CHESAPEAKE BAY

DRAFT Comprehensive Water Resources and Restoration Plan

May 2018

US Army Corps of Engineers®

This document was developed in coordination with multiple stakeholders, including the Chesapeake Bay Program, U.S. Fish and Wildlife Service, District of Columbia, states of Delaware, Maryland, New York, Virginia, West Virginia, and commonwealths of Pennsylvania and Virginia.

Foreword

The Chesapeake Bay and its contributing watershed is a national treasure. The dynamic features and natural ecological processes that formed the balance and abundance Captain John Smith encountered over 400 years ago are still at work today. Nature is seeking to restore balance to the impacts humans have had on the Chesapeake Bay Watershed and its ecosystem—impacts from centuries of land use changes and growing populations as well as impacts from a changing climate. For more than 30 years, the Chesapeake Bay Program (CBP) along with federal, regional, state, local, and non-governmental organizations, which make up the Chesapeake Bay Program Partnership (Partnership), have been collaborating on the restoration of this national treasure, culminating most recently in the development of the 2014 Chesapeake Bay Watershed Agreement (2014 Bay Agreement). The 2014 Bay Agreement established comprehensive goals and outcomes for the watershed by the year 2025. To date, there are improvements in the overall health of the watershed, which are a testament to the collective effort invested in this journey to ensure future generations enjoy the beauty and bounty of an ecosystem in equilibrium. To fully reach Chesapeake Bay restoration goals, the increasing stresses from development pressures and climate change impacts must be considered and addressed using an integrated water resources management approach.

The U.S. Army Corps of Engineers (USACE) has been an important partner in advancing the Chesapeake Bay restoration effort through a range of legislative authorities, programmatic activities, and aquatic ecosystem restoration and construction projects. Through its contributions, USACE has made significant measurable improvements to the health of the Chesapeake Bay and conditions across the watershed (following legacy actions that contributed to its degradation). However, there are remaining issues, needs, and opportunities indicating USACE can serve in a leadership role to support an integrated water resources management approach. This approach aligns with other USACE mission areas (flood risk management, navigation) to support resilient communities within the watershed. This **Chesapeake Bay Comprehensive Water Resources and Restoration Plan (CBCP)** is intended to identify actions for USACE to advance the long-term restoration effort, complementing ongoing and planned efforts by the Partnership. Given the vast work that has been undertaken toward Chesapeake Bay restoration, this effort is unique in that it is focused on facilitating implementation.

The CBCP represents a significant milestone, with the report preparation coinciding with the start of development of the U.S. Environmental Protection Agency (EPA) Phase III watershed implementation plans (WIPs). The CBCP establishes a Restoration Roadmap for those actions and commitments to inform the next steps for implementation actions to achieve the goals presented in the 2014 Bay Agreement. Through scaled analyses, engagement with a variety of stakeholders, and use of extensive existing data and information, the CBCP identifies restoration needs and opportunities for future actions at the Bay watershed scale while highlighting specific local-level project opportunities to help regional partners achieve established restoration goals and outcomes. This effort will complement the ongoing and planned actions leading to the 2014 Bay Agreement's 2025 milestone for integrated water resources management.

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Acronyms

ARP	Anacostia Restoration Plan
BMP	best management practice
CAP	Continuing Authorities Program
CBCP	Chesapeake Bay Comprehensive Plan
CBP	Chesapeake Bay Program
CBP3	community-based public-private partnership
COG	Metropolitan Washington Council of Governments
CSOs	combined sewer overflows
D.C.	District of Columbia
DE	Delaware
DOD	U.S. Department of Defense
EO	Executive Order
EPA	U.S. Environmental Protection Agency
FLC	Federal Leadership Committee
FPMS	Floodplain Management Services Program
GIS	geographic information system
GIT	Chesapeake Bay Program Goal Implementation Team
MD	Maryland
MD DNR	Maryland Department of Natural Resources
MDE	Maryland Department of the Environment
MPA	Maryland Port Administration
MS4	municipal separate storm sewer system
NFWF	National Fish and Wildlife Foundation
NGO	non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NY	New York
ORP	Oyster Recovery Partnership
PA	Pennsylvania
PADEP	Pennsylvania Department of Environmental Protection
PAR	Planning Aid Report
PAS	Planning Assistance to States
P3	public-private partnership

RTE	Rare, threatened, and endangered
SAV	submerged aquatic vegetation
TMDL	total maximum daily load
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VA	Virginia
VIMS	Virginia Institute of Marine Science
VMRC	Virginia Marine Resources Commission
WIP	watershed implementation plan
WRDA	Water Resources Development Act
WRRDA	Water Resources Reform and Development Act
WV	West Virginia
WVIJDC	West Virginia Infrastructure and Jobs Development Council
WWTP	Wastewater Treatment Plant

Introduction to the CBCP

REPORT'S PURPOSE AND ORGANIZATION

The Chesapeake Bay Comprehensive Water Resources and Restoration Plan (CBCP) identified and evaluated problems, needs, and opportunities in the Chesapeake Bay Watershed using an integrated water resources management approach. The team conducted geospatial analyses to identify high-quality areas for potential conservation, degraded areas for restoration, and gaps in restoration actions or duplication of efforts. This watershed assessment was undertaken in cooperation with Chesapeake Bay stakeholders and partners and employed a collaborative approach to watershed planning, seeking to avoid duplication of ongoing or planned actions of other federal, state, or local agencies or non-governmental organizations (NGOs) in the watershed (past or present).

The 2014 Chesapeake Bay Watershed Agreement (2014 Bay Agreement) and associated management strategies developed by the Chesapeake Bay Program (CBP) goal implementation teams (GITs) provided the groundwork and served as a guide in the development of the CBCP. The U.S. Army Corps of Engineers (USACE) is actively involved in several CBP GITs, including Sustainable Fisheries, Habitat, and Healthy Watersheds, and various working groups. The purpose of this plan is to maximize use of existing information regarding the 2014 Bay Agreement goals and outcomes to inform future investment decisions at local, regional and national scales.

The CBCP is organized to present the findings of the geospatial analyses and corresponding products so that it assists multiple users across the Chesapeake Bay Partnership (Partnership).

- The main report presents the key findings and recommendations.
- The Planning Analyses and the Agency Coordination and Public Involvement Appendices describe the analyses completed to develop the Restoration Roadmap and the stakeholder outreach that occurred.
- The State and District of Columbia Annex is organized by the respective jurisdiction to specifically support implementation. Each chapter provides a summary of CBCP information and analyses tailored to the respective jurisdiction.
- Multiple electronic products (including the geodatabase, data and maps), which were not suitable for presentation in paper format, are available on the CBCP webpage at http://www.nab.usace.army.mil/Missions/Civil-Works/Chesapeake-Bay-Comprehensive-Plan/.

