious is 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 private property owners, particularly in the Southwest and Patapsco subwatersheds.

Table 2-20 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)	245.6	10.3%	50.8%
	Private	1271.0	53.2%	42.1%
	City Right of Way	793.3	33.2%	43.1%
	Parcel/ROW with Rail	79.5	3.3%	10.9%
Middle Branch	City Owned (non-ROW)	152.4	9.8%	31.5%
	Private	764.7	49.3%	25.3%
	City Right of Way	515.8	33.2%	28.0%
	Parcel/ROW with Rail	119.8	7.7%	16.5%
Patapsco	City Owned (non-ROW)	25.3	2.2%	5.2%
	Private	570.9	49.7%	18.9%
	City Right of Way	301.3	26.2%	16.4%
	Parcel/ROW with Rail	250.9	21.8%	34.5%
Southwest Harbor	City Owned (non-ROW)	60.1	6.1%	12.4%
	Private	413.8	42.1%	13.7%
	City Right of Way	231.6	23.6%	12.6%
	Parcel/ROW with Rail	277.7	28.2%	38.2%

*Area of the right of way is estimated

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 absorb and retain heat from the sun. Elevated temperatures from urban heat islands, particularly during the summer, can affect a community's environment and quality of life, including an increased thermal loading, increase in the rate of NOx reactions driving the generation of air pollutants, impaired water quality, and compromised human health.

Figures 2-14 and 2-15 illustrate daytime and nighttime summer temperature readings. Impervious surfaces both radiate heat as well as hold heat. Thus, the highest temperatures for daytime temperatures are those CSAs with large amounts of impervious surfaces and lowest tree canopy and vegetation (which provide evapo-tranpirative cooling and shade), including many of the CSA's in the core of the downtown area. Then those same impervious surfaces can re-radiate heat at night, preventing neighborhoods from cooling down in the summer. Those CSA's that are hottest during both the day and night are Poppleton/the Terraces/Hollins Market, Downtown/Seton Hill, Inner Harbor/Federal Hill, Oldtown/Middle East, Inner Harbor/Little Italy, Madison/East End, and Patterson Park North & East (which is north of the park).
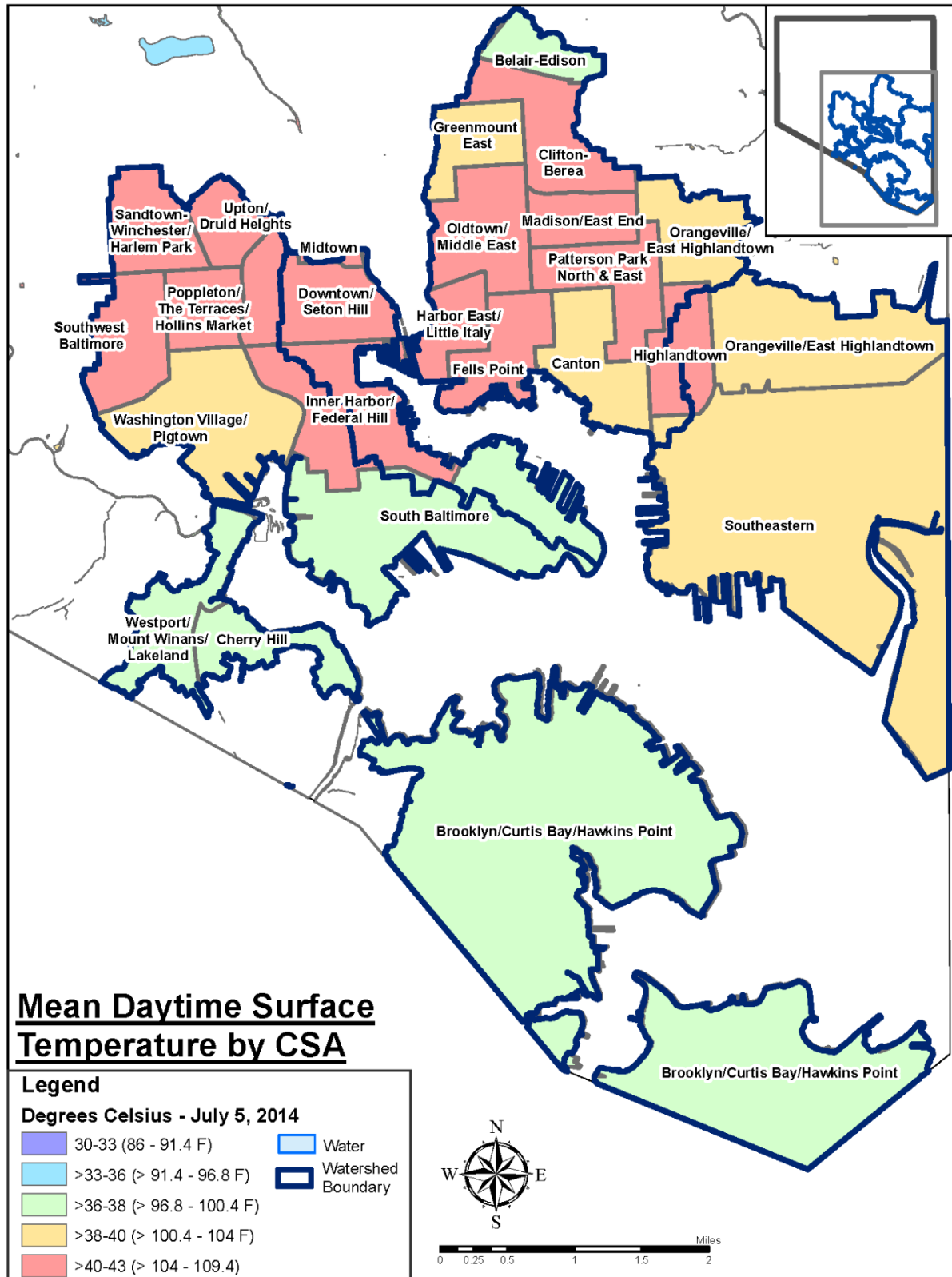
Figure 2-14 Daytime Summer Temperature within Subwatersheds
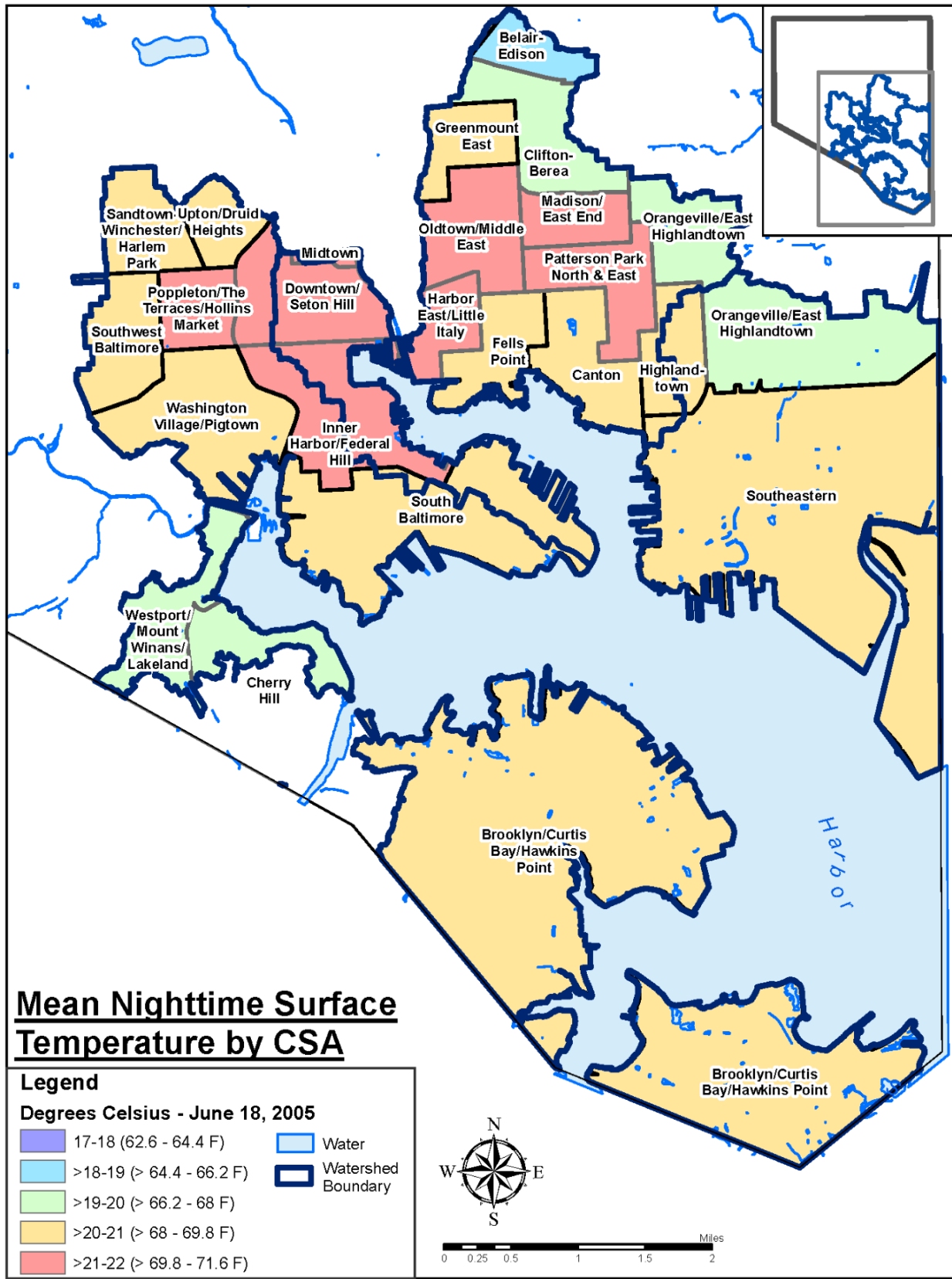
Figure 2-15 Nighttime Summer Temperature within Subwatersheds

2.6 Urban Tree Canopy (UTC) Priority Planting Map

In 2012, Tree Baltimore, 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 2-16). The predominant priority zone of each subwatershed is summarized in Table 2-21.

Table 2-21 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
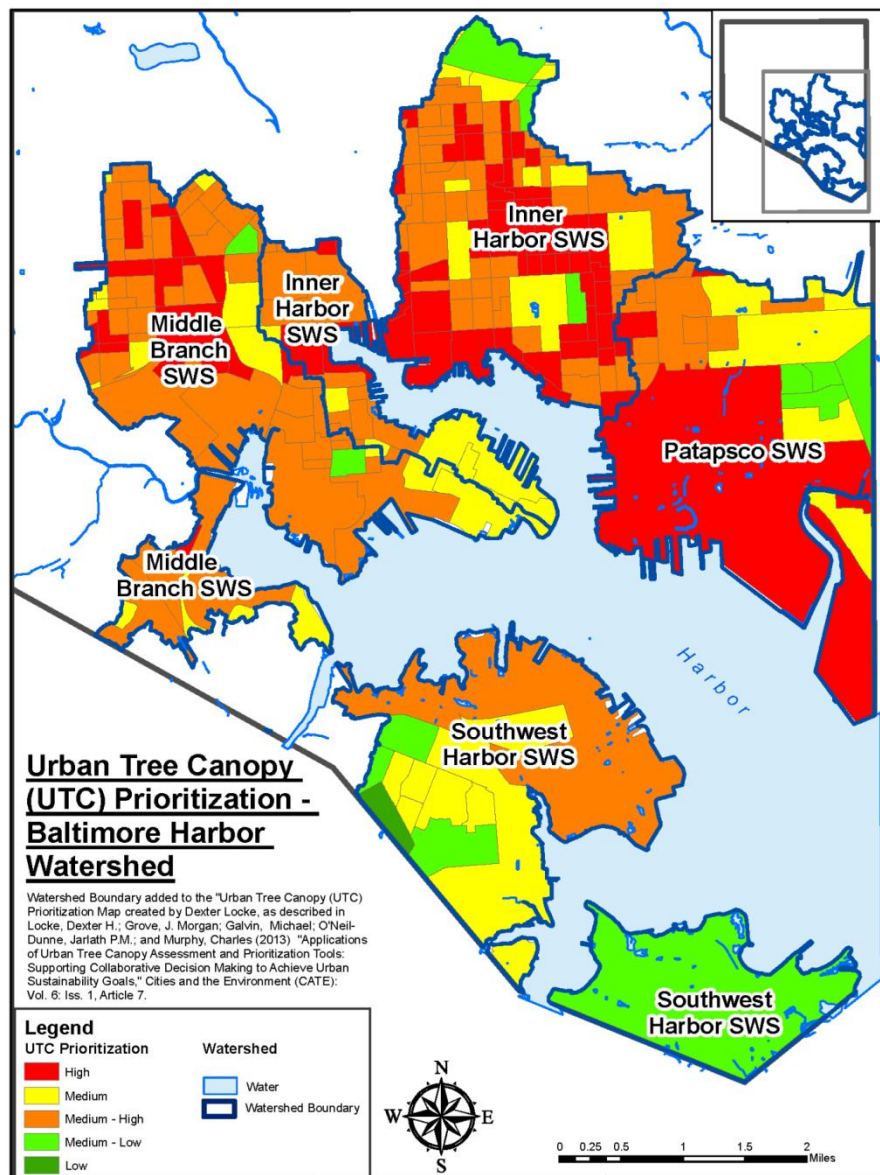
Figure 2-16 UTC Priority Planting Map

2.7 Wet 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 Gwynn's 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 massive network of 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 need 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 need repair, which can result in ground water infiltrating into the sanitary sewer lines and causing SSOs.

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. The Planning Department oversees the CIP and works with the various City agencies to prepare a new six-year program each year.

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 2-22 CIP Projects

Contract	Name	Phase
ER4127	Environmental Restoration Project 11	In Design
SC892	Structural rehabilitation Chambers at PWWTP	Under Construction
SC903	Improvement of Patapsco Collection System	Planned
SC914	Improvements to Sanitary Sewers in Low Level Sewershed BL	Planned
SC919	Improvements to Sanitary Sewers in the Outfall Sewershed	Planned
SC926	Electrical Distribution System at Patapsco WWTP	Planned
SC930	Clinton St. Force Main Replacement	Under Construction
SC938	Headworks Facilities Improvements at the Patapsco WWTP	In Design
SC948	Rehabilitation of Brooklyn Pumping Station	Under Construction
SC950	Caroline Street Pumping Station	Under Construction
SC962	Improvements to Sanitary Sewers in the South East Area of Baltimore City	Under Construction
SC963	Improvements to Sanitary Sewers in the South West Area of Baltimore City and Maidens Choice Pressure Sewer Assessment and Uplands Sewer Replacement	Under Construction
SC965	Improvements to the Sanitary Sewers in the North East Area of Baltimore City	Under Construction
SC976	Improvements in the Greenmount, Hampden, and Bolton Hill Areas in Jones Falls	Under Construction
SDC 7768	Harris Creek Storm Drain	In Design
WC1270	Water Infrastructure Rehabilitation	Planned
WC1272	Pennington Ave & Vicinity Water Main Replacement	Under Construction
WC1293	Water Main Replacement Ridgemeade Ave, Poole St., Bakers St., Winchester St., Fayette St. et al	Under Construction
WC1314	Oliver Neighborhood & Vicinity Water Main Replacements	Under Construction
WC1339	Upton Neighborhood and Vicinity - Water Main Rehabilitation	Under Construction
WC1363	Allendale Neighborhood and Vicinity Water Main Rehabilitation	Under Construction
WC1365	Berea Neighborhood and Vicinity Water Main Rehabilitation	In Design
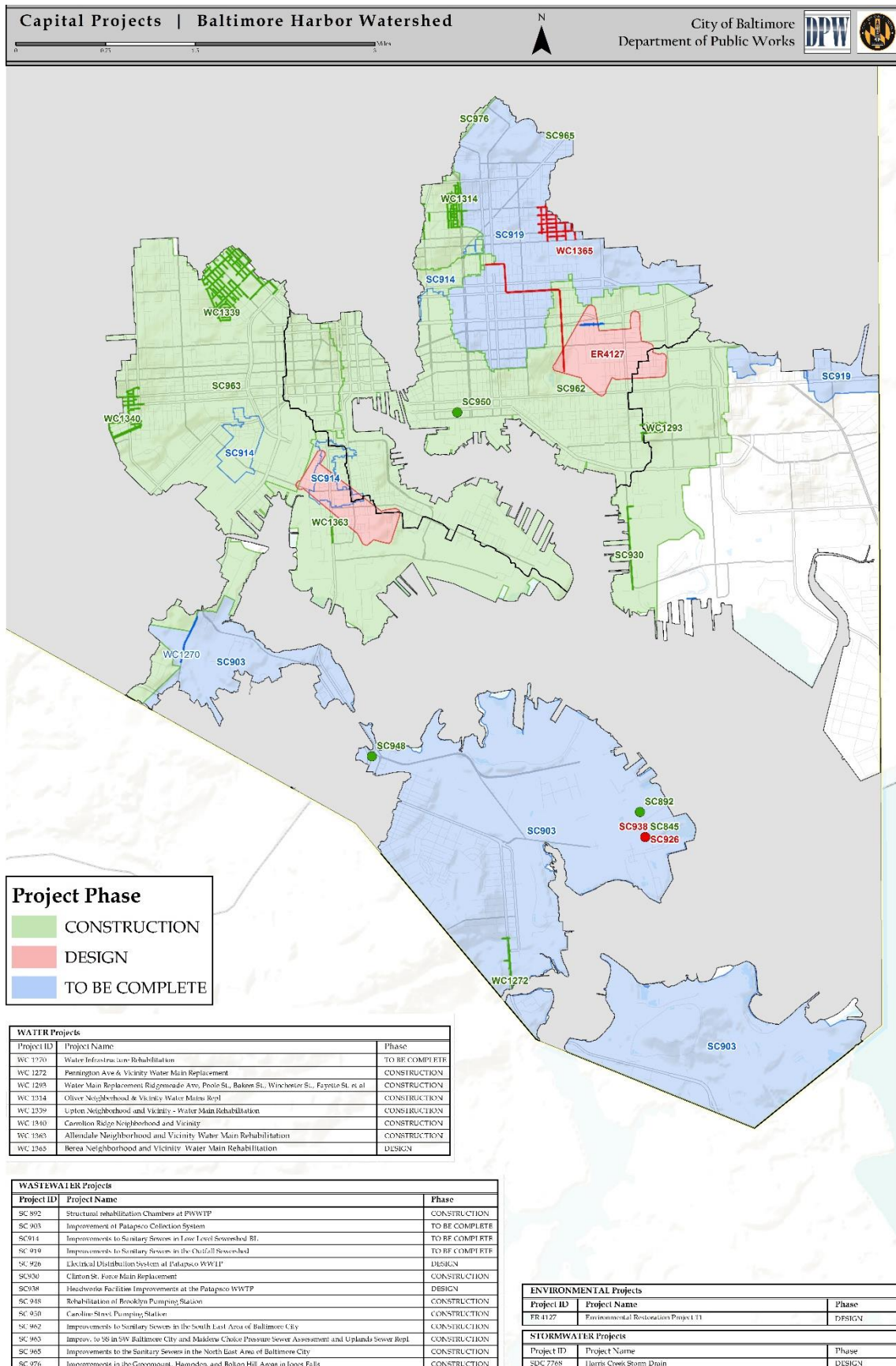
Figure 2-17 CIP Projects within Watershed