Figure 1 presents the organization of the CBCP report and corresponding products.

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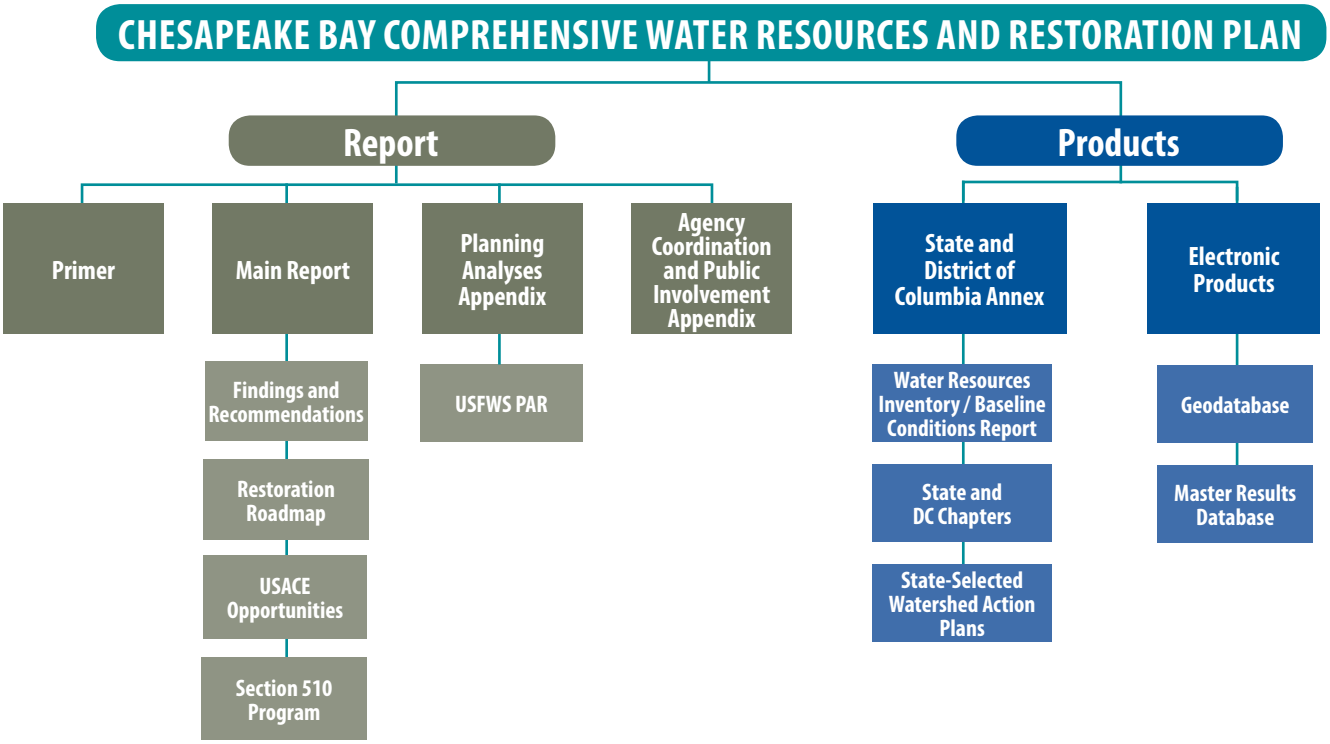


Figure 1. CBCP Organization and Products Generated

OVERVIEW OF CHESAPEAKE BAY COMPREHENSIVE WATER RESOURCES AND RESTORATION PLAN

2014 Chesapeake Bay Watershed Agreement

Since 1983, there have been many agreements guiding Chesapeake Bay restoration. These agreements include the Chesapeake Bay Agreement of 1983, 1987 Chesapeake Bay Agreement, Chesapeake 2000, and 2014 Bay Agreement. Through the 2014 Bay Agreement, the Partnership has recommitted its efforts to restoration of the bay and its watershed. Specific goals were established for resources in the following categories: sustainable fisheries, vital habitats, water quality, toxic contaminants, healthy watersheds, stewardships, land conservation, public access, environmental literacy, and climate resiliency. The goals will be described specifically in each pertinent section of this document. They are also in the "Goals & Outcomes" section of the 2014 Bay Agreement.

Study Area

The Chesapeake Bay Watershed covers 64,000 square miles (165,760 square kilometers) and includes parts of six states (Virginia, Maryland, Delaware, West Virginia, Pennsylvania, and New York) and all of the nation's capital (**Figure 2**). The watershed extends about 500 miles north to south from the headwaters of Otsego Lake, near Cooperstown, New York, to Suffolk, Virginia, and west to east from near Blacksburg, Virginia, to Berlin, Maryland (near Ocean City, Maryland). The watershed has 11,684 miles of shoreline, including tidal wetlands and islands. The watershed's rivers all drain into one shallow tidal basin, the Chesapeake Bay, and the bay's tidal tributaries. The Chesapeake Bay is the nation's largest estuary and the third largest in the world and one of the world's most productive ecosystems. It is in the middle Atlantic Coastal Plain province and was formed when the lower valley of the Susquehanna River was drowned as glaciers melted during the post-Wisconsin rise in sea level.

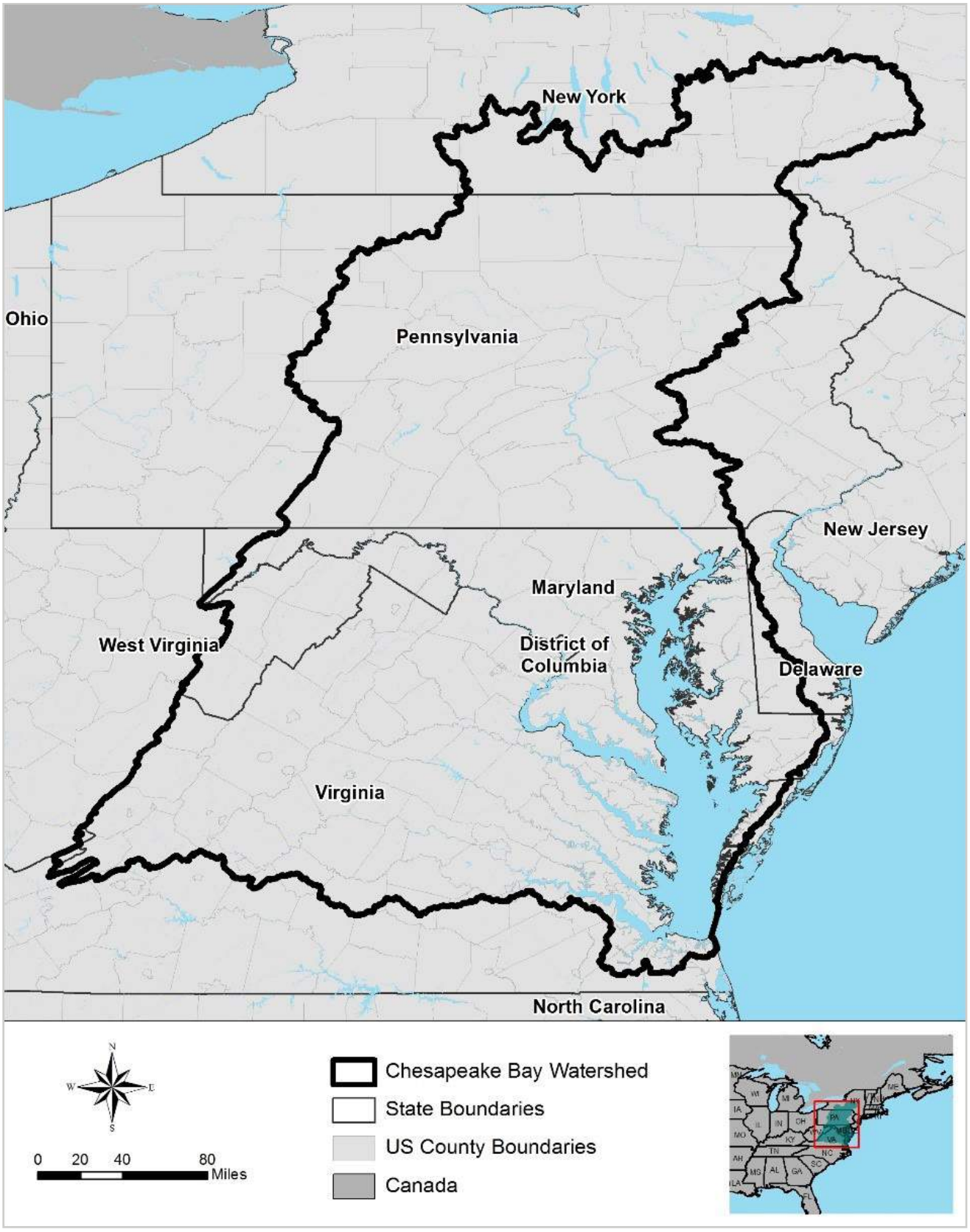


Figure 2. CBCP Study Area (Chesapeake Bay Watershed)

Authorization

USACE Baltimore and Norfolk Districts were authorized to develop a comprehensive and integrated restoration plan to guide implementation of projects affecting the Chesapeake Bay estuary and its watershed. The watershed assessment was conducted under the authority provided by the U.S. Senate Committee on Environment and Public Works, Committee Resolution, adopted September 26, 2002. The study resolution reads as follows:

> ""Resolved by the Committee on Environment and Public Works on the United States Senate, that the Secretary of the Army is requested to review the report of the Army Corps of Engineers on the Chesapeake Bay Study, dated September 1984, and other pertinent reports, with a view to developing a coordinated, comprehensive master plan within the Corps mission areas for restoring, preserving, and protecting the Chesapeake Bay ecosystem. The plan shall focus on integrating existing and future work of the Corps of Engineers, shall be developed in cooperation with State and local governments, other Federal agencies, the Bay Program, the Chesapeake Bay Commission, and the Chesapeake Executive Council, and shall encompass all Corps actions necessary to assist in the implementation of the goals of the 2000 Chesapeake Bay Agreement. The plan shall identify additional feasibility studies and research efforts required to better understand and solve the environmental problems of the Chesapeake Bay."

The CBCP was also conducted under supplemental authority provided by Section 4010(a) of the Water Resources Reform and Development Act of 2014 (WRRDA 2014), which links the CBCP to Section 510, a design and construction authority entitled Chesapeake Bay Environmental Restoration and Protection Program. Section 4010(a) directs development of a "comprehensive Chesapeake Bay restoration plan" no later than 2 years after the enactment of the WRRDA 2014. Section 510 provides for design and construction, cost-shared 75 percent federal and 25 percent non-federal, of water-related resources protection and restoration projects, and is to be based on the comprehensive plan. Types of projects eligible for assistance include those for sediment and erosion control; protection of eroding shorelines; ecosystem restoration, including restoration of submerged aquatic vegetation (SAV); protection of essential public works; beneficial uses of dredged material; and other related projects that may enhance the living resources of the estuary. Non-federal sponsors for Section 510 projects can include federal, state and local governmental agencies.

Sponsor

For the CBCP, USACE is the lead federal agency, with a 75 percent cost share, and the National Fish and Wildlife Foundation (NFWF) is the non-federal sponsor, with a 25 percent cost share. Congress chartered NFWF in 1984 as a charitable and nonprofit organization registered as a 501(c)(3) corporation (NFWF 2018a).

Within the northeastern regional office, the NFWF Chesapeake Bay Program administers grant awards, ranging from $8 to $12 million annually, from the Chesapeake Bay Stewardship Fund, through two competitive grant programs: Innovative Nutrient and Sediment Reduction Grant Program and Small Watershed Grant Program (NFWF 2018b).[1] The grants awarded from this fund are used to assist local communities with restoring polluted rivers and streams through a myriad of conservation and restoration projects (NFWF 2018b)

Primary Problem

Since the signing of the 1983 Chesapeake Bay Agreement, the problems affecting the Chesapeake Bay have been well-documented. The primary problem is degradation of the structure and function of the Chesapeake Bay aquatic ecosystem from human actions, which leads to a less resilient Chesapeake Bay.