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. Capital projects, such as SC914, are intended to reduce the amount of groundwater that enters or infiltrates into sanitary sewers, which overwhelms the sanitary pipes hydraulically and can cause wet weather overflows. These projects consist of performing repairs and installing pipe and manhole liners that seal joints and breaks where groundwater once entered the sanitary lines. 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 2-18 shows the location of SSOs in the BH. 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.
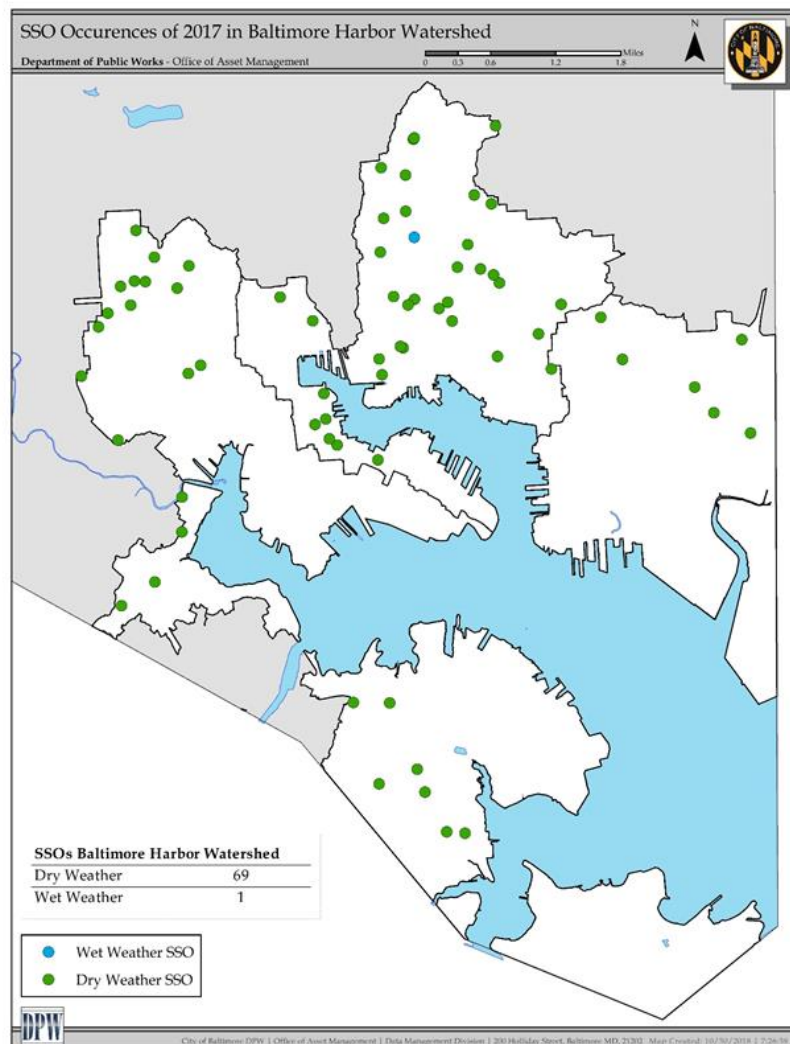
Figure 2-18 Dry and Wet Weather SSOs

2.8 Dirty Streets / Alleys and Clogged Storm Drains

Dirty streets and alleys not only diminish the quality of life of neighborhoods, they also make trash and associated pollutants accessible to stormwater runoff, which ultimately transports the debris and pollutants into storm drains before releasing them into waterways[5]. The Dirty Streets and Alleys variable represents the rate of service requests for dirty streets and alleys through Baltimore's 311 system per 1,000 residents, and has been compiled by CSAs.[6] Clogged storm drains represent the rate of service requests for addressing clogged storm drains made through Baltimore's 311 system per 1,000 residents, also compiled within CSA's. Both indicators represent reflect a combination of environmental condition and resident engagement, and can be used to target trash reduction programs, while recognizing that part of what is not captured in higher levels of reporting may reflect a greater problem or may reflect greater knowledge of the 311 program and trust the responsiveness of government to the problem using that system. 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 2-23 and Figures 2-19 and 2-20).

Table 2-23 Rate of Dirty Streets / Alleys and Storm Drains per 1,000 Residents

CSA	Rate of Dirty Streets and Alleys Reports per 1,000 Residents	Rate of Clogged Storm Drain Reports per 1,000 Residents
Belair-Edison	74.9	2.6
Brooklyn/Curtis Bay/Hawkins Point	71.1	1.8
Canton	46.5	4.7
Cherry Hill	8.0	2.4
Clifton-Berea	140.0	3.4
Downtown/Seton Hill	29.8	9.5
Fells Point	56.3	7.9
Greenmount East	176.1	5.3
Harbor East/Little Italy	27.7	5.5
Highlandtown	160.7	5.5
Inner Harbor/Federal Hill	34.8	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
Orangeville/East Highlandtown	138.1	5.5
Patterson Park North & East	207.0	6.1
Poppleton/The Terraces / Hollins Market	85.5	5.9
Sandtown-Winchester/Harlem Park	89.2	2.8
South Baltimore	25.9	4.1
Southeastern	30.0	4.3
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

[5] See Section 3.2 for a description of trash related programs.
[6] While dirty street and alleys and clogged storm drain SRs are often used as indicators of community cleanliness, they can also be indicative of engaged residents.
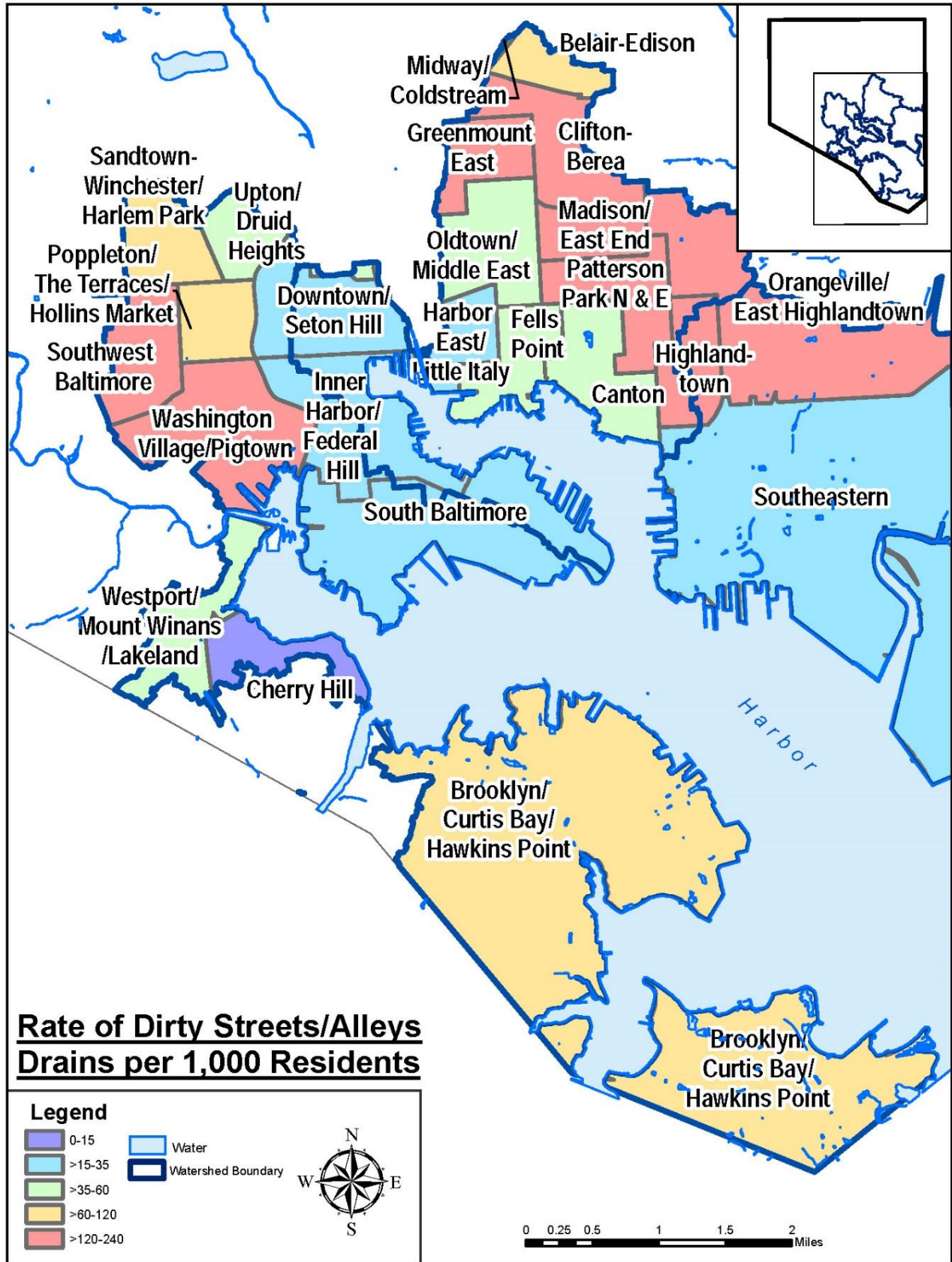
Figure 2-19 Rate of Dirty Streets/Alleys per 1,000 Residents
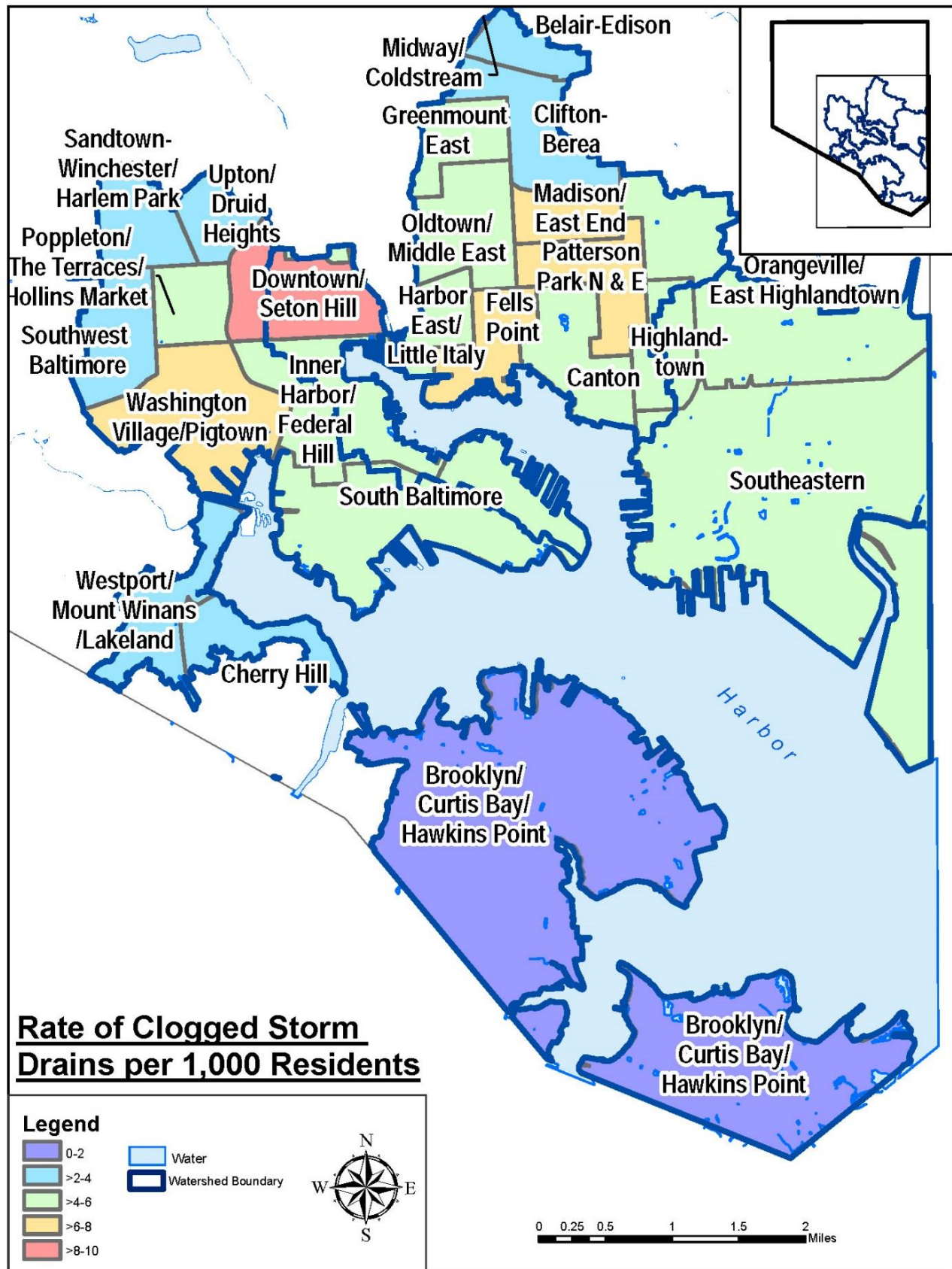
Figure 2-20 Rate of Reported Clogged Storm Drains per 1,000 Residents
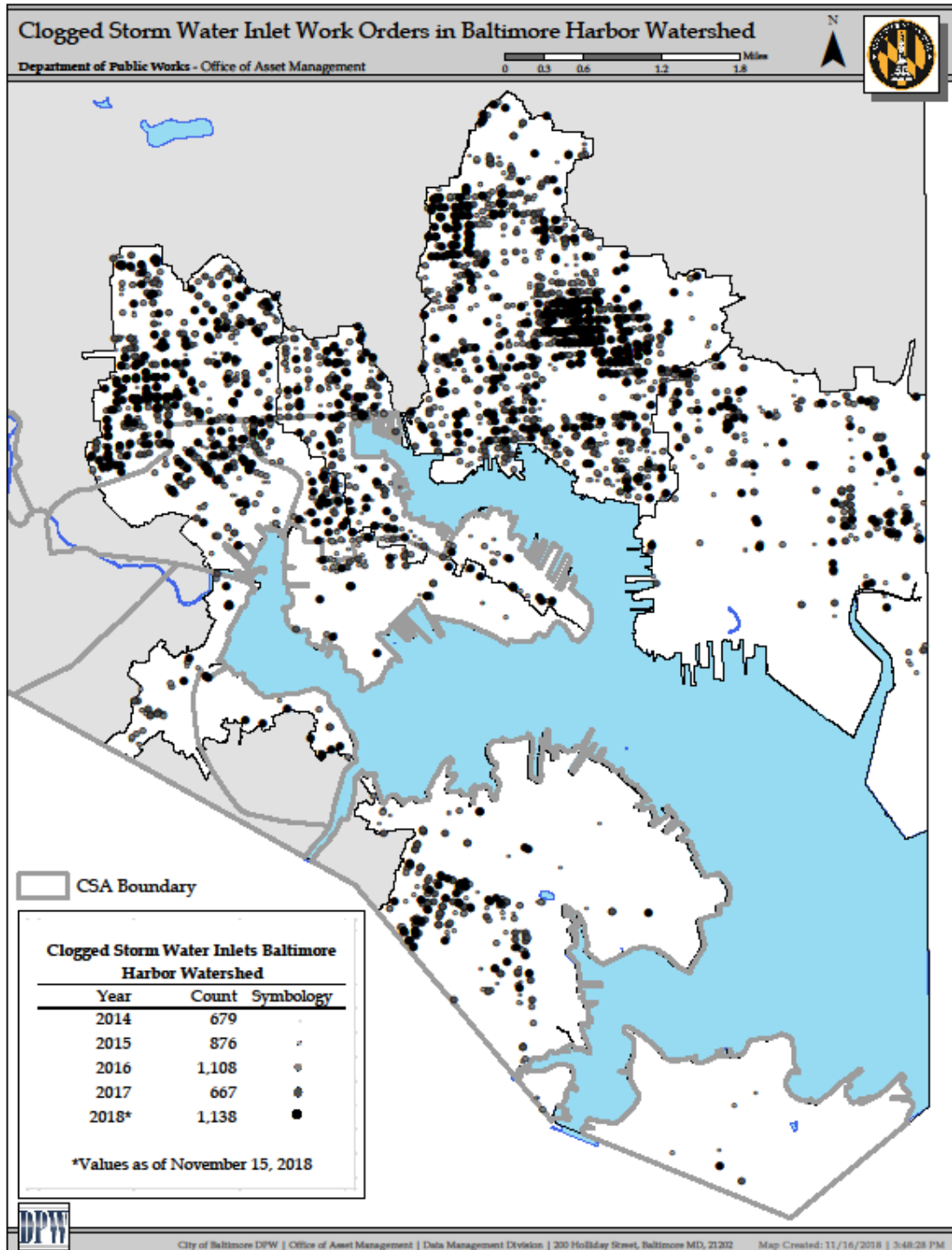
Figure 2-21 Clogged Inlet Locations

Figure 2-21 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 Visual Watershed Inspection

Upon completion of the desktop analysis, a visual inspection of the watershed was conducted in November 2018. The purpose was to field verify the desktop analysis and to refine the BMP recommendations made in Section 5.5. The visual inspection focused on the following areas:

Belair-Edison

- Clifton Park
- Land use – housing types and yards
- Schools (Lillie May Jackson Charter)
- Green street opportunities (identified in the Baltimore Green Network)

Berea / Clifton

- Green street opportunities (identified in the Baltimore Green Network)
- INSPIRE school areas
- Land use – housing types and yards
- Green street opportunities – Federal Street / Oliver Street / Chester Avenue / Patterson Park Avenue
- Collington Square Park

Brooklyn / Curtis Bay / Hawkins Point

- Schools (Ben Franklin High School and Curtis Bay Middle School)
- Larger property owners

Madison East End / McElderry Park

- Green street opportunities (Baltimore Green Network)
- Street trees
- Ellwood Park / Bocek Park

Oldtown / Middle East

- Perkins Housing
- Harford Avenue corridor

Southeast Baltimore

- Dundalk Avenue / Holabird Avenue corridor
- Gersuch Creek
- Colgate Creek
- Graceland Park neighborhood
- Land use – housing types and commercial properties

Washington Village

- Schools – Charles Carroll Barrister, George Washington, and Sharp Ledenhall
- Carroll Park

- Carroll Camden area (street trees / commercial properties)

- Baltimore Green Network corridors

As part of the MS4 WIP and Deep Blue project (Section 2.11.1), visual inspections were made in Westport and Highlandtown for feasibility of stormwater BMPs. Additionally, visual inspections for land use density and right-of-way opportunities / barriers were made in Fells Point, Inner Harbor, Federal Hill, and South Baltimore.