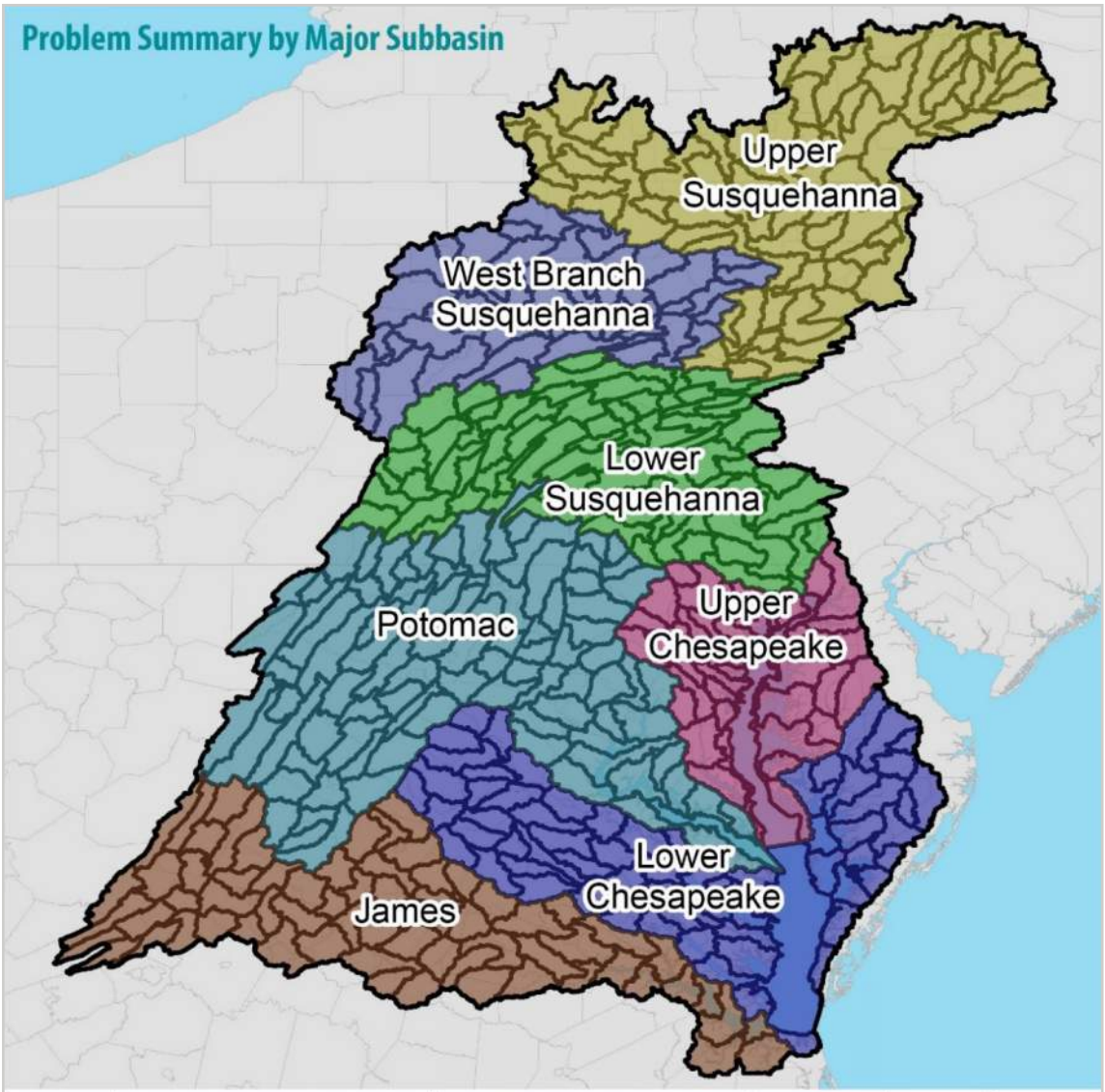
1 With a request for proposals for the Innovative Nutrient and Sediment Reduction Grants Program, specifically intended to identify potential projects that dramatically accelerate quantifiable pollutant reduction, NFWF evaluates project proposals with criteria that consider potential projects within NFWF's Targeted Rivers and Watersheds that support the co-benefits of improved water quality, habitat restoration, and species recovery outcomes. Similarly, the Small Watershed Grants Program, which is intended to award projects that promote community-based efforts, also awards grants for potential projects that support co-benefits. This grant-making evaluation and award process follows an integrated water resources management approach—like the integrated approach used to complete the CBCP—to identify conservation and restoration opportunities that would meet multiple objectives within a prioritized geographic area of relatively smaller scale to achieve measurable results.

Solutions to the problem are two-fold, requiring both implementation and coordination. For solutions to succeed within an integrated water resources management framework, it is necessary to (1) enhance interagency collaboration between agency programs and projects to streamline data sharing, reduce costs, and increase implementation of restoration and conservation actions, and (2) identify strategies and projects for ecosystem restoration that may reduce flood risk, increase ecosystem and community resilience, support sustainable fisheries, promote environmental education and stewardship, and provide recreation and public access. The CBCP seeks to facilitate both needs.

HYDROLOGIC UNITS

The USGS has classified U.S watersheds, based on hydrologic features, into hydrologic units (region, subregion, accounting unit, cataloging unit). Each hydrologic unit is assigned a unique hydrologic unit code (HUC). The higher the number, the smaller the watershed drainage area. For example, a HUC 6 watershed has a larger drainage area than a HUC 10 watershed.

Based on existing information, a broad overview of the regional-scale problems affecting the watershed is provided in **Table 1**. This table presents a snapshot of the problems in the watershed at a major subwatershed boundary scale (hydrologic unit code (HUC) 6). Only a select group of land cover metrics that are connected to watershed health are provided: riparian forested buffers, agriculture, forest, and imperviousness. Lack of forests and forest buffers, extent of agricultural lands, and amount of impervious surface are major drivers of a watershed's health. The 2014 Bay Agreement forest buffer goal is to restore 900 miles of riparian forest buffers per year and to conserve existing buffers until at least 70 percent of riparian areas in the watershed are forested. The table provides a glimpse of which subbasins are below those goals. Agriculture and imperviousness (paved areas) are linked to altered hydrology, increased runoff and pollutants, reduction of groundwater infiltration, and loss and disconnection of habitats. Although, natural areas are sensitive to any increase in imperviousness, negative impacts from impervious cover become widespread once approximately 10 percent of the landscape has been paved. It may be necessary to view land cover data, specifically imperviousness, at a smaller action plan scale to understand local conditions.



	VULNERABILITY				LAND COVER PERCENTAGE[a]				ABANDONED MINE LAND PROBLEM AREA[b]	PRE-DOMINANT IBI[c]	IMPAIRED STREAM MILES LISTED ON 303(D)
	Future Development	Flood Concerns	Shorelines	Future Wetland Loss	Forested Buffer	Agriculture	Forested	Impervious			
Upper Susquehanna	NO	!	NO	! nontidal	62	6	57	3	!	2	2383
West Branch Susquehanna	NO	!	NO	! nontidal	78	5	72	2	!	2	1266
Lower Susquehanna	!	!	NO	! nontidal	58	15	49	5	!	2	1660
Upper Chesapeake	!	!	!	! both	62	15	27	8	NO	1	1446
Potomac	!	!	!	! both	66	7	53	5	!	2	3350
Lower Chesapeake	!	!	!	! both	71	11	44	3	NO	2	3209
James	!	!	!	! both	81	2	69	4	NO	2	2334

N = Identifies that this category is not a problem in the area
! = Identifies that the problem exists in the area
Data sources: Land cover data from Chesapeake Bay Conservancy (2016), Abandoned Mine Land Problem Areas provided by the Pennsylvania Department of Environmental Protection (PADEP), and Pre-Dominant IBI from Chesapeake Bay Program Benthic Index of Biotic Integrity (B-IBI) (CBP 2012)

Table 1. Problem Summary by Major Subbasin

Future Stressors

The U.S. Fish and Wildlife Service (USFWS) prepared a Planning Aid Report (Planning Analyses Appendix) as a product to inform the broader CBCP effort. USACE requested USFWS assist with identifying future stressors and evaluating impacts to resources under USFWS jurisdiction. The following stressors were identified: climate change; urbanization and development of natural vegetative landscapes; invasive species; agricultural impacts (sediment loading and nutrients from fertilizers and livestock); silviculture[2]; oil and gas development; mining; hydropower, dams, road crossings, and culverts; and water withdrawal for consumptive use.

Vision

The Chesapeake Bay is a watershed of national significance. The preamble of Executive Order (EO) 13508, Chesapeake Bay Protection and Restoration (2009) states the Chesapeake Bay is a national treasure constituting the largest estuary in the U.S. and one of the largest and most biologically productive estuaries in the world. The EO identifies that to restore the health of the Chesapeake Bay it will require protecting and restoring habitat and living resources, conserving lands, and improving management of the natural resources. The CBCP integrates the EO's strategies into the CBCP's overall watershed vision, which is aligned with the 2014 Bay Agreement vision. The CBCP watershed assessment therefore integrated the 2014 Bay Agreement vision, including the term resilient, into the CBCP vision statement, aligning it with the need to adapt the health of the watershed to future stressors of the restoration effort.

> We envision an environmentally and economically sustainable and resilient Chesapeake Bay Watershed with clean water, abundant life, conserved lands and access to water, a vibrant cultural heritage, and a diversity of engaged citizens and stakeholders.

The CBCP is responsive to and complies with many EOs. Primarily, the CBCP has been developed in alignment with EO 13508. Additionally, the CBCP is consistent with the Efficient Federal Operations Executive Order (EO 13834), which directs federal agencies to operate in a manner that increases efficiency, optimizes performance, eliminates unnecessary use of resources, and protects the environment. Actions to be prioritized are actions that reduce waste, cut costs, enhance the resilience of federal infrastructure and operations, and enable more effective accomplishment of an agency's mission. The CBCP recognizes that the policy of the U.S. is to protect the environment and sets goals to reduce potable and non-potable water consumption and comply with stormwater management requirements. The CBCP also aligns with EO 13805, The Presidential Advisory Council on Infrastructure, which sets the policy of the executive branch to advance infrastructure projects that protect the environment and sets a mission to increase public-private partnerships (P3) for infrastructure projects for the council.

Primary Goal and Objectives

The CBCP's primary goal is to provide a comprehensive and integrated water resources management plan to assist with implementation of the 2014 Bay Agreement. Throughout the CBCP effort, USACE and NFWF staff engaged stakeholders to identify problems, needs, and opportunities and to avoid duplication of ongoing or planned actions by others. Integrated water resources management requires the understanding of ongoing, collaborative actions occurring among the Partnership to identify those actions that have been completed or are planned for implementation by others. The CBP, especially the 2014 Bay Agreement GITs, was instrumental in providing feedback during the CBCP development. Because of the collaborative efforts and based on the geospatial analyses, the results include a Restoration Roadmap to inform where and how USACE mission areas can be used to support and complement the ongoing efforts to achieve the 2014 Bay Agreement goals. The Restoration Roadmap

2 Silviculture is the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society such as wildlife habitat, timber, water resources, restoration, and recreation on a sustainable basis. https://www.fs.fed.us/forestmanagement/vegetation-management/silviculture/index.shtml

can also be used by all partners to inform future investment decisions. **Table 2** summarizes the objectives of the CBCP watershed assessment to achieve the 2014 Bay Agreement's goals.

Objectives 1 and 2 are fulfilled by the content of the CBCP and it various products. Objective 3 is met by the State-Selected Watershed Action Plans and the candidate restoration projects. Objective 4 is addressed in the "Implementation Strategy" section of this report.

CBCP OBJECTIVES

1. Develop a **comprehensive, strategic, and integrated water resources plan** to guide the implementation of projects to assist in meeting the 2014 Bay Agreement goals and outcomes.
2. Identify areas for **aquatic ecosystem restoration, protection, or preservation** to assist in meeting the 2014 Bay Agreement objectives.
3. Identify at least one **project in each of the six states and District of Columbia for implementation or technical assistance by USACE** and that supports the 2014 Bay Agreement objectives.
4. Identify new policies or programs or improve upon existing policies and programs to **achieve an environmentally and economically sustainable and resilient Chesapeake Bay Watershed**.

Table 2. Overview of CBCP Objectives

VALUE TO THE NATION

The Chesapeake Bay Watershed is the largest U.S. estuary (64,000 square mi drainage area), out of about 100 estuaries (CBP 2018a) and is the third largest estuary in the world (CBF 2018). The watershed represents a highly diverse and biologically important area of the U.S. Within the Chesapeake Bay Watershed, there are 16 national wildlife refuges representing important habitats for native plants and animals, including endangered and threatened species (USFWS 2017). The Atlantic Flyway, one of four main avian migratory routes and a critical layover area for North American migratory birds, runs the length of the Chesapeake Bay Watershed. Almost one-third of waterfowl wintering along the Atlantic Coast winter on the Chesapeake Bay (USFWS 2018).

The watershed is home to approximately 18 million people (as of 2016) and is projected to increase to 21 million people by 2040 (CBP 2018b). Employing an integrated watershed resources management approach promotes preservation and protection of healthy/high value habitat while restoring areas with degraded ecosystem functions.

USACE can serve in a leadership role to employ its authorities and programs on watershed projects across the nation, aligning communities of practice such as Systems Approach to Geomorphic Engineering or USACE's collaborative program Engineering with Nature to assist in resolving complex water resource problems and promoting sustainable and resilient ecosystems and communities. USACE supports flood risk, coastal flood risk and climate change adaptation planning, water supply, and ecosystem restoration efforts using a collaborative approach. USACE's support and collaboration with the Partnership ensured the watershed assessment and planning analyses were completed successfully and incorporated shared vision planning to formulate solutions that encompass the 2014 Bay Agreement's vision—an environmentally and economically sustainable and resilient Chesapeake Bay Watershed.

USACE has been involved in water resources management actions across the Chesapeake Bay Watershed since the early 1800s. Over the past 200 years, USACE missions have evolved to meet the needs of the nation, including evolving from controlling water resources to managing them regionally and integrating collaborative approaches to address challenges. Integrated water resources management uses practical science and technology combined with collaborative approaches to address water resources challenges. For the CBCP, the integrated water resources development approach identified problems and opportunities across the Chesapeake Bay Watershed that intersect disparate circumstances (loss of habitat, water quality, flooding and the disconnection of floodplains,

eroding shorelines) and results in the Restoration Roadmap to guide future investments with the goal of achieving the metrics in the 2014 Bay Agreement.