2.10   Socio-Economic Conditions & Health Related Factors

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, Baltimore city has a near 20-year gap in life expectancy across neighborhoods. Addressing these disparities will likely require the intentional consideration of opportunities for health protection and promotion within decision making processes across multiple sectors, including land-use design and planning, beyond those traditionally associated with healthcare and public health systems.

For instance, the built environment is a known determinant of health outcomes, and socio-economic factors drive vulnerability to environmental and other risks to health. Modification of the built environment through installation of ESD, tree planting, and similar practices can mitigate hazardous environmental exposures (e.g., heat burden and air quality), or provide health supporting resources (e.g., access to nature). Programs and partnerships can also be developed that support community needs while addressing watershed concerns.

Therefore, data was also gathered on a wide variety of socio-economic and also human health related factors to inform this assessment. Table 2-24 is a summary of six (6) key factors. Additional factors were considered to inform the geographic prioritization of work, as discussed in detail within the Suitability Analysis Chapter 4.

Table 2-24 Social / Economic Conditions by CSA

SWS	CSA	Life Expectancy	Hardship Index	% White	% Age <18	% Age 65+	Median Income
Inner Harbor (IH)	Belair-Edison	72.0	55	9.3	28.0	8.4	$38,906
	Canton	78.4	11	90.1	7.5	10.3	$91,736
	Clifton-Berea	66.9	61	3.3	21.1	15.6	$25,738
	Fells Point	78.7	23	80.5	10.7	6.0	$77,433
	Greenmount East	67.9	73	2.9	24.5	12.9	$23,277
	Harbor East / Little Italy	72.1	58	33.1	22.0	6.0	$36,579
	Madison / East End	68.9	90	5.2	29.5	6.5	$27,454
	Midtown	76.4	32	54.4	6.2	13.6	$38,867
	Midway / Coldstream	69.0	72	2.3	22.2	13.0	$34,523
	Oldtown / Middle East	70.4	80	8.1	24.6	13.3	$14,105
	Patterson Park N&E	72.4	50	54.1	21.8	6.1	$56,652
IH & MB	Downtown / Seton Hill	67.5	26	49.3	6.1	4.4	$44,819
	Inner Harbor / Federal Hill	79.2	16	79.2	11.6	11.5	$88,854
	South Baltimore	76.7	17	89.7	11.3	7.8	$88,487
Middle Branch (MB)	Cherry Hill	69.5	74	5.1	37.2	8.2	$22,659
	Poppleton / The Terraces / Hollins Market	68.4	75	17.2	25.9	9.0	$17,228
	Sandtown-Winchester / Harlem Pk	7.0	80	0.8	26.0	11.4	$24,374
	Southwest Baltimore	68.0	76	17.4	26.8	11.2	$24,946
	Upton/Druid Hts	68.2	82	3.7	31.7	10.4	$15,950
	Washington Village	70.1	56	39.6	19.3	8.0	$48,175
	Westport / Mt Winans / Lakeland	73.8	64	24.2	28.5	6.9	$41,368
IH & PT	Highlandtown	74.5	38	80.1	15.3	10.0	$71,660
	Southeastern	72.7	69	55.2	27.1	13.5	$32,102

SWS	CSA	Life Expectancy	Hardship Index	% White	% Age <18	% Age 65+	Median Income
Patapsco (PT)	Orangeville /E. Highlandtown	73.0	59	63.9	25.0	12.4	$40,431
SW Harbor	Brooklyn / Curtis Bay / Hawkins Point	69.7	76	48.4	27.2	6.3	$35,862

Life Expectancy
This represents the average number of years a person living from birth to death in a set location could expect to live. Health outcomes, including life expectancy, are the result of a complex set of interwoven factors that extend beyond biological factors, behavior, and healthcare to include the modifiable socio-economic and environmental conditions that shape people's lives.

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 people of color 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.

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

2.11   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 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 BH Watershed.

2.11.1   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 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 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), DPW, and the communities of Oliver and Highlandtown. Master plans for each community identify potential stormwater management projects on both public and private property.

2.11.2   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 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 Plan 2.0 (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 stormwater 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 (on-going)
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 Middle Branch and Baltimore Harbor.

2.11.3 Other Plans

Baltimore Green Network Plan (2018)
The Baltimore Green Network Plan, led by the Department of Planning (DOP), is a 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. 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.

INSPIRE Schools Plans (2016-2019).
INSPIRE, which stands for Investing in Neighborhoods and Schools to Promote Improvement, Revitalization, and Excellence, focuses on public improvements within the quarter-mile area around each school. Led by the Department of Planning (DOP), the plans include Bay Brook Elementary/Middle School (E/MS), Fort Worthington E/MS, Harford Heights ES, John Ruhrah E/MS, and Fairmount Harford Charter 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, 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, the Johns Hopkins Medical System, Bon Secours, Kaiser Permanente, Saint Agnes, University of Maryland, and Mercy Hospital.

2.12 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 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 other 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 BH 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 stormwater management projects 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 Planning Department's Office of Sustainability and Baltimore City Public Schools 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 Maryland 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 stormwater infrastructure, since installation of these facilities can support environmental education within schools, especially those schools with active environmental leadership initiatives.

Social and Emotional Learning and Student Wholeness - 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. This supports one of the three pillars the City Schools' Blueprint for Success, Student Wholeness. There are opportunities to integrate education about water into the curriculum, since it 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 with natural processes, it is necessary to evaluate the state of existing land, water, and biological elements that provide for their needs.

Public Health Initiatives
The approach taken by this WA includes the goal of maximizing the human relevant co-benefits associated with watershed restoration efforts, including a focus on contributing to health supportive communities and social equity. Therefore, it is the intent to explore how the siting of projects and development of programs and partnerships can support public health focused initiatives in the watershed. The Baltimore Harbor includes the Medstar Harbor Hospital, which recently installed several ESD facilities in partnership with Blue Water Baltimore with the goal of providing access to nature on their hospital campus to support healing. Additionally, a multi-year grant was recently awarded to the Department of Recreation and Parks and the Office of Planning that focused on creating opportunities for access to nature to mitigate the health impacts of trauma; an initiative that is clearly aligned with strategies associated with watershed restoration.

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.

The Non-Tidal River waters of the MD 8-digit Baltimore Harbor watershed are designated as Use I - Water Contact Recreation, and Protection of Non-tidal warm-water Aquatic Life, while the tidal waters are designated as Use II - Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting. Specific water quality criteria for designated uses can be found in COMAR Sec. 26.08.02.03-3.

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 *2018 Integrated Report of Surface Water Quality in Maryland States*, which was approved by USEPA in April of 2019. Within the 2018 report, impairments that are estimated to require a TMDL within the next two years are identified. These impairments are listed within Table 3-2.

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.

3.11.2   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.

3.11.3   Local TMDLs and Impairments
Table 3-1 lists the five (5) pollutants with TMDLs currently approved by the EPA with established load reduction requirements. Additionally, the Baltimore Harbor has nine additional impairment listings, two of which are structural and not related to any particular pollutant (Table 3-2). Since the Baltimore Harbor Watershed is included within the Patapsco Mesohaline (PAT-MH) segmentshed used for the Chesapeake Bay TMDL, impairments noted for the PAT-MH segments are also included in 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 (rev. 2015)	260,323.0	221,274.0	LBS/ year	Annual Avg.	15%
Total Phosphorus	2007 (rev. 2015)	28,177.0	23,951.0	LBS/ year	Annual Avg.	15%
Trash	2015	217,495.7	228,370.6	LBS/ year	Annual Avg.	NA
Pesticides (Chlordane)	2001	0.00059	0	ug/l	Annual Avg.	NA
PCBs	2012	435.27	30.44	g/yr	Annual Avg.	93%

https://mde.maryland.gov/programs/Water/TMDL/Pages/sumittals_a-l.aspx

Table 3-2 Baltimore Harbor Water Quality Impairment and Assessments Listings

Impairment	Applicable Segment	Status	Approval Date
Bacterial (Enterococcus)	Tidal subsegment of MD-PATMH: Middle Branch/Northwest	Impaired	TMDL not yet established
Sulfates (replaces Biological listing 2016)	Baltimore Harbor	Impaired	TMDL not yet established
Chlorides	Baltimore Harbor	Impaired	TMDL not yet established
Total Suspended Solids (TSS) (replaces Biological listing 2016)	Baltimore Harbor & - PATMH - Patapsco River Mesohaline (Note TSS is addressed by the Chesapeake Bay TMDL)	Impaired	TMDL not yet established
Zinc (sediments)	Tidal subsegment of MD-PATMH: Middle Harbor & Inner Harbor/Northwest Branch	Impaired	WQA Complete 2005 - TMDL not yet established
Lead (sediments)	Tidal subsegment MD-PATMH: Inner Harbor/Northwest Branch	Impaired	WQA Complete 2005 - TMDL not yet established
Chromium (sediments)	PATMH - Patapsco River Mesohaline	WQA Complete 2014	WQ Standards met – some insufficient data
Habitat – Lack of Riparian Buffer	Baltimore Harbor	Non-pollutant Impairment	N/A
Habitat – Channelization	Baltimore Harbor	Non-pollutant Impairment	N/A

https://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/2016IR.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. Nutrients are also contributed by municipal wastewater treatment plants (WWTPs) discharging to the MD-PATMH tidal segment (including the Patapsco WWTP located within the watershed), and industrial point sources (both those owned and operated by Baltimore City and by private entities). TMDLs set for industrial and WWTP point sources vary from plant to plant and are based on implementation of available technologies to achieve water quality criteria.

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 structural 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 employs a two-part, three-phase strategy to meet the WLA. The first part utilizes 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 is concurrent with the first, employing partnerships as a sustainable method for compliance with the trash TMDL. The initial 5-year phase incorporates 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.

Sulfates *(this and other indicators collectively replace the biological listing – 2016 Integrated Report)*
Sulfates have been identified as potentially contributing to impairments in the biological health of various organisms in the Baltimore Harbor. Sulfates are present in roadway runoff, resulting from oils and de-icing products.

Chlorides *(this and other indicators collectively replace the biological listing – 2016 Integrated Report)*
Chlorides have been identified as potentially contributing to impairments in the biological health of various organisms in the Baltimore Harbor. Chlorides are present in roadway runoff, resulting de-icing products.

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 bio-accumulative 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. Chlordane is a bio-accumulative chemical that is carcinogenic and can cause both acute and chronic toxic effects, similar to the biological effects of PCBs. While no longer in use, it is found in

sediment and fish tissues.

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.

No current regular loading occurs for chlordane, but individual residents may have stored chlordane. Reduction depends on offering opportunities for individuals to properly dispose of hazardous waste, and relies on biological and hydrologic processes within microbial communities, fish, and sediment. Chlordane concentrations in the watershed are expected to decline over time through biodegradation and dispersal during the natural recovery process of the estuary.

Sediment *(this and other indicators collectively replace the biological listing – 2016 Integrated Report)*
There is no local TMDL for sediment (TSS) for the Baltimore Harbor Watershed. However, TSS is addressed in the Chesapeake Bay TMDL (see Section 3.1.2) which the Baltimore Harbor contributes to, so this report will also address sediment.

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.

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. Based on the 2016 and Draft 2018 Integrated Report of Surface Water Quality, a TMDL may need to be developed for Zinc and Lead in sediments within the Inner Harbor, Northwest Branch, and Middle Harbor portions of the PAT-MH.

Lack of Riparian Buffer & Channelization
(this and other indicators collectively replace the biological listing – 2016 Integrated Report)
Lack of riparian buffer & channelization are noted impairments to water quality that are structural, resulting from the existing intensely developed nature of the watershed. No TMDL has been developed since these are not related to pollutants.

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 are found in Section 5.4.

Table 3-3 Water Quality Pollutants and Contributing Factors

Pollutant	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)

Pollutant	Contributing Factors
Sediments (TSS)	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)
Chlordane & PCBs	Land Use (Legacy PCBs due to past industrial uses)
Metals	Untreated Impervious surfaces Land Use (industrial) Often bound to sediment (see contributing factors for sediment)
Trash	Untreated Impervious surfaces (runoff) Behavior (Trash not disposed of properly) Land Use (Corner stores / fast food establishments)
Sulfates & Chlorides	Untreated Impervious surfaces (runoff) De-icing products on roadways
Channelization & Lack of Riparian Buffer	Intensive land development Impervious surfaces and resulting peak runoff

3.12 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, only one monitoring station (the sampling station at S Linwood Ave. and Elliot St.) which has the highest nutrient values of all monitoring stations (100% Nitrogen and 55% Phosphorus), showed an increase in FY18 in sampling results above the threshold for nutrients. Additionally, this monitoring station tested highest for Enterococci (2,304 MPN/100 ml). Thus, the contributing drainage area to this monitoring location provides opportunities for water quality improvement projects and should be targeted.

3.12.2 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.

4   SUITABILITY ANALYSIS & PRIORITIZATION

4.1   Introduction

The regulatory purpose of this Watershed Assessment is to identify and prioritize strategies and areas 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 not just the physical conditions of the watershed, but also factors related to human behavior and the interface between human populations and the environment. This analysis, necessary to achieve the primary regulatory targets, creates a natural, aligned opportunity to leverage the activities required under the MS4 permit to address the additional (non-regulatory) goal of prioritizing locations and activities to better address equity and serve communities in Baltimore.

It is recognized that Baltimore city has a near 20-year gap in life expectancy across neighborhoods, with geographic disparities in environmental quality, socio-economic conditions, 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). Addressing these disparities requires the incorporation of intentional consideration of opportunities to protect and promote health across multiple sectors outside of fields traditionally associated with healthcare or public health.

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, sediment, bacteria, trash, and metals.
      i. Identify areas where installed restoration projects are likely to 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 , including the following, associated with ESD practices:
      i. Heat island mitigation and decreased utility bills
      ii. Improve existing green spaces/prove accessible green spaces
      iii. Air quality enhancements
      iv. Pedestrian safety and comfort
      v. Support educational and workforce development initiatives
      vi. Foster community acceptance and stewardship
      vii. Align with existing community needs/goals
      viii. Mental and restorative health benefits
      ix. Maximize the direct beneficial environmental outcomes associated with implementation of restoration efforts, including:
         • Decrease flooding
         • Protect and restore shorelines, buffers, and natural areas
         • 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 was developed based on the understanding that ESD projects provide a range of known co-benefits that are valuable in a highly developed, dense urban area like Baltimore, but also require a specific set of physical environmental conditions to be feasible. Where ESD projects may not be feasible, projects focused on alternative practices, programs, or partnerships may be appropriate, and can be developed with targeted goals in mind that may provide programmatic benefits to communities. The prioritization described below is used to identify areas that will be assessed first for feasible and appropriate projects, programs, and partnerships with the intent of prioritizing ESD practices where feasible.

Prioritization of CSA's was done city-wide, and included the following steps:

1. **Prioritization by Community Statistical Areas (CSAs):**
   a. <u>Prioritization by CSA:</u> A scoring process was developed to assess and prioritize CSAs based on:

   i. the feasibility for implementation of ESD projects based on the physical conditions within each CSA;
   ii. an assessment of socio-economic and racial equity related conditions within CSAs; 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) understood to be modifiable through implementation of projects, programs, and partnerships related to restoration activities.

2. **Identification of watershed resources and areas of opportunity:**
   a. <u>Watershed Resources and Opportunities:</u> 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 5.2)
   a. <u>Identification of Suitable locations for Projects and Programs:</u> A list was compiled of the ideal conditions for various types of projects and programs identified within the watershed. Once this list was compiled, areas where ideal conditions exist based on the suitability analysis were identified.

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

a. **Prioritization by Community Statistical Areas**

Geographic areas within the watershed were first prioritized based on Community Statistical Areas (CSAs). To accomplish this, three main Prioritization Categories were identified as relevant for achieving the goals of this watershed assessment, defined by multiple embedded factors. Each CSA was ranked in terms of priority relative to others across the city within each Prioritization Category, based on the factors identified. Results from prioritization within the three Prioritization Categories were aggregated to arrive at an Overall Prioritization of CSA's, considering factors across all three Prioritization Categories.

The three (3) Prioritization Categories were defined as:

- Physical Feasibility for ESD practices

- Equity (socio-economic & racial)

- Health Supportive Community

4.2.a.1   Prioritization based on Physical Feasibility for ESD Practices

Physical feasibility factors were defined based on the conditions which would be ideal for implementation of ESD projects by DPW[7]. Prioritizing CSAs 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 is necessary to ensure planned restoration work can provide the greatest possible benefit while minimizing the cost burden for the public.

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

- Acres of Eligible Impervious in CSA
- Acres of 0-5% slopes in CSA
- Percent of Eligible Impervious available in CSA that is either within the City Rights of Way or on City Owned land
- Acres of Hydrologic Soil Groups A & B in CSA

Physical feasibility data was extracted for the area of each CSA using Arc GIS 10.3 mapping software. Cut points used to assign points for each factor were established based on quintiles derived from the results.

4.2.a.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 BMP's implemented as part of restoration activities, including 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. Areas with more residents that identify as other than white were also prioritized, as these areas have experienced systemic disinvestment throughout Baltimore's history. 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.

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[7] Physical feasibility within this prioritization framework is aimed at identifying priority areas for projects by DPW due to the inclusion of the factor," Percent of Eligible Impervious available in CSA that is either within the City Rights of Way or on City Owned land". However, opportunities to for DPW or partners to engage private land owners and businesses in restoration efforts can be identified using this prioritization analysis and information contained throughout this assessment. For example, by identifying CSA's with high priorities in the Equity and Health Supportive Communities Prioritization Categories with higher levels of Eligible Impervious on private land, as summarized in the Watershed Resources and Opportunities tables, and as indicated by favorable physical conditions summarized throughout this report.

Factors considered for the Equity Prioritization Category were as follows:

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

Factors considered for the Health Supportive Communities[8] Prioritization Category were as follows:

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

Cut points used to assign points for each factor were established based on natural breaks in the data considering all CSAs across Baltimore. Cut-points reviewed to ensure they were reasonable with regard to assessing relevant differences between CSAs and adjusted as necessary.

4.2.a.3   Scoring and Overall Priority Designation

Within each Prioritization Category, each CSA was assigned a score for each factor considered (1-5 points), based on its ranking relative to other CSAs across the city (5 points for higher priority, 1 point for lower priority). The scores for all factors were then summed to create a score for each CSA within each Prioritization Category.

Scores for each Prioritization Category were then divided into groups based on quintiles considering all CSA's across Baltimore City, and ranked. CSAs within each quintile were then assigned a Priority Designation (Priority 1 = High Priority; Priority 5 = Low Priority) within each Prioritization Category.

To arrive at an Overall Prioritization across the three Prioritization Categories, a composite score was created by assigning points to each Priority Designation within the three Prioritization Categories (5 points for priority 1 through 1 point for priority 5). This was necessary to avoid the artificial weighting of the importance of the Prioritization Categories based on the number of factors identified within each, which would have resulted from summing the raw scores**.** These points were then summed.

The resultant composite scores were divided into quintiles to determine the Overall Priority Designation for CSA (Priority 1 = High Priority; Priority 5 = Low Priority).

Table 4-1 contains the results of the ranking and prioritization process for all CSAs.

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

Table 4-1 Prioritization of CSAs

Category	Factor	Belair-Edison	Brooklyn / Curtis Bay / Hawkins Point	Canton	Cherry Hill	Clifton / Berea	Downtown / Seton Hill	Fells Point	Greenmount East	Harbor East / Little Italy	Highlandtown	Inner Harbor / Federal Hill	Madison East End	Midtown
Equity SES	% White(Inv)	4	2	1	5	5	2	1	5	3	1	1	5	1
	% No HS Diploma or Equiv.	2	5	1	3	4	1	1	4	3	3	1	5	2
	Median Income	3	3	1	4	4	2	1	4	3	1	1	4	3
	HH Poverty	3	4	1	5	4	2	1	4	4	2	1	4	2
	Hardship Index	3	5	1	5	4	2	1	5	3	2	1	5	2
Equity Outcomes	Life Expectancy	3	4	2	4	5	5	2	5	3	3	1	4	2
Equity Score (Points Total)		18	23	7	26	26	14	7	27	19	12	6	27	12
Equity Priority Designation (1=High Priority)		**3**	**2**	**5**	**1**	**1**	**4**	**5**	**1**	**3**	**5**	**5**	**1**	**5**
Health- EnvEx	%Impervious Not Shaded	2	3	4	2	4	5	5	4	5	5	5	5	5
	Daytime Surface Temp	3	3	4	3	5	5	5	4	5	4	5	5	5
	Nighttime Surface Temp	2	4	4	3	3	5	4	4	5	4	5	5	5
	%Walked	1	1	1	2	2	5	4	2	5	2	4	3	4
Health Resources	%Unemployment	4	4	1	4	5	1	1	5	4	2	1	5	2
	% No Vehicle	3	3	1	5	4	4	2	5	4	2	2	5	4
	Violent Crime	3	4	2	4	4	5	3	4	5	4	3	4	4
	% Canopy	3	4	4	3	5	5	5	4	5	5	5	5	4
	% Parks/Greenspace	2	4	3	3	5	5	5	4	5	5	5	5	4
Health Supportive Community Score		23	30	24	29	37	40	34	36	43	34	35	42	37
Health Supp. Comm. Priority Designation		**4**	**2**	**4**	**3**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**1**	**1**
Physical Feasibility	Ac Eligible Impervious	4	5	1	1	2	2	1	2	1	1	4	1	4
	Ac ABS oils	4	5	2	4	3	2	1	3	1	1	1	1	1
	Ac <5% Slope	4	5	1	3	2	2	1	2	1	1	3	1	2
	% of CSA E. Imperv. On Pub Land	4	1	4	5	3	5	1	5	5	1	4	4	3
Physical Feasibility Score		16	16	8	13	10	12	4	4	8	4	12	7	10
Physical Feasibility Priority Designation		1	1	5	3	5	4	5	4	5	5	4	5	2
Overall Priority		**2**	**1**	**5**	**2**	**2**	**3**	**5**	**1**	**3**	**5**	**4**	**2**	**4**

Table 4 1 Prioritization of CSAs (cont.)

Category	Factor	Midway Coldstream	Oldtown / Middle East	Orangeville / E. Highlandtown	Patterson Park N & E	Poppleton Terrace / Hollins market	Sandtown Winchester / Harlem Park	South Baltimore	Southeastern	Southwest Baltimore	Upton / Druid Heights	Washington Village	Westport / Mt. Winans / Lakeland
Equity SES	% White(Inv)	5	4	2	2	3	5	1	2	3	5	2	3
	% No HS Diploma or Equiv.	5	5	5	3	5	5	1	5	5	5	3	5
	Median Income	4	5	3	1	4	4	1	3	4	5	3	3
	HH Poverty	4	5	2	4	5	4	1	4	5	5	4	3
	Hardship Index	4	4	3	3	4	4	2	3	5	4	4	3
Equity Outcomes	Life Expectancy	5	5	3	3	5	5	1	4	5	5	3	4
Equity Score (Points Total)		27	28	18	16	27	27	7	21	27	29	19	21
Equity Priority Designation (1=High Priority)		**1**	**1**	**3**	**4**	**1**	**1**	**5**	**2**	**1**	**1**	**3**	**2**
Health- EnvEx	%Impervious Not Shaded	4	5	4	5	4	4	4	4	4	4	4	3
	Daytime Surface Temp	5	5	4	5	5	5	3	4	5	5	4	3
	Nighttime Surface Temp	4	5	3	5	5	4	4	4	4	4	4	3
	%Walked	1	5	1	2	4	1	1	1	1	2	4	1
Health Resources	%Unemployment	5	3	2	2	4	4	5	3	4.	4	4	4
	% No Vehicle	4	5	3	2	5	5	1	3	5	5	3	3
	Violent Crime	4	5	4	4	5	4	1	3	5	5	5	4
	% Canopy	4	5	4	5	4	4	5	5	4	4	4	3
	% Parks/Greenspace	4	5	4	5	4	4	5	5	4	4	3	3
Health Supportive Community Score		35	43	29	35	40	35	29	32	36	37	35	27
Health Supp. Comm. Priority Designation		**2**	**1**	**3**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**3**
Physical Feasibility	Ac Eligible Impervious	2	3	5	2	1	3	3	5	5	2	4	4
	Ac ABS oils	1	1	4	2	2	2	1	2	2	1	2	3
	Ac <5% Slope	1	3	5	1	1	2	5	5	4	2	5	4
	% E. Imperv. Pub Land	2	4	1	3	5	5	1	1	3	5	1	2
Physical Feasibility Score		6	11	15	8	9	12	10	13	14	10	12	13
Physical Feasibility Priority Designation		5	4	2	5	5	4	5	3	2	5	4	3
Overall Priority		**2**	**1**	**2**	**4**	**2**	**2**	**5**	**2**	**1**	**2**	**3**	**2**
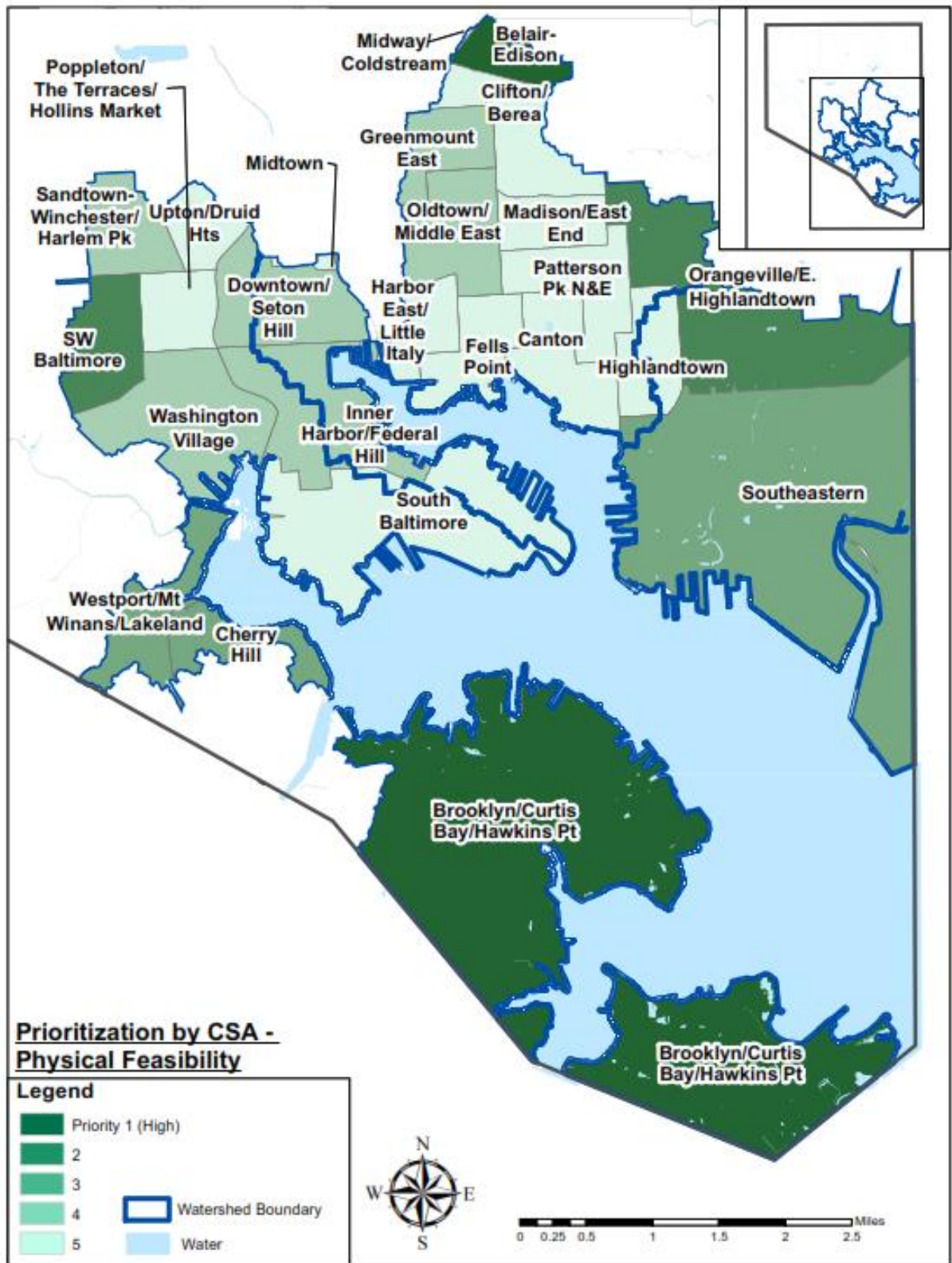
Figure 4-1 Prioritization of CSAs by Physical Feasibility Factors
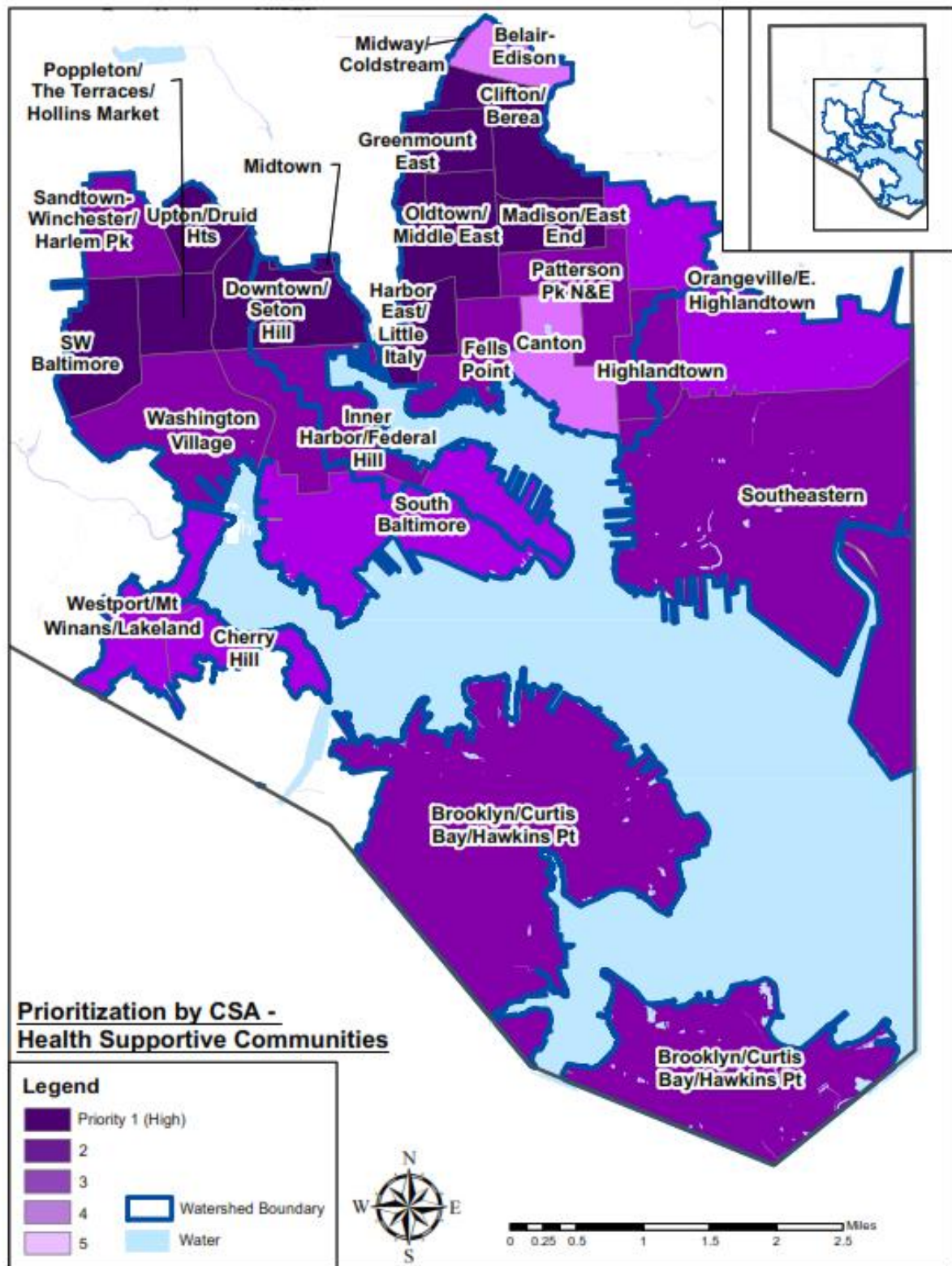
Figure 4-2 Prioritization of CSAs by Health Supportive Community Factors
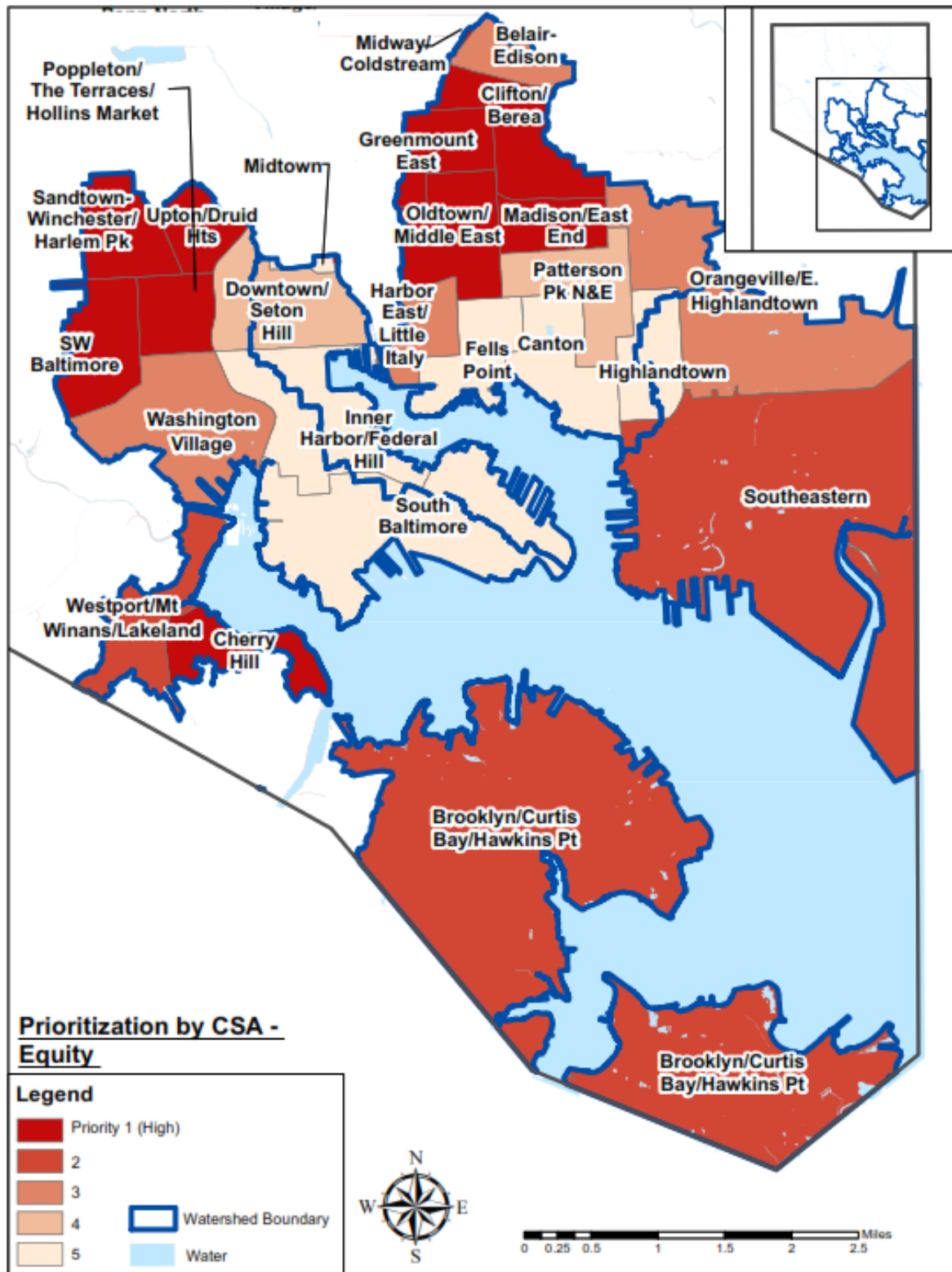
Figure 4-3 Prioritization of CSAs by Equity related Factors
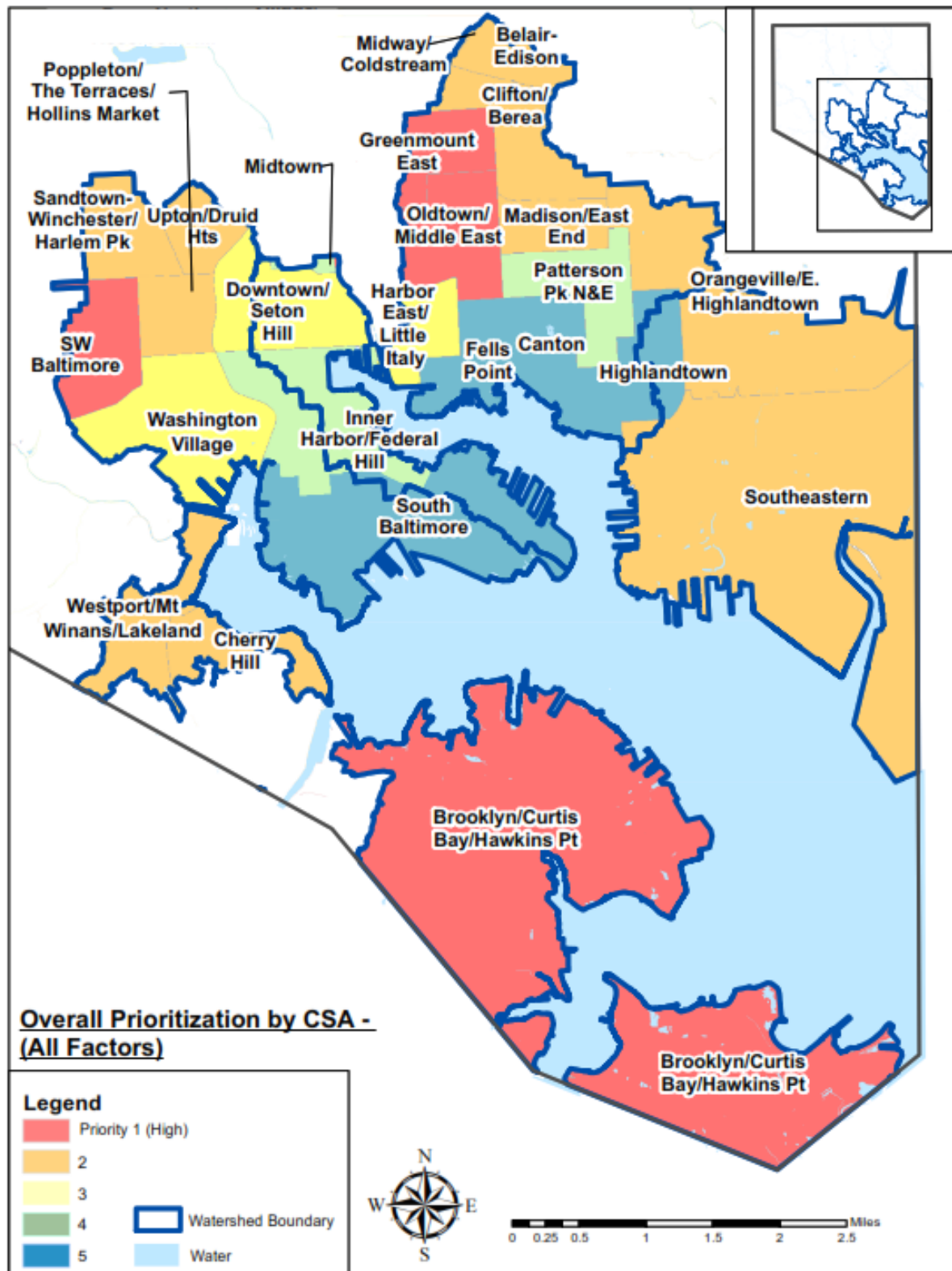
Figure 4-4 Overall Prioritization by CSA