PLANNING ANALYSES

Watershed planning is intended to inform multiple audiences and decision-makers at all levels of government and non-government and to present a strategic roadmap to inform future investments. Over the past 30 years, the Partnership, in its overall organization and restoration actions, has established much of the foundation for the CBCP analyses. To achieve CBCP-specific objectives, further analyses were completed to identify high-quality areas for conservation, degraded areas for restoration, and gaps in restoration actions or duplication of efforts. Geospatial analyses were the primary methodology used to achieve these analyses. Using existing spatial data obtained from many sources (federal, state, and local agencies; academia; NGOs), specific questions were used to solicit input regarding problems and opportunities within the Chesapeake Bay Watershed. Stakeholder meetings and webinars were used as question-answer platforms to identify, coordinate, and solicit feedback among NFWF, federal, state and local governmental agencies, stakeholders, and other interested parties.

Following an initial inventory of existing datasets and coordination with the CBP GITs, 170 geospatial data layers were available to conduct planning analyses. When overlaying multiple data layers in a geographic information system (GIS), additional information and new comparisons could be derived. **Figure 3** presents the process used to evaluate existing datasets for use in planning analyses.

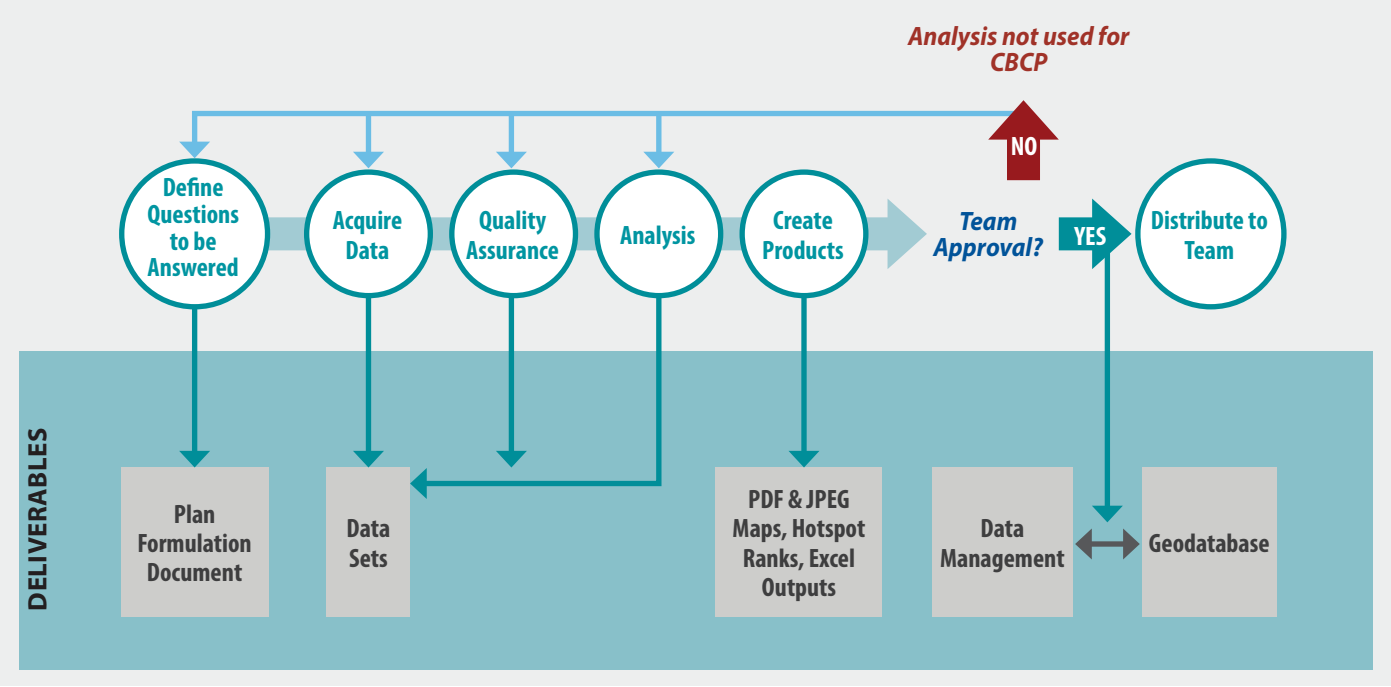


Figure 3. Technical Approach of the GIS Process

Scale of Analyses

The U.S. Geological Survey (USGS) has classified U.S. watersheds, based on hydrologic features, into hydrologic units (region, subregion, accounting unit, cataloging unit). Each hydrologic unit is assigned a unique hydrologic unit code (HUC) (USGS 2018). Planning analyses were conducted at the HUC 10 scale, hereafter referred to as subwatershed. This scale was chosen to balance data limitations, feasibility, and meaningfulness. The subwatershed scale is small enough to provide information representative of local conditions, but large enough to enable manageable computations. Importantly, much of the data available were valid at this scale. There are 425 subwatersheds in the watershed, ranging from 30,000 to 754,000 acres. The average size of a subwatershed in the Chesapeake Bay is 103,500 acres. **Figure 4** shows Chesapeake Bay subwatershed boundaries.

Results are later presented at three scales: (1) a baywide analysis (Restoration Roadmap), (2) a jurisdiction analysis (State and District of Columbia jurisdictional boundary), and (3) a watershed analysis (State-Selected Watershed Action Plans).