4.1.1 Identification of Watershed Resources and Opportunities

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

This mapping of watershed opportunities and resources serves to identify potential innovative programs 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 4-2 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 BH:
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 BMORE 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 BMORE 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
📍 High Ped. Crash Intersection

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

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

0   0.175 0.35   0.7   1.05   1.4
                                              Miles

Figure 4-5 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
📍 High Ped. Crash Intersection

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

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

0   0.175 0.35   0.7   1.05   1.4
└─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┘ Miles

Figure 4-6 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
📍 High Ped. Crash Intersection

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

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

0   0.175 0.35   0.7   1.05   1.4
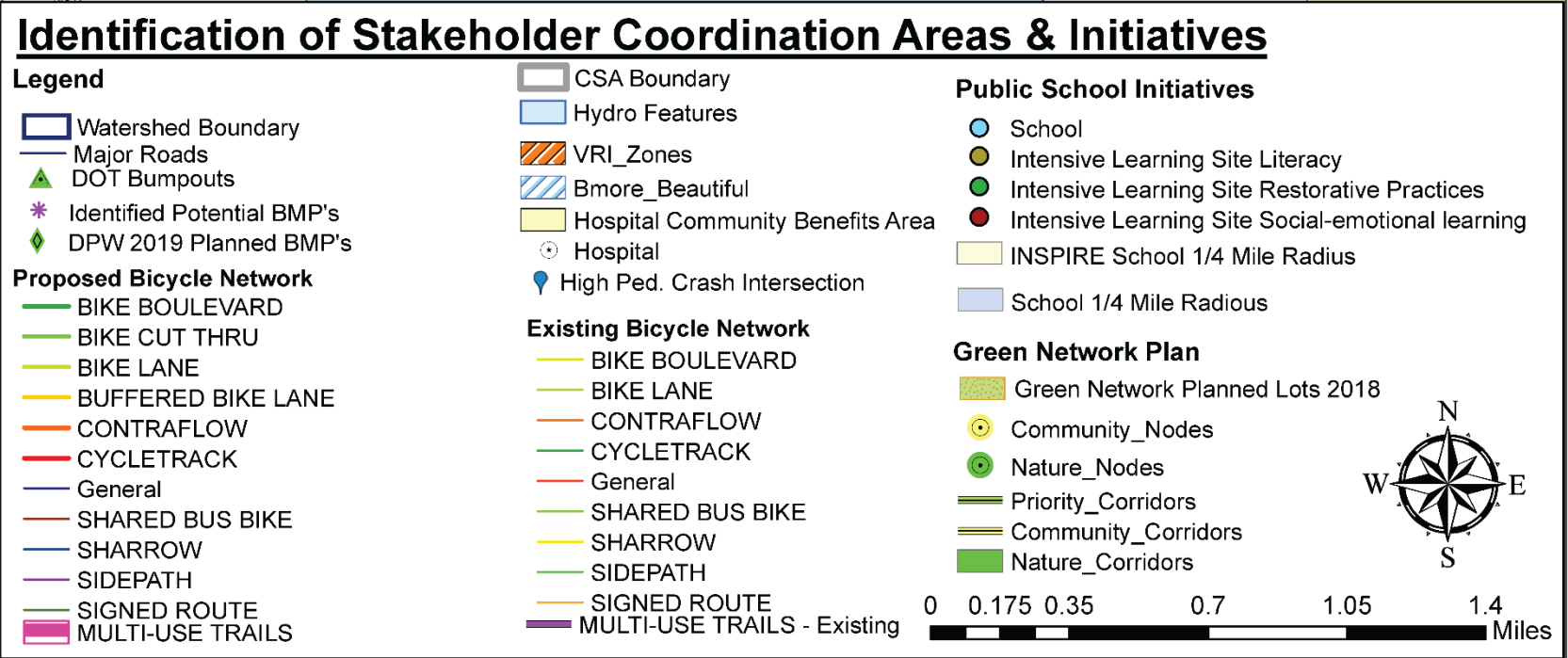   Miles

Figure 4-7 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
📍 High Ped. Crash Intersection

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

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

0 0.175 0.35 0.7 1.05 1.4 Miles

Figure 4-8 Stakeholder Coordination Areas and Initiatives – SW Harbor Subwatershed

Unemployment Rate and % No High School Equivalent

Legend

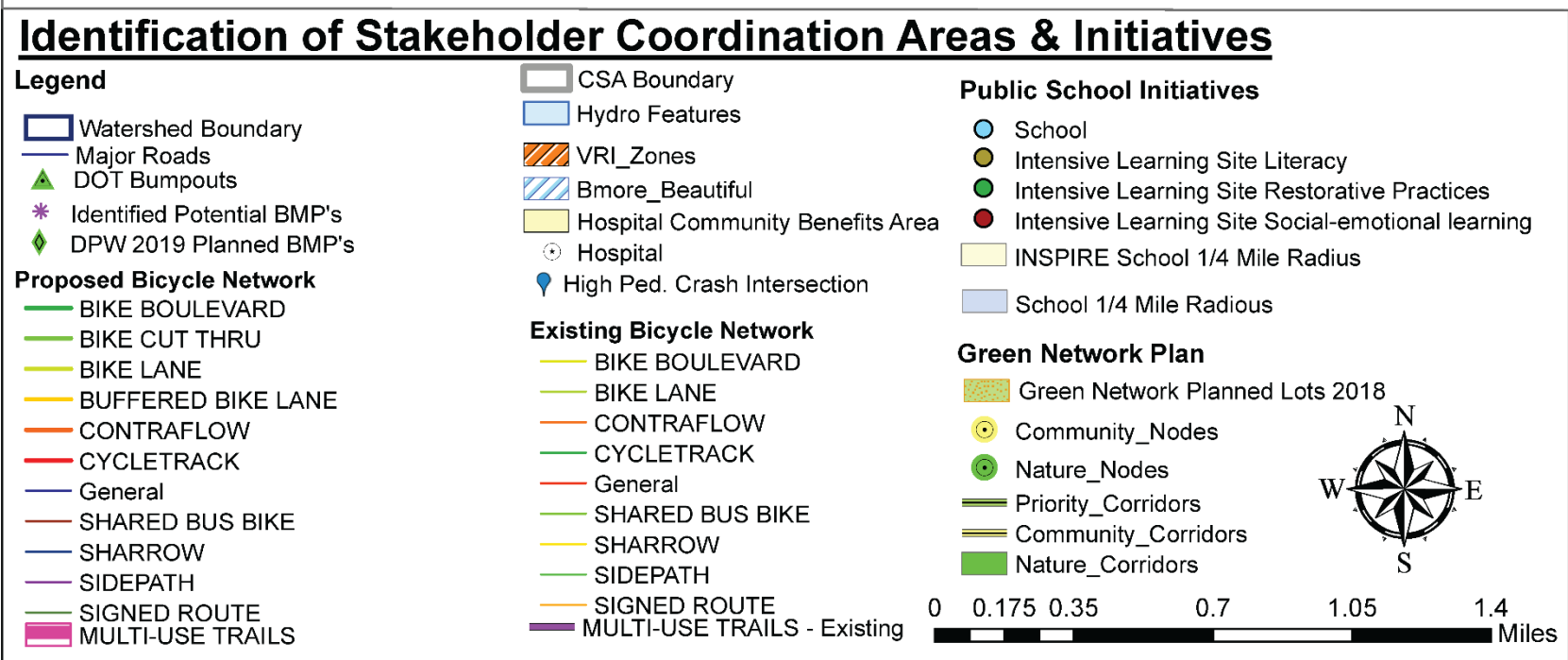| % Un-employed		% without High School Diploma or Equiv.	
	0-5%	○	0-5%
	>5-10%	●	>5-10%
	>10-15%	○	>10-15%
	>15-20%	●	>15-20%
	>20%	●	>20%

Watershed Boundary
Water

0 0.25 0.5 1 1.5 2 2.5 Miles

Figure 4-9 Unemployment Rate no HS Equivalency

Figure 4-100 Percent of Residents with No Access to a Vehicle

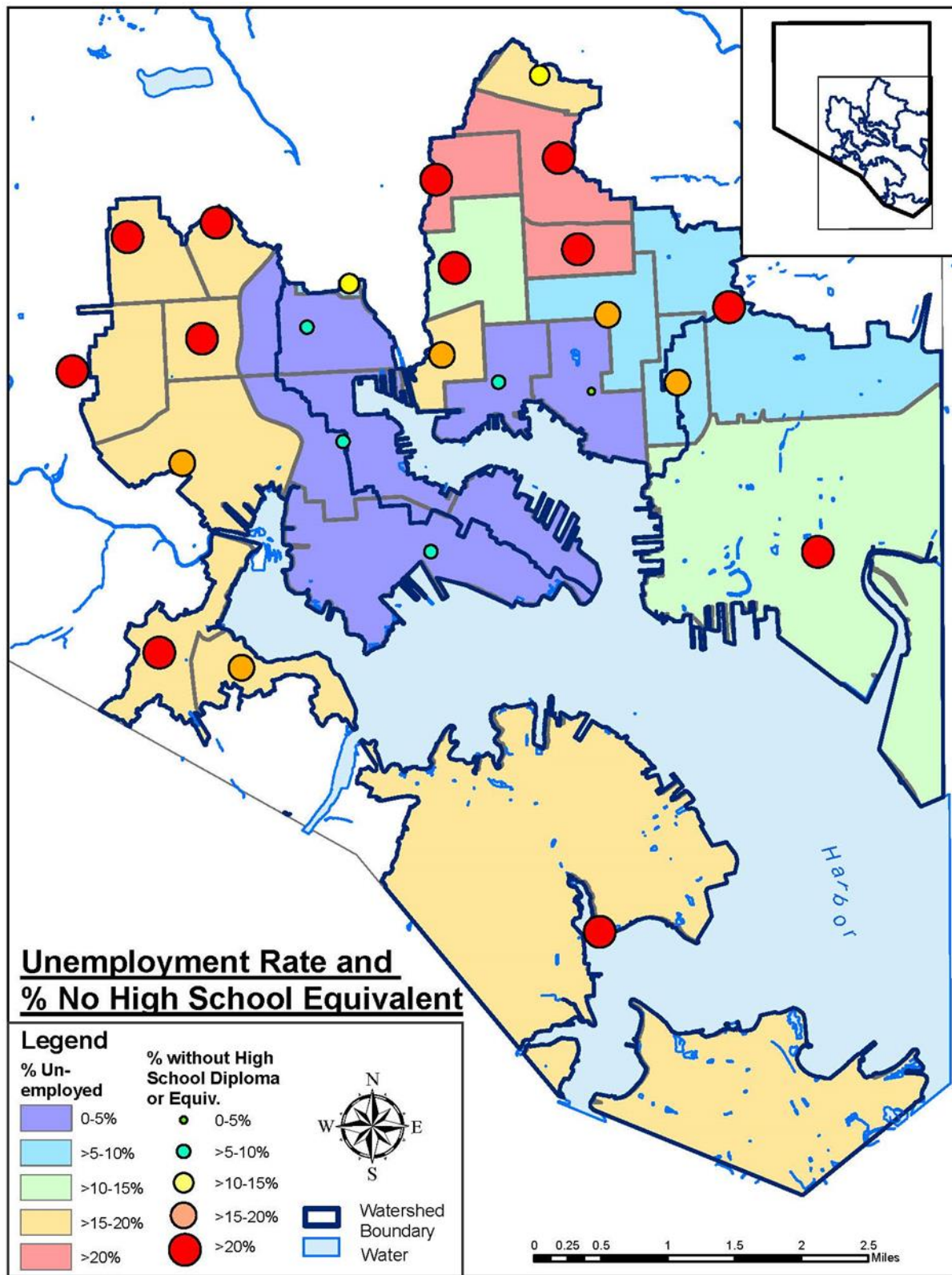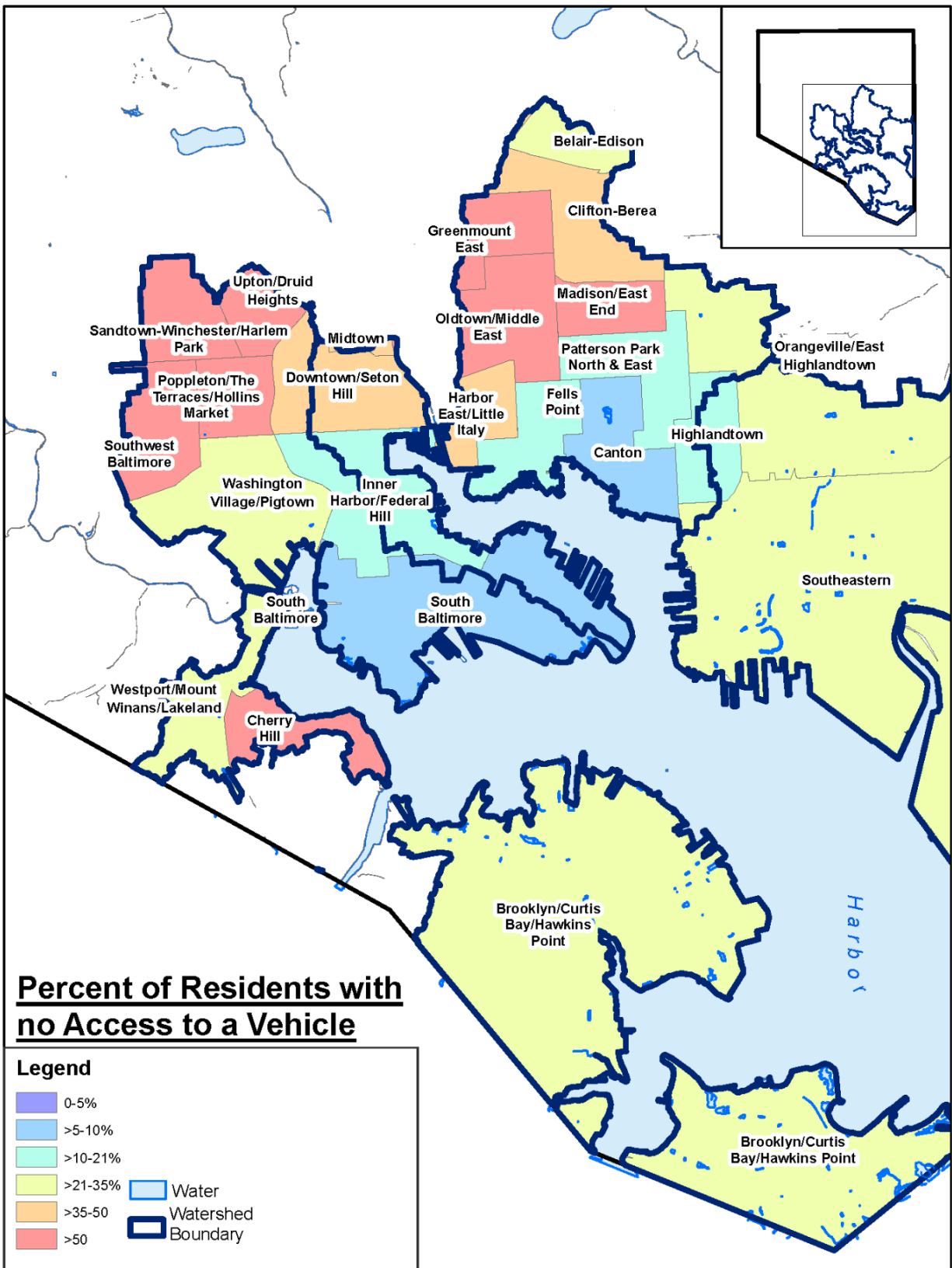Table 4-3 contains a summary of the watershed resources and stakeholder coordination initiatives identified in Figures 4-5 through 4-8. Resources that represent discrete point locations were summarized using a number. Large zones or linear resources are indicated by an "X" when present. Land use and impervious area are indicated by a percentage of the CSA or acres as indicated. This table This table and the workforce and vehicle access information shown in Figures 4-9 and 4.10 were used to inform the opportunities identified in Section 5 of this report.

Table 4-3 Watershed Resources and Opportunities Summary Table- Priority #1 CSAs (Portion within the Watershed)

Criteria	Brooklyn / Curtis Bay / Hawkins Point	Greenmount East	Oldtown / Middle East	Southeastern	Southwest Baltimore
Green Network Community Corridor	X	X	X	X	X
Green Network Nature Corridor				X	
Green Network Priority Corridors	X	X	X	X	X
Green Network Community Nodes		1			3
Green Network Nature Nodes					
Green Network Planned 2019					1
School (or 1/4 mile radius)	4	3	7	3	3
Inspire School (or 1/4 mile radius)	1	2	1	1	
School ILS Restorative Practices (or 1/4 mile radius)	1	1		1	
School ILS Social Emotional Learning (or 1/4 mile radius)	1	2	1		1
School ILS Literacy (or 1/4 mile radius)			1		1
School - Green Healthy Schools 2017/2018 (or 1/4 mile radius)	1			1	1
School GHG Multiple Years (or 1/4 mile radius)					1
School - GHG - TMDL directly related (or 1/4 mile radius)	1			1	
VRI Zone	X	X			X
BMORE Beautiful	X	X	X		X
Hospital Community Benefits Area	X	X	X	X	X
Planned 2018 DPW BMP's	5				2
FY 2020 DOT CIP Areas			X		X
Planned Bike Lane (more than sharrow/sidepath)	X	X	X	X	X
Planned multi-use trail	X			X	X
Planned bike lane (sharrow/sidepath)		X	X		X
Existing bike lane (more than sharrow/sidepath)	X	X	X		X
Existing bike lane (sharrow/sidepath)	X	X	X		X
Major Redevelopment Area (DCHD)			X	X	
Neighborhood Subcabinet Area DHCD			X		
Commercial District	1.3%	5.1%	11.3%	10.0%	5.5%
High Density Residential		86.6%	44.6%		78.2%
Low Density Residential	6.5%			10.0%	
Institutional			22.3%		0.3%
Mixed Use	1.3%				0.6%
Office	0.2%	3.0%	3.3%		0.9%
Industrial	82.3%	2.5%	1.4%	70.0%	10.4%
Open Space	4.5%	2.9%	1.0%		3.9%
Home Ownership >50%			54.9%	59.6%	
Home Ownership <50%	41.3%	27.4%			23.6%

Criteria	Brooklyn / Curtis Bay / Hawkins Point	Greenmount East	Oldtown / Middle East	Southeastern	Southwest Baltimore
Regulated Floodplain	X	X	X	X	X
Elig. Imperv. on City Owned Property (Ac) (no rail)	60.0	10.1	28.0	12.2	9.5
Elig. Imperv. on Private Property (Ac) (no rail)	413.6	70.0	117.4	323.2	94.1
Elig. Imperv. on Right of Way (Ac) (no rail)	231.1	59.3	82.4	173.4	85.1

Table 4-4 Watershed Resources and Opportunities Summary Table – Priority #2 CSA's (Portion within the Watershed)

Criteria	Belair Edison	Cherry Hill	Clifton/Berea	Madison East End	Midway / Coldstream [1]	Orangeville/ E. Highlandtown	Poppleton / Hollins Market	Sandtown Winchester / Harlem Park	Southeastern	Upton / Druid Heights	Westport/ Mount Winans/ Lakeland
Green Network Community Corridor	X	X	X	X		X	X	X	X	X	X
Green Network Nature Corridor									X		X
Green Network Priority Corridors	X	X	X	X		X	X	X	X		
Green Network Community Nodes			1			2		4		X	
Green Network Nature Nodes		1									
Green Network Planned 2019								1			
School (or 1/4 mile radius)	2	1	6	5	1	3	4	3	3	3	
Inspire School (or 1/4 mile radius)			1	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)				1		1		2		3	
School - Green Healthy Schools 2017/2018 (or 1/4 mile radius)				2		2	1	3	1	1	
School GHG Multiple Years (or 1/4 mile radius)							1				
School - GHG - TMDL directly related (or 1/4 mile radius)				1		2	1	1	1		
School GHG - TMDL Tangentially Related (or 1/4 mile radius)											

Criteria	Belair Edison	Cherry Hill	Clifton/Berea	Madison East End	Midway / Coldstream [1]	Orangeville/ E. Highlandtown	Poppleton / Hollins Market	Sandtown Winchester / Harlem Park	Southeastern	Upton / Druid Heights	Westport/ Mount Winans / Lakeland
VRI Zone			X	X				X		X	
B'more Beautiful	X	X	X	X		X	X	X		X	X
Hospital Community Benefits Area	X	X	X	X	X	X	X	X	X	X	X
Planned 2018 DPW BMP's		1		6			1	8		2	4
FY 2020 DOT CIP Areas							X	X		X	
Planned Bike Lane (more than sharrow/sidepath)	X	X	X	X	X	X	X	X	X	X	X
Planned multi-use trail	X	X				X	X	X	X	X	X
Planned Bikelane (sharrow/sidepath)			X	X	X		X	X			
Existing Bike Lane (more than sharrow/sidepath)			X	X	X		X	X			
Existing multi-use trail		X									
Existing Bikelane (sharrow/sidepath)			X	X	X			X			
High crash intersections										1	
Major Redevelopment Area (DCHD)				X			X			X	
Neighborhood Subcabinet Area (DCHD)			X				X				
Commercial District	2.8%	1.4%	8.0%	10.5%	67.5%	10.4%	8.2%	0.6%	10.0%	3.1%	7.1%
High Density Residential			58.6%	70.7%		9.4%	79.4%	92.7%		71.4%	0.1%
Low Density Residential	2.6%	33.1%	4.0%		23.2%	3.5%	2.5%	0.4%	10.0%	16.6%	7.7%
Institutional		12.7%		5.1%		7.2%					
Mixed Use	9.1%	1.0%	3.8%			8.2%	7.9%	0.2%		3.5%	3.1%
Office						0.2%	0.5%				
Industrial	4.90042	6.442	10.4%	4.8%	0.3%	53.0%	0.6%	1.4%	70.0%		54.5%
Open Space	80.6363	23.43	9.9%	9.5%	9.0%	10.0%	1.4%	4.6%	0.0%	5.3%	12.6%
Home Ownership >50%	54.2%					51.1%			59.6%		
Home Ownership <50%		47.5	30.60%	23.1%	34.5%		29.4%	28.9%		29.8%	46.2
Regulated Floodplain		X				X			X		
Elig. Imperv on City Owned Property (Ac) (no rail)	22.5	13.9	21.4	7.5	0.0	18.0	9.6	32.5	12.2	16.1	1.4
Elig. Imperv on Private Property (Ac) (no rail)	9.1	40.9	116.3	65.8	2.4	293.1	47.9	62.9	323.2	37.5	84.7
Elig. Imperv on Right of Way (Ac) (no rail)	10.6	20.9	77.1	52.9	1.7	134.4	54.4	60.6	173.5	41.0	31.0

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, ESD (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** – 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
In the context of the Baltimore Harbor watershed, projects consist of two types: Environmental Site Design (ESD) Practices, and Alternative BMPs. While restoration projects can also include traditional BMPs like ponds or alternative BMPs like shoreline or stream restoration they are not included in this assessment because there are limited opportunities for these types of practices on city-owned property within the watershed. Specific locations for these practices will be explored further within the Watershed Implementation Plan (WIP).

5.1.1   Environmental Site Design (ESD)
ESD practices, also known as green stormwater infrastructure, 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 can often be integrated into the retrofit of streets, parking lots, small parks, and school grounds. However, ESD practices can be expensive to install in hyper-urbanized environments with dense development like exist in the Baltimore Harbor Watershed. For instance, practices requiring excavation can be limited by conflicts with existing utilities; practices relying on infiltration are limited by highly compacted or low drainage soil conditions resulting from urban mixed soils; and conflict with right-of-way needs like on-street parking can create barriers to community acceptance.

There are opportunities for incorporating ESD practices into complete and green street projects, and also on school grounds or parkland where they can be used for environmental education. Smaller practices like rain gardens and downspout disconnect may be used on residential and institutional property where space or excavation potential is limited.

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 are aligned 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 (which include those done by others but tracked by DPW), and proposed MS4 projects by DPW. 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 DPW 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 MS4 WIP 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.
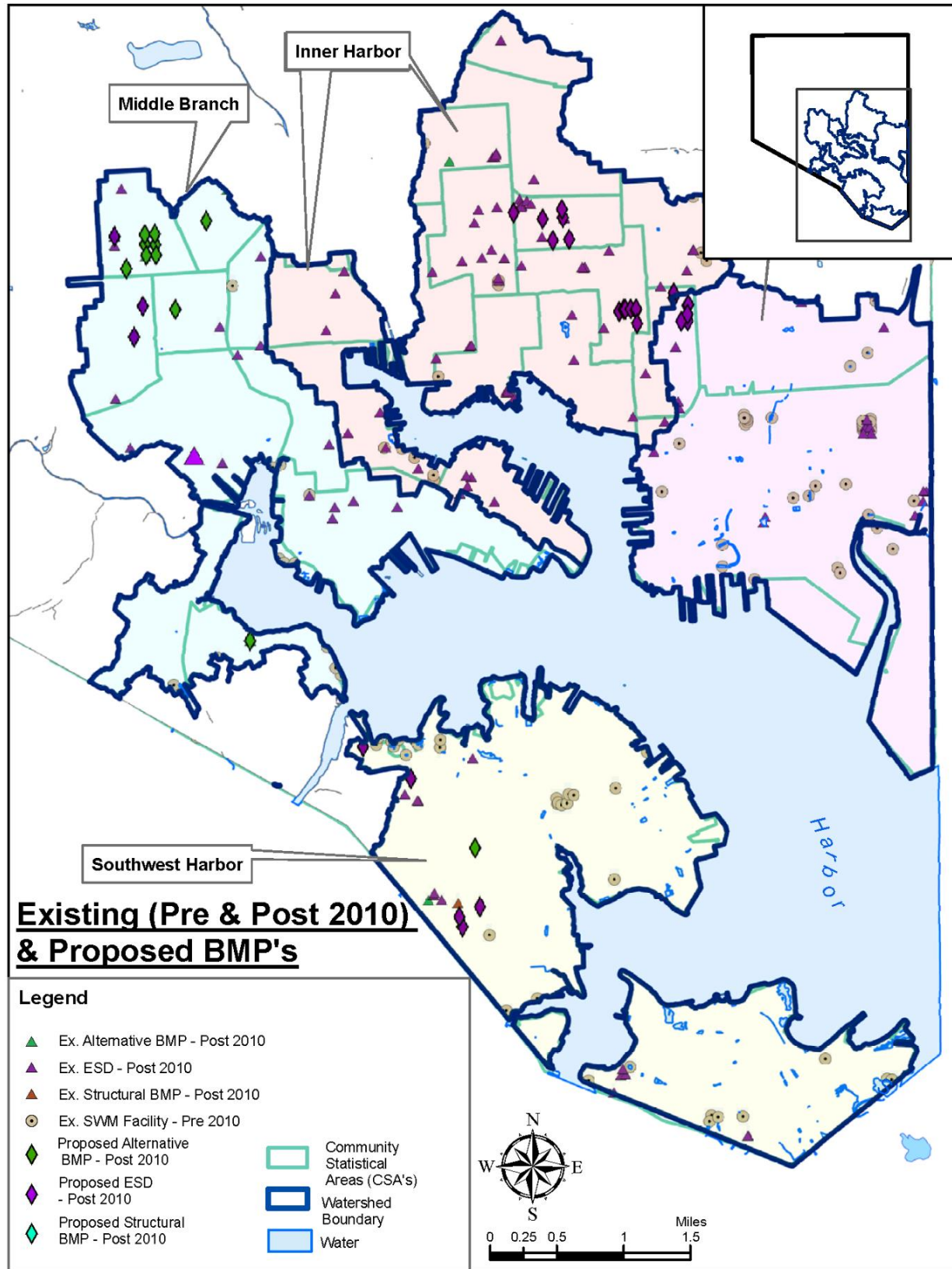
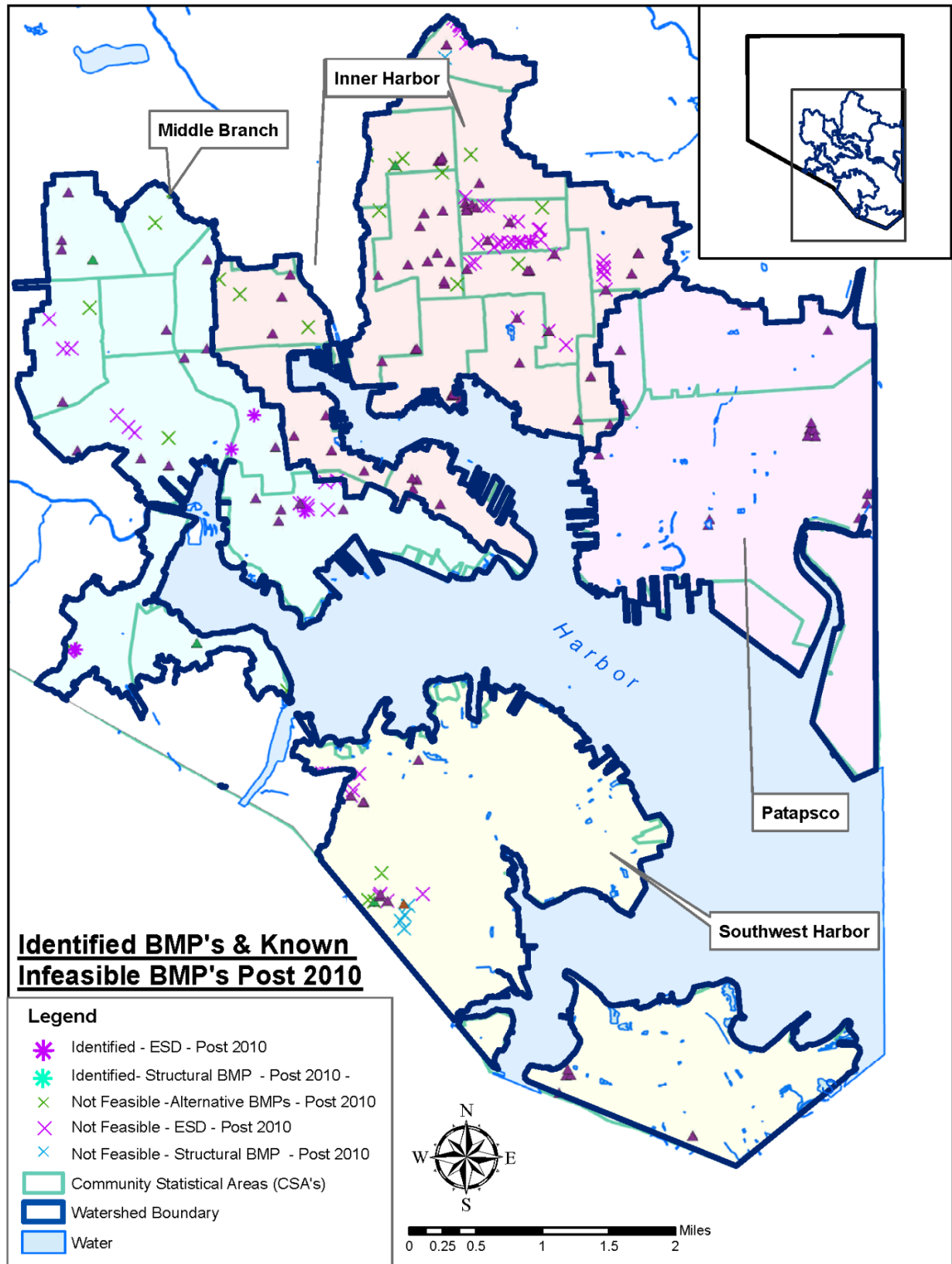*Figure 5-1 Existing and Currently Proposed BMP's*

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 BH is located in the Central, Southeast and Southwest quadrants. As noted previously, the Central Quadrant is swept weekly, while the Southeast and Southwest quadrants 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 late 2018, "Smart Cans" were installed in several business districts and commuter corridors in the Baltimore Harbor. 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, DPW initiated a proactive catch basin and debris collector cleaning program. 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[9]
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).[10] There are seven stream impact sampling (SIS) stations within the watershed:

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[9] The Chesapeake Bay Program and MDE have not quantified the benefit in relation to impervious restoration at this time.
[10] 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).