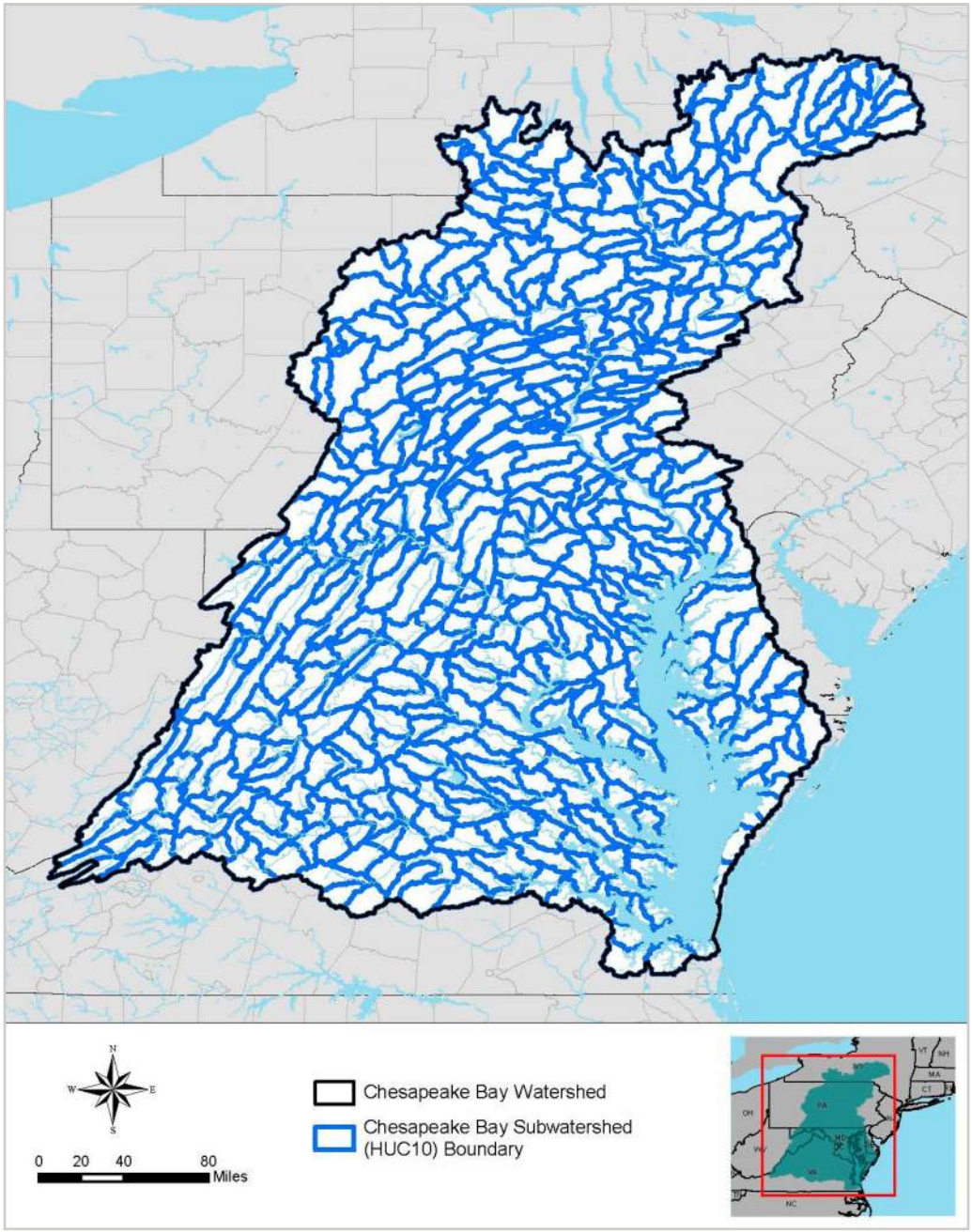


Figure 4. Chesapeake Bay Subwatershed (HUC 10 Hydrologic Unit) Boundaries

Figure 5. Composite Analyses

Formulation

Geospatial analyses were used to evaluate various restoration strategies and align actions for addressing problems and opportunities. Geospatial analyses included both composite analyses and investigations of specific restoration opportunities (e.g., stream restoration, wetland restoration, riparian buffers).

The composite analyses were the initial step taken to screen and organize the 170 data layers collected. Each composite analysis organized numerous data layers into one data layer focused on a specific topic. The eight specific topics compiled were (1) identified priorities by stakeholders, (2) restoration actions, (3) USACE mission analyses and military lands, (4) healthy/high-value habitat, (5) connectivity, (6) stressors, (7) threats, and (8) socioeconomics. The resulting layers served as the building blocks of the restoration opportunities analysis, deriving the problems and opportunities to be highlighted in the CBCP. **Figure 5** is a conceptual representation of the composite analyses.

Each of the eight topics was a stand-alone analysis. In addition, restoration opportunities analyses were developed by combining or overlaying one or more of the eight composite topics to create a comprehensive assessment of restoration and implementation opportunities. The Planning Analyses Appendix discusses the details of the formulation.

Restoration and conservation strategies were aligned with the 2014 Bay Agreement "Goals and Outcomes" to guide formulation. The 2014 Bay Agreement goals are to:

- Protect, restore and enhance finfish, shellfish and other living resources, their habitats and ecological relationships to sustain all fisheries and provide for a balanced ecosystem in the watershed and Chesapeake Bay.
- Restore, enhance and protect a network of land and water habitats to support fish and wildlife and to afford other public benefits, including water quality, recreational uses and scenic value across the watershed.
- Reduce pollutants to achieve the water quality necessary to support aquatic living resources and protect human health.
- Ensure the Chesapeake Bay and its rivers are free of the effects of toxic contaminants on living resources and human health.
- Sustain state-identified healthy waters and watersheds, recognized for their high quality and/or high ecological value.

- Conserve landscapes treasured by citizens in order to maintain water quality and habitat; sustain working forests, farms and maritime communities; and conserve lands of cultural, indigenous and community value.
- Expand public access to the Chesapeake Bay and its tributaries through existing and new local, state and federal parks, refuges, reserves, trails and partner sites.
- Enable students in the region to graduate with the knowledge and skills needed to act responsibly to protect and restore their local watersheds.
- Increase the number and diversity of local citizen stewards and local governments that actively support and carry out the conservation and restoration activities that achieve healthy local streams, rivers and a vibrant Chesapeake Bay.
- Increase the resiliency of the Chesapeake Bay watershed, including its living resources, habitats, public infrastructure and communities, to withstand the adverse impacts from changing environmental and climate conditions.

The CBCP strategies were developed in coordination with NFWF and CBP GITs and were intended to integrate the various 2014 Bay Agreement management strategies and biennial work plans. Potential management measures for implementation of these strategies were identified and screened. See the Planning Analyses Appendix for a full discussion of management measures.

Management Measure. An action (feature, activity, strategy, policy) that can be undertaken to meet planning objectives.

The connections between the 2014 Bay Agreement and CBCP strategies were used in the restoration opportunities analysis. **Table 3** presents the strategies identified for the restoration opportunities analyses, questions investigated, analyses completed, and analyses' alignment with a 2014 Bay Agreement goal or outcome. Because of lack of data, lack of connection to USACE missions, or inability to define a geospatial analysis for which to investigate restoration opportunities, not all 2014 Bay Agreement goals or outcomes were investigated by the CBCP. The Planning Analyses Appendix provides further detail on the restoration opportunities analyses completed, composite analyses topics included, and data layers used.

Additional planning analyses focused on topics not directly contained in the 2014 Bay Agreement, including an investigation of future threats and potential climate change impacts, such as tidal marsh migration; the consideration of rare, threatened, and endangered (RTE) species; and an evaluation of the extent and impacts of road crossings. These topics are each connected to building resilience in the Chesapeake Bay Watershed.