- Linwood & Elliott
- Lakewood & Hudson
- 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[11]

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

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

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

5.2.6   Public Education and Engagement [12]

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 BH 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 BH 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:

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[11] See footnote 30.
[12] See footnote 30.

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 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 ESD and structural stormwater management facilities, 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 pick-up, 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.

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.

Baltimore Development Corporation
The Baltimore Development Corporation (BDC) is a quasi-public organization that 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.

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 oversee the Capital Improvement Program (CIP) and have developed long term development plans for Baltimore including the Green Network Plan and the Sustainability 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. Their focus on equity includes structural, procedural, transgenerational, and distributional equity[13]. 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 stormwater management projects and other restoration efforts.

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 to lower its environmental impact through its daily operations, and with schools to meet the Maryland Environmental Literacy Standards by integrating the Next Generation Science Standards into curricula.

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.

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 stormwater management projects, including mosquito control/ponding water, outreach and partnerships around healthy environments, heat related illness, and office of youth violence.

Department of Housing Community Development (DHCD)
DHCD 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 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.

Department of Transportation (DOT)
The DOT 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. Opportunities may exist to collaborate on complete and green streets project and to coordinate work in the ROW.

Environmental Control Board (ECB)
The ECB coordinates the Bmore Beautiful program, which engages residents as leaders of cleanup crews in their communities. Resident leaders coordinate and manage teams of residents who perform clean-up activities in their communities and are compensated for their work.

Mayor's Office of Employment Development (MOED)
The Mayor's Office of Employment Development 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.

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[13] https://planning.baltimorecity.gov/equity-planning-committee#Defining%20Equity

MOED operates a mobile workforce center that may be able to attend events, which is designed to connect residents with opportunities for employment, and also offers other workforce readiness services, which may include expungement.

5.3.2   Non-government Organizations (NGOs) - City Wide

Baltimore is fortunate to have a number of 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. BTT also works with the school system to plant trees on school grounds.

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 led Photovoice projects in the Mondawmin and Highlandtown neighborhoods in the Baltimore Harbor watershed. Photovoice is a community engagement tool which allows residents to communicate their perspectives on various issues using photography as a tool. BWB also offers resident training events on pollution identification and reporting, storm drain art, rain barrel workshops, and participates in several community engagement initiatives with other non-profit partners.

Chesapeake Bay Foundation

Chesapeake Bay Foundation (CBF) is the largest independent conservation organization dedicated solely to saving the Bay. CBF's efforts include advocacy, restoration, education, and litigation. Related to watershed restoration within Baltimore City, CBF implements various watershed restoration projects, engages public leaders in policy and restoration, and also provides educational experiences to Baltimore City school students through hands-on field experiences, professional learning training to teachers who integrate investigative projects engaging students in their natural environment and adult education through restoration projects and raising public support for water quality issues in the Bay's waterways.

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 stormwater infrastructure in Baltimore. CBT also provides funding to schools that are implementing environmental education programs.

Civic Works / Baltimore Center for Sustainable 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 Sustainable Careers. The Center is dedicated to the creation of business and employment initiatives that contribute to environmental sustainability and are open to all Baltimore job seekers. One of its workforce development programs installs stormwater management projects and offers maintenance training to underemployed residents 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, education, and training, and works in partnership with Blue Water Baltimore to help congregations conduct water audits and develop stormwater management 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 ESD projects as part of its park restoration projects. PPF is 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 litter 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.

Hospitals
Non-profit hospitals are required to conduct community health needs assessments and invest in community benefits initiatives as part of the requirements created by the Affordable Care Act. These Community Health Needs assessments can be used to understand their goals related to health and may become opportunities to inform collaboration on projects or programming related to the aligned mission of supporting community health within the watersheds. Several hospitals have been identified with community benefits districts that overlap with communities in the Baltimore Harbor Watershed, including University of Maryland, Johns Hopkins, Bon Secours, Mercy, and Medstar, and Saint Agnes Hospitals and the Kaiser Permanente health system, which also has community benefits requirements.

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 initiatives, 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, workforce development, and tree planting and care.

Waterfront Partnership

The Waterfront Partnership of Baltimore is a Business Improvement District dedicated to improved maintenance, beautification and visitor services for the Waterfront. A key program of the Waterfront Partnership is the Healthy Harbor Initiative, which aims to make the Harbor safe again for swimming and fishing. Waterfront Partnership has installed three water wheel powered trash interceptors, coordinated oyster plantings, installed floating wetlands, and provided community engagement in targeted neighborhoods and through the use of social media.

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 the implementation of different strategies needs to occur in tandem with each other.

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

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

3. Engage stakeholders in the planning process for ESD projects on public property and in the ROW.

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, the next highest priority CSAs 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 + ¼ miles of School/an INSPIRE school - Bus stop - Fire hydrant	• DPW • DOT • Local community groups

PROJECTS		
BMPs	**Criteria for priority locations**	**Partner**
ESD practices - Schools	+ Existing Green Team + CASEL	• DPW • BCPSS • Office of Sustainability • Planning • Environmental NGOs
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 • Baltimore Housing • Planning / BOS
Tree planting	+ UTC Priority Planting Map + Open tree pits + Available space (new pits)	• DPW • BCPSS • BCRP Forestry • TreeBaltimore
PROGRAMS		
BMPs	**Criteria for priority locations**	**Partner**
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
Incentive Programs - BMPs - Programs	+ Commercial land use + NSFP + Low / Medium Density Housing	• IPC • BWB • BDC • Catholic Charities
IDDE	+ Monitoring locations + SR complaints	• DPW • Environmental NGOs

PARTNERSHIPS		
BMPs	**Criteria for priority locations**	**Partner**
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 + Stewardship training programs (Civic Works Stormwater Stewards; BMORE Beautiful Block Captains; Green Stoop Challenge Participants, UMD Watershed Stewards, BOS Planning Academy/Sustainability Ambassadors, or similar)	• Hospitals • BCPSS • Environmental NGOs Planning / BOS • MOED • National Aquarium • Health Department
Workforce Development	+ High unemployment	• MOED • BCGC • NGICP • Parks & People Foundation • Blue Water Baltimore • Civic Works
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 • BCRP • Blue Water Baltimore • Park & People Foundation

5.5   Opportunities by CSA: Priority #1 Areas

5.5.1   Brooklyn / Curtis Bay/ Hawkins Point

Brooklyn/Curtis Bay/Hawkins Point is a relatively large CSA and represents the entire Southwest Harbor Watershed. It scored 2 in both the equity and health supportive communities prioritization analyses and 1 in the physical feasibility prioritization analysis. Conditions in some areas of the CSA 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 & Saint Agnes Hospital community Benefits areas, and designation as a VRI zone and a BMORE 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 (413 Ac.), with substantial eligible impervious exists within the right of way (231 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 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 bump out locations.

- Explore opportunities for ESD retrofit at area schools

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

- 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.

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

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

- Explore opportunities for innovative Watershed Connections programming to promote and increase awareness of health-related co-benefits of restoration activities within the Medstar Harbor & Saint Agnes Hospitals' Community Benefit Areas.

- Engage with BMORE Beautiful, VRI, and other partners on watershed connection engagement and litter reduction efforts.

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

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

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

5.5.2 *Greenmount East*
Greenmount East scored Priority 1 in the equity analysis and in the health supportive community analysis, and priority 4 in the Physical feasibility analysis. With an unemployment rate of over 20% and over 50% of households without access to a vehicle, prioritization of ESD near residential areas and any associated potential workforce development programs could benefit this community. Multiple opportunities for stakeholder coordination were identified including Green Network corridors, and multiple schools within ¼ mile (including two INSPIRE schools and three participating in CASEL (restorative practices and social emotional learning curriculum), Bmore Beautiful, and designation as a VRI zone. The CSA also contains several proposed and

existing bike lanes and may include future DOT work which will require coordination and may present opportunities for cost savings. The area is primarily high density residential and commercial, the majority of eligible impervious is on private property. Working with businesses or private property owners may be important, however low levels of home ownership may create a challenge as this may require working with landlords. Relatively high levels of eligible impervious also exist within the right-of-way, creating an opportunity to work with DOT to identify opportunities that align with any planned projects. About 10 acres of eligible impervious exist on city-owned properties, primarily highly impervious school yards that are adjacent to parks (Dr. Bernard Harris School, Johnston Square Elementary, and Harford Heights Elementary adjacent to Johnston Square and Madison Square Park). There may be opportunities to identify projects in conjunction with public engagement or educational programming at these locations.

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.

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

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, and planned CIP projects in the right-of-way

- Explore Alternative BMPs like street tree planting.

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

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

- Explore opportunities for ESD installation on park land with adjacent impervious surfaces.

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

- Provide education and outreach to homeowners, landlords, renters, and business owners, 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 homeowner/business owner incentive programs like ESD installation, and for homeowners, renters, and business owners rain barrels, tree planting, and community clean-ups.

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

- Engage with BMORE Beautiful, VRI, and other partners on watershed connection engagement and litter reduction efforts.

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

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

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

5.5.3   Oldtown / Middle East

Oldtown/Middle East scored Priority 1 in the equity analysis, Priority 1 in the health supportive community analysis, and Priority 4 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), and designation as a VRI zone. 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 pedestrian safety and streetscape improvements.

- 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 bump out locations.

- Explore Alternative BMPs like street tree planting.

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

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

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

- 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 homeowner/property owner 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 and Mercy Hospitals' Community Benefit Areas.

- Engage with VRI related programs and other partners on watershed connection engagement and litter reduction efforts.

- Connect residents with existing green stormwater infrastructure workforce development programs, like

YH2O and the Baltimore Center for Sustainable Careers.

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

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

5.5.4   Southwest Baltimore

Southwest Baltimore scored as Priority 1 in the equity analysis and in the health supportive community analysis, and priority 2 in the Physical feasibility analysis. At moderately high levels of unemployment (15-20%) and over 50% 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 (two focusing on CASEL social emotional learning and one focused on CASEL restorative practices curriculum, and one school with a green team operating for at least 2 years). Southwest Baltimore is a VRI zone and a BMORE Beautiful community, so there is an existing focus on community service and environmental health related to trash and stormwater. It is part of the Bon Secours, Mercy, University of Maryland, and the St. Agnes Hospitals Community Benefits Service Areas.

Southwest Baltimore includes a Green Network site, planned for near term implementation (Vincent Street Park Expansion), and already planned DPW BMP's. It includes some areas that may be incorporated into DOT's FY 2020 CIP, and also areas with proposed bike lanes, creating an opportunity to coordinate work. Most of this CSA is high density residential (79%) with some industrial (10%) and commercial (6%). Most residential is renter occupied, with home ownership rates of 24%. Most eligible impervious (94 Ac.) is on private property, followed by 85 Ac. In the ROW and 10 Ac. on non-ROW, city owned property. Identifying opportunities in the right of way and city owned land alongside opportunities to work with renters, landlords, and businesses on private property will be important toward achieving restoration goals.

Recommendations include:

- Explore opportunities for ESD within the right of way, on vacant lots, and other city owned property, especially in in areas where other agencies or 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 nodes and corridors, and in particular the Vincent St. Park Expansion.

- Coordinate with DOT on identified DOT's FY 2020 CIP work, complete streets, bicycle network and pedestrian safety/traffic calming work, multi-use trail, and potential bump out locations.

- Explore opportunities for in the ROW to create "green streets", within ¼ mile of schools. Explore opportunities for ESD installation and watershed connection programming in and around schools.

- Coordinate with schools on environmental education programs, in particular where ESD practices may be installed. Explore opportunities to align restoration programs and outreach with CASEL programming at schools.

- Explore opportunities to align programming with work done by BMORE Beautiful, within VRI zones, and in conjunction environmental health related projects within the CSA.

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

- Engage with BMORE Beautiful and the VRI around watershed connection based engagement and litter reduction efforts.

- Provide education and outreach to homeowners, landlords and renters, and business owners, 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.

- Promote incentive programs to residents and business for rain barrels, tree planting, and community clean-ups.

- Connect residents with existing workforce development programs, like YH2O, BMORE Beautiful, and the Baltimore Center for Sustainable Careers.

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

5.6 Opportunities by CSAs: Priority Areas #2

5.6.1 Belair Edison

Belair Edison scored as Priority 3 in the equity analysis and 4 in the health supportive community analysis, and priority 1 in the Physical feasibility analysis. At moderately high levels of unemployment (15-20%) and moderate levels of no vehicle access (21-35%), of residents with no access to a vehicle, workforce development opportunities associated with restoration activities, and prioritization of ESD near residential areas, could be beneficial. The portion of the Belair Edison CSA within the Baltimore Harbor watershed includes Clifton Park. Nearby Herring Run Park is outside of the watershed, but still within the CSA and adjacent to the neighborhood. Green Network green and community corridors and existing and proposed bicycle and pedestrian routes connecting both parks to each other and the residential and commercial districts present opportunities to align stormwater work with future projects by others, while offering visibility and supporting outreach and communication opportunities. This CSA within the watershed also includes the Lillie May Carroll Jackson Charter School, which could an opportunity to engage with students around any projects identified. The Belair-Edison CSA includes part of a BMORE Beautiful community, so there is an existing focus on community service and environmental health related to trash and stormwater. While the area of Belair Edison CSA within the watershed doesn't include planned DPW stormwater projects, several projects outside of the watershed but within the area understood to be the neighborhood are planned, presenting additional opportunities for engagement.

Most of this CSA within the watershed is open space (80%) with some low density residential (3%) mixed use residential (9%) Most residential properties are owner occupied, and yard space is present, which demonstrates opportunities to engage with single family residents around actions they can take on their property. Most eligible impervious (22.5 Ac.) is on city owned property, followed by 10 Ac. within the ROW and 9 Ac. on private property. Identifying opportunities on city owned land (park land) alongside opportunities to work with homeowners, renters, and landlords will be important toward achieving restoration goals. Coordinating with the Belair Edison Neighborhoods Inc organization may be an opportunity to expand outreach and engagement efforts, as they coordinate existing outreach and resident and business engagement events.

Recommendations include:

- Explore opportunities for ESD within the right of way, within Clifton Park and other city owned property, especially in corridors leading to planned DPW projects or in areas where other agencies have initiatives regarding green or multi-modal transportation corridors.

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

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

- Explore opportunities for in the ROW to create "green streets", within ¼ mile of the school. Explore opportunities for ESD installation and watershed connection programming in and around 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 homeowner incentive programs like ESD installation; and to renters and home-owners rain barrels, tree planting, and community clean-ups.

- Work with existing organizations like the Belair Edison Neighborhoods Inc and other organizations involved in resident and business engagement to explore potential project locations, disseminate information on resident and business engagement, and potential watershed connections programming.

- Connect residents with existing green stormwater infrastructure workforce development programs, like YH2O and the Baltimore Center for Sustainable Careers, and the MOED mobile unit.

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

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

- Engage with BMORE Beautiful and other partners on watershed connection engagement and litter reduction efforts.

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

5.6.2   Cherry Hill

The Cherry Hill scored priority 1 for equity and 3 for health supportive community and physical feasibility. The CSA offers good options for installing ESD practices, given the number of potential ESD locations identified in the area, wide streets in the public housing area where flooding has been an issue, local initiatives like BWB's Deep Blue and the South Baltimore Gateway Master Plan, and includes Arundel Elementary School, which is participating in the CASEL restorative practices program. It is home to several very active community organizations, including the Cherry Hill Community Coalition, the Cherry Hill Development Corp, and the Youth Resiliency Institute, and is a Bmore Beautiful community, so has a history of engaging residents to care for public spaces.

Recommendations include:

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

- 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 the CASEL participating school focused on alternative practices.

- Coordinate with the Cherry Hill Community Coalition, the Cherry Hill Development Corp, and the Youth Resiliency Institute, Cherry Hill Tenants Association, and other community organizations regarding project location, outreach, and potential watershed connection programming.

- 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 Recreation and Parks on ESD opportunities for the new Reedbird Recreation Center.

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic

calming work, and potential bump-out locations.

- Coordinate with schools on environmental education programs, in particular where ESD practices are installed and/or planned.

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

- Promote homeowner incentive programs like rain barrels, tree planting, and community clean-ups.

- Coordinate with non-profit partners to explore ESD opportunities on private property.

- Coordinate with BWB and other local stakeholders in implementing the Deep Blue Plan.

5.6.3   Clifton / Berea

Clifton / Berea scored as a low priority CSA for physical feasibility but top priority for the equity and health supportive communities analyses. Unemployment levels and access to a vehicle is consistent with the adjacent Oldtown/Middle East CSA, 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:

- Coordinate with Recreation and Parks on potential ESD opportunities in Clifton Park

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

- Explore opportunities for ESD retrofits 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 bump out locations.

- Explore opportunities for ESD installation and watershed connection programming at and around school areas, mixed use areas, and planned DPW projects.

- 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 homeowner 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.

- Connect residents with existing green stormwater infrastructure workforce development programs, like YH2O and the Baltimore Center for Sustainable Careers, and the MOED mobile unit.

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

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

- Engage with BMORE Beautiful and other partners on watershed connection engagement and litter reduction efforts.

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

5.6.4   *Madison East End*

Madison East End scored in the highest priority based on health supportive communities and equity considerations and was priority 5 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 a VRI zone, and designation as a BMORE beautiful neighborhood area, and as a targeted focus area for enhanced outreach strategies to be piloted for the first Environmental Impact Bond (EIB) financed projects. There is also an active engagement initiative around greening efforts led by Waterfront Partnership and Friends of Library Square. 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 (66 Ac.) or the right of way (53 Ac.), with very little on city-owned land (8 Ac.). 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.

- 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 bump out locations.

- Explore Alternative BMPs like street tree planting.

- Explore opportunities for ESD retrofit at areas schools.

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

- 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.

- 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 for Watershed Connections programming to promote and increase awareness of health related co-benefits of restoration activities within the Johns Hopkins and Mercy Hospital Community Benefit Areas.

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

- Coordinate with non-profit partners to explore ESD opportunities on private property.

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

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

- Engage with BMORE Beautiful, VRI, Waterfront Partnership, and Friends of Library Square on watershed connection based engagement, litter reduction efforts, and EIB outreach.

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

5.6.5 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 Clifton Berea (see 5.15.1) and within the Jones Falls watershed.

5.6.6 Orangeville/E. Highlandtown

Orangeville scored Priority 2 in physical feasibility and priority 3 in both equity and health supportive communities. 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), and designation as a BMORE Beautiful Neighborhood and VRI zone. The CSA also contains proposed bike lanes and a proposed multi-use trail. Most of this CSA is industrial (53%) followed by commercial (10%) and high density residential (9%), followed by institutional (7%). It also includes a mix of open space, office, and mixed use. Home ownership is relatively high for the watershed at 51%. Most eligible impervious (293 Ac.) is on private property, followed by 134 Ac. (ROW) and 18 Ac. non-ROW, city owned property (without rail). 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 and nodes.

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, multi-use trails, and potential bump out 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 homeowner/property owner incentive programs like ESD installation, and for homeowners and renters rain barrels, tree planting, and community clean-ups.

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

- Engage with BMORE Beautiful and the VRI on watershed connection based engagement, litter reduction efforts, and EIB outreach.

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

5.6.7   Poppleton / Hollins Market

Poppleton/Hollins Market scored as Priority 5 for physical feasibility, Priority 1 for the health supportive communities' analysis and 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. 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 BMORE Beautiful neighborhood. These factors provide an opportunity to engage neighbors around greening and trash clean-up in partnership with aligned initiatives. It is part of the Johns Hopkins and the St. Agnes, Bon Secours, Mercy, and University of Maryland Hospital Community Benefits Service Areas.

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 (79 %), with about 8% each mixed use and commercial areas. There are slightly more acres of eligible impervious within the right of way (54 Ac.) compared to on private property (48 Ac.), with only about 10 Acres on City owned, non-ROW property.

Recommendations include:

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

- Explore Alternative BMPs like street tree planting.

- 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 bump out locations.

- Explore opportunities for ESD retrofit at area schools.

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

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

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

- 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, etc.) and watershed connections related outreach.

- Explore opportunities for Watershed Connections programming to promote and increase awareness of health-related co-benefits of restoration activities within the St. Agnes, Bon Secours, Mercy, and University of Maryland Hospital Community Benefit Areas.

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

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

- Engage with BMORE Beautiful around watershed connection engagement and litter reduction efforts.

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

5.6.8   *Sandtown Winchester / Harlem Park*

Sandtown Winchester / Harlem Park scored as Priority 4 for physical feasibility, Priority 2 for the health supportive communities' analysis, and Priority 1 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 VRI zone and a BMORE 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 nearly equal amounts of eligible impervious within the right of way (61 Ac.) and on private property (63 Ac.), and 33 Ac. on city owned property.

Recommendations include:

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

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

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

- 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 Watershed Connections programming to promote and increase awareness of health-related co-benefits of restoration activities within the St. Agnes, Bon Secours, Mercy, and University of Maryland Hospital Community Benefit Areas.

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

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

- Engage with BMORE Beautiful and the VRI around watershed connection based engagement and litter reduction efforts.

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

5.6.9 *Southeastern*

Southeastern scored as Priority 2 in the equity analysis and in the health supportive community analysis, and 3 for the physical feasibility analysis. 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 (70%) followed by low density residential (10%) with a high rate of home ownership (60%), and 10 % commercial. Most eligible impervious (323 Ac.) is on private property, followed by 173 Ac. In the ROW and 28 Ac. on non-ROW, city owned property. Identifying opportunities in the ROW 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.

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

- Evaluate streams for potential restoration opportunities

- 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.

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

> BMP's like tree planting.

- 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 Community Benefit Areas.

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

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

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

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

5.6.10 *Upton / Druid Heights*

Upton/Druid Heights scored as Priority 1 in the equity analysis and in the health supportive community analysis, and priority 5 in the Physical feasibility analysis. At moderately high levels of unemployment (15-20%) and over 50% 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 (community corridors and nodes) and three schools (all focusing on CASEL literacy programming one school with a green team within the last 2 years). Upton/Druid Heights is a VRI zone and a BMORE Beautiful community, so there is an existing focus on community service and environmental health related to trash and stormwater. It is part of the Johns Hopkins and the St. Agnes, Bon Secours, Mercy, and University of Maryland Hospital Community Benefits Service Areas.

This area also includes planned DPW BMP's, areas that may be incorporated into DOT's FY2020 CIP, and also areas with proposed bike lanes, creating an opportunity to coordinate work. Most of this CSA is high density residential (71%) with some low density residential (17%) industrial (10%) and open space (5%). Most residential is renter occupied, with home ownership rates of 30%. Most eligible impervious (41 Ac.) is in the ROW, followed by 38 Ac. on private property, and 16 Ac. on non-ROW, city owned property. Identifying opportunities in the right of way and city owned land alongside opportunities to work with renters, landlords, and homeowners will be important toward achieving restoration goals. Coordinating with Druid Heights Community Development Corp, No Boundaries Coalition, and others involved in resident engagement in the area may help expand reach of outreach and engagement.

Recommendations include:

- Explore opportunities for ESD within the right of way, on vacant lots, and other city owned property, especially in in areas where other agencies or 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 nodes and corridors, with potential connections to the Harlem Parks Green Network site in adjacent Sandtown Winchester/ Harlem Park.

- Coordinate with DOT on identified DOT's FY 2020 CIP work, complete streets, bicycle network and pedestrian safety/traffic calming work, multi-use trail, and potential bump out locations.

- Explore opportunities for in the ROW to create "green streets", within ¼ mile of schools. Explore opportunities for ESD installation and watershed connection programming in and around schools.

- Coordinate with schools on environmental education programs, in particular where ESD practices may be installed. Explore opportunities to align restoration programs and outreach with CASEL literacy programming at schools.

- Explore opportunities to align programming with work done by BMORE Beautiful, within VRI zones, and in conjunction environmental health related projects within the CSA.

- Explore opportunities for Watershed Connections programming to promote and increase awareness of health-related co-benefits of restoration activities within the St. Agnes, Bon Secours, Mercy, and University of Maryland Hospital Community Benefit Areas.

- Explore opportunities for Watershed Connections programming to promote and increase awareness of health-related co-benefits of restoration activities within the St. Agnes, Bon Secours, Mercy, and University of Maryland Hospital Community Benefit Areas.

- Engage with BMORE Beautiful and the VRI around watershed connection-based engagement and litter reduction efforts.

- Provide education and outreach to homeowners, landlords and renters, and business owners, 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.

- Promote incentive programs to residents and business for rain barrels, tree planting, and community clean-ups.

- Work with existing organizations like the Druid Heights CDC, No Boundaries Coalition, and other organizations involved in resident engagement to explore potential project locations, disseminate information on resident and business engagement, and potential watershed connections programming.

- Connect residents with existing workforce development programs, like YH2O, Bmore Beautiful, and the Baltimore Center for Sustainable Careers.

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

5.6.11 Priority Area #2: Westport/Mt. Winans/Lakeland

Westport/Mt. Winans/Lakeland scored 2 in the equity prioritization analysis and 3 for health supportive communities and physical feasibility. The majority of the this CSA within the watershed I zoned for industrial use, with some office zones (7%), open space (12%) and limited residential (3%). Major transportation corridors like Patapsco Avenue and several rail lines present barriers. However, there are opportunities to engage larger private property owners and opportunities within the right of way may be explored within ¼ mile of Lakeland Elementary school just outside the watershed boundary, where some potential bump out locations have been identified by DOT.

Recommendations include:

- Explore ESD and tree planting opportunities along Patapsco Avenue.

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

- Coordinate with DOT around planned bump-out work and potential additional ESD siting and outreach opportunities.

- Explore opportunities to enhance the identified multi-use bike trail with ESD and alternative practices such as tree planting.

- Explore outreach and incentive programs for commercial property owners.

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Data	Source
Mercy Community Benefits Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/Mercy-CBR17.pdf
University of Maryland Community Benefits Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/UMMC-CBR17.pdf
Bon Secours Community Benefits Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/BonSecours-CBR17.pdf
Johns Hopkins (Both) Community Benefits Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/JHH-CBR17.PDF
Medstar Harbor Hospital Community Benefits Area	Created from zip codes identified in 2018 Community Benefits report at https://ct1.medstarhealth.org/content/uploads/sites/7/2018/06/MedStar_CHNA_Report_2018-FINAL.pdf?_ga=2.97635996.280585316.1543592446-2070020116.1535464969

Saint Agnes Harbor Hospital Community Benefits Service Area	Saint Agnes FY2018 Community Health Needs Assessment available online at https://www.stagnes.org/wp-content/uploads/2017/11/FY18-CHNA_FINAL-6-15-18.pdf
Daytime Summer Surface Temperature Baltimore	The daytime temp was from 7/5/14 and the nighttime was from 6/18/2005. Provided by Mehdi Heris & Austin Troy. Data collection methods described in detail in : Heris, M., Bagstad, K., Troy, A., Middel, A., Rhodes, C., Matuszak, J., Piloting Urban Ecosystem Accounting for the U.S. *Ecosystem Services. Manuscript submitted for publication.*
Nighttime Summer Surface Temp Baltimore	
Daytime Summer Surface Temperature Baltimore by 2010 CSA	Used Zonal Statistics to calculate the mean temperature within the 2010 CSA boundaries from the surface temperature rasters provided by Mehdi Heris & Austin Troy. Data collection methods described in detail in : Heris, M., Bagstad, K., Troy, A., Middel, A., Rhodes, C., Matuszak, J., Piloting Urban Ecosystem Accounting for the U.S. *Ecosystem Services. Manuscript submitted for publication.*
Nighttime Summer Surface Temp Baltimore by 2010 CSA	
2010 Neighborhood Boundaries	Downloaded from Open Data Baltimore https://data.baltimorecity.gov/Neighborhoods/Neighborhoods-Shape/ysi8-7icr

Zoning	Downloaded from Open Data Baltimore https://data.baltimorecity.gov/Geographic/Zoning-Shape/vvi4-ef6w
School Locations, CASEL Status, and Green Team Status of schools.	School location information provided by Baltimore City Public Schools on 12/10/2018, and joined to information on CASEL programming downloaded from the page https://www.baltimorecityschools.org/schools/school_list and additional information on and Green and Healthy School Grants provided by the Baltimore City Public Schools Green School Coordinator. List of INSPIRE schools was retrieved from https://baltimore21stcenturyschools.org/projects. All lists were downloaded in December 2018.
Floodplain	Downloaded from Open Data Baltimore Sept 2018 https://data.baltimorecity.gov/Geographic/Floodplain-Shape/pqt8-n8r7
Hydrography	Downloaded from Maryland GIS Data Catalog http://data.imap.maryland.gov/datasets/9ba87d5942744b3bb61c78dd22c76564_0
Critical Area	Downloaded from Open Data Baltimore Sept 2018 https://data.baltimorecity.gov/Geographic/Critical-Area-and-Resource-Conservation-Areas/m5av-ntyv
Locations of Hospitals	Downloaded from Open Baltimore Nov 2018. https://data.baltimorecity.gov/Health/Hospitals/g9ck-7zns "This data set shows the location of Baltimore City hospitals. The purpose of this data is to assist the City of Baltimore in identifying institutions that provides health care treatment by specialized staff and equipment. To assist the City's emergency organizations in identifying health institution during an emergency event. Cartographic, analysis, and planning." Multi-Purpose health centers are not included.
Railroads	Downloaded from Open Baltimore Nov 2018. https://data.baltimorecity.gov/Geographic/Railroad-Shape/buxu-32qi
BNIA Data Dictionary	Downloaded from https://bniajfi.org/indicators/all
2010 CSA Boundaries & BNIA Data	Downloaded from BNIA https://bniajfi.org/community/Baltimore%20City/
BH Watershed Boundary & Subwatersheds	Created by cross referencing the Watershed Boundaries available to download from MDE at (MDE - https://mde.maryland.gov/programs/Water/TMDL/DataCenter/Pages/8DigitWatershed.aspx) with the NPDES drainage areas ( ) and topography ( )
BH Watershed Boundary	Created by cross referencing the Watershed Boundaries available to download from MDE at (MDE - https://mde.maryland.gov/programs/Water/TMDL/DataCenter/Pages/8DigitWatershed.aspx) with the NPDES drainage areas ( ) and topography (LiDAR Elevation Dataset - Bare Earth DEM at 1m resolution - downloaded in 2008, compiled by Sanborn.)
Major Roads	TigerLine Data
Water Features	TigerLine Data
Land Use/Land	Name: County Land Use Land Cover 2010 Dataset provided by the State of Maryland,

Cover	containing summary statistics from the state issued 1973, 2002, and 2010 land use/land cover datasets, created to provide a generalized view of how land has been developed and changed over time. Downloaded from the Maryland GIS Data Catalog <http://data.imap.maryland.gov/datasets/97717f333baf4e79abb7ab8098a99ee5_0>
Slope	LiDAR Elevation Dataset - Bare Earth DEM at 1m resolution - downloaded in 2008, compiled by Sanborn.
Soils (Hydrologic Group)	Originator: U.S. Department of Agriculture, Natural Resources Conservation Service Publication Date: July 15, 2006 Title: Digital General Soil Map of U.S. - City of Baltimore, Maryland - Downloaded from https://gdg.sc.egov.usda.gov/GDGOrder.aspx on 18-Sept-2018
Impervious Baseline 2015	Digitized and Photogrammetrically captured pavement edges based off of aerial photograph from 2011. Serves as the baseline for the DPW MS4 permit.
Eligible MS4 Impervious	Created by starting with the Impervious Baseline data, then removing impervious surfaces on federally or state owned property, industrial parcels that are not city-owned (owned by Mayor and City Council), and impervious surfaces within known drainage areas for stormwater management facilities installed after 2010 based on DPW records (as these have gone through review under the current stormwater management regulations and are assumed to be managed to the maximum extent practicable (MEP)).
Land parcels in Baltimore, by ownership type (NPDES Source Sector) with Industrial parcels noted and parcels with railways (at grade or below grade)	Property Ownership Database maintained by Baltimore City coded by ownership type with 2018 Industrial Permit holders (list provided by MDE) identified. Railways downloaded from Open Data Baltimore. https://data.baltimorecity.gov/Geographic/Railroad-Shape/buxu-32qi
Development Trends	Provided by the Department of Housing and Community Development - Baltimore City. Contains Neighborhood SubCabinet areas, (7 focus areas identified by Baltimore City for redevelopment. Planning process currently underway); Major Redevelopment areas (Not officially designated, but areas that have been identified where significant land changes are currently taking place); and Community Development Clusters (areas flagged for potential housing development, but with varying degrees of certainty and boundary integrity)
Green Network Pilot Sites	Created a shapefile of Green Network Pilot Project locations using a list provided by the Planning Department's Office of Sustainability, mapped to the Baltimore City Real Property Parcel Dataset (accessed October 2018) using the join function in Arc GIS based on Block Lot information.
Green Network Nodes/Corridors	Geodatabase Provided by the Department of Planning Office of Sustainability on Sept. 21, 2018
High Crash Pedestrian Intersections	List Provided by the Department of Transportation, and imported as points into ArcGIS.
BMORE Beautiful Neighborhoods	Created using the list of participating communities available at <https://mayor.baltimorecity.gov/BMORE_Beautiful> Accessed September 2018 and the Neighborhoods Shapefile downloaded from Open Data Baltimore September 2018 <https://data.baltimorecity.gov/Neighborhoods/Neighborhoods-Shape/ysi8-7icr>

Bicycle Master Plan	Map Package Provided by the Baltimore City Department of Transportation 2018
Existing Bicycle Facilities	Map Package Provided by the Baltimore City Department of Transportation 2018
Violence Reduction Initiative (VRI) Zones	Provided by the Baltimore City Office of Information & Technology (BCIT) - 2018
Storm & Sewer Infrastructure & 311 Call Density	Provided by DPW Office of Asset Management 2018
Proposed & Identified/Not Feasible Restoration Projects	Provided by DPW Office of Engineering and Construction 2018
% White % w/o High School Diploma/Equivalency Median Income % Households in Poverty % Walked to Work % Without Vehicle Access % Tree Canopy	BNIA Vital Signs 16 – Downloaded from https://bniajfi.org/community/Baltimore%20City/ See All Vital Signs Indicators for description of variables https://bniajfi.org/indicators/all
Hardship Index Life Expectancy % Parks & Greenspace	Baltimore City Health Department Vital Signs Reports (See reports for description of variables) https://health.baltimorecity.gov/neighborhoods/neighborhood-health-profile-reports
Percent Impervious (Not shaded)	Chesapeake Conservancy Conservation Innovation Center – High Resolution Land Cover data – Downloaded from : https://chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/land-cover-data-project/