Table 3. CBCP Restoration: Alignment with 2014 Bay Agreement

CBCP Strategies	Problem/Opportunity Identification Question(s)	Opportunity Analysis Completed	2014 Bay Agreement Goal and Outcome Met
Habitat Restoration	*Where do opportunities exist to implement habitat restoration opportunities (streams, freshwater fish, submerged aquatic vegetation (SAV), oysters, black duck, riparian buffer) to further the 2014 Bay Agreement goals and outcomes, maximize/optimize aquatic ecosystem restoration, flood risk management, and community resilience benefits?*	Riparian Buffers Opportunities	◆ Vital Habitats – Forest Buffer (riparian), Stream Health, Brook Trout ◆ Sustainable Fisheries – Fish Habitat ◆ Water Quality
		Stream Restoration Opportunities	◆ Vital Habitats – Stream Health, Brook Trout ◆ Water Quality ◆ Sustainable Fisheries – Fish Habitat
		Fish Passage Removal Opportunities	◆ Vital Habitats – Fish Passage, Stream Health, Brook Trout ◆ Water Quality
		Oyster Restoration Opportunities	◆ Sustainable Fisheries – Oyster
		SAV Opportunities	◆ Vital Habitats – SAV ◆ Water Quality

Table 3. CBCP Restoration: Alignment with 2014 Bay Agreement

CBCP Strategies	Problem/Opportunity Identification Question(s)	Opportunity Analysis Completed	2014 Bay Agreement Goal and Outcome Met
Wetlands Restoration	*Where do opportunities exist to implement wetland restoration opportunities and protect existing wetlands to further the 2014 Bay Agreement goals and outcomes, maximize/ optimize aquatic ecosystem restoration, flood risk management, beneficial use of dredged material, and community resilience benefits?*	Tidal Wetland Restoration and Enhancement Opportunities	◆ Vital Habitats – Wetlands ◆ Climate Resiliency
		Nontidal Wetland Restoration and Enhancement Opportunities	◆ Vital Habitats – Wetlands
		Wetland Restoration for Avian Wildlife Opportunities	◆ Vital Habitats – Wetlands, Black Duck
		Wetland Restoration (Beneficial Use of Dredged Materials) Opportunities	◆ Vital Habitats –Wetlands
		Wetlands Threats	◆ Climate Resiliency ◆ Vital Habitats- Wetlands
Improve Connectivity	*Where do opportunities exist to improve habitat connectivity and human connectivity to healthy habitats?*	Healthy Habitat at Risk to Future Threats	◆ Climate Resiliency ◆ Water Quality – Healthy Watersheds
		Improve and Maintain Human Connections to the Natural Environment	◆ Stewardship – Citizen Stewardship
Land Conservation	*Where do conservation opportunities exist to increase connectivity, enhance restoration success, and address social and economic vulnerabilities?*	Conservation Opportunities	◆ Water Quality – Healthy Watersheds
		Opportunities to Provide Added Societal Benefits	◆ Stewardship – Citizen Stewardship
		Threats Reduction Potential	◆ Climate Change – Climate Resiliency
Shorelines and Stream bank Stabilization	*Where can shoreline opportunities for restoration and conservation be implemented to maximize/optimize aquatic ecosystem restoration and community resilience?*	Opportunities to Reduce Habitat Loss due to Shoreline Erosion	◆ Climate Change – Climate Resiliency ◆ Vital Habitats – Wetlands
		Stream Restoration Opportunities to Reduce Risk to Future Threats	◆ Climate Resiliency; ◆ Water Quality ◆ Vital Habitats – Stream Health
Chemical Contaminant Remediation	*Consider remediation and conservation opportunities with respect to chemical contamination in the watershed.*	Chemical Contaminant Remediation Opportunities	◆ Toxic Contaminants ◆ Water Quality

Opportunity Assessment and the Restoration Roadmap

Opportunities for action were identified throughout the Chesapeake Bay Watershed from the geospatial analyses each opportunity assessment (**Table 4**) generated, a geospatial analysis, and map to show subwatersheds with the greatest potential, need, or impairment, depending on the nature of the evaluation. Opportunity-specific analyses and maps can assist stakeholders in locating implementation projects to support resiliency or to address the specific 2014 Bay Agreement goal or outcome investigated by that evaluation.

The value-added component to the CBCP is the Restoration Roadmap. The roadmap is a compilation of all *Opportunities* identified and identifies the potential of a given subwatershed to address multiple 2014 Bay Agreement goals and outcomes, thereby providing co-benefits. The Restoration Roadmap was formulated by tabulating the number of times an individual subwatershed was identified in the *Opportunity* maps across all analyses. **Table 4** summarizes how the planning analyses and *Opportunity Assessments* were compiled to develop the roadmap. The relevant 2014 Bay Agreement outcomes and whether the analysis is applicable in estuarine, non-estuarine, or both subwatershed types is specified.

Table 4. Restoration Roadmap Development: Compilation of Opportunity Assessments

Restoration Roadmap		Applicable Subwatersheds*	
Opportunity Assessment	2014 Chesapeake Bay Agreement Outcome Alignment	Non-estuarine	Estuarine
Stream Restoration/Floodplain Reconnection	◆ Vital Habitats – Stream Health, Brook Trout ◆ Sustainable Fisheries – Fish Habitat ◆ Water Quality	Yes	Yes
Forested Riparian Buffers	◆ Vital Habitats – Forest Buffer (riparian), Stream Health, Brook Trout ◆ Sustainable Fisheries – Fish Habitat ◆ Water Quality	Yes	Yes
Wetland Restoration (tidal)	◆ Vital Habitats – Wetlands ◆ Climate Resiliency	No	Yes
Wetland Restoration (nontidal)	◆ Vital Habitats – Wetlands	Yes	Yes
Threats Analysis	◆ Climate Resiliency	Yes	Yes
Eroding Shorelines	◆ Climate Resiliency ◆ Vital Habitats – Wetlands	No	Yes
Wetland Restoration for Avian Wildlife	◆ Vital Habitats – Wetlands, Black Duck	Yes	Yes
Utilizing Dredged Material in Wetland Restoration	◆ Vital Habitats – Wetlands	No	Yes
Conservation	◆ Land Conservation ◆ Healthy Watersheds ◆ Water Quality	Yes	Yes
Connectivity	◆ Healthy Watersheds ◆ Water Quality	Yes	Yes
Oyster Restoration	◆ Sustainable Fisheries – Oyster	No	Yes
Watershed Stressor Analysis	◆ Sustainable Fisheries – Oyster ◆ Water Quality	Yes	Yes
SAV Restoration	◆ Vital Habitats – SAV ◆ Water Quality	No	Yes
Toxic Contamination	◆ Toxic Contaminants ◆ Water Quality	Yes	Yes
Marsh Migration	◆ Vital Habitats – Wetlands ◆ Climate Resiliency	No	Yes
Regional Flow and Connectivity	◆ Land Conservation ◆ Healthy Watersheds ◆ Vital Habitats – Wetlands; Water Quality	Yes	Yes

*Due to the number of analyses applicable only in estuarine areas (e.g., oyster restoration, SAV), results were separated and scored only in those subwatersheds where the activity has the potential to occur, eliminating bias towards estuarine areas when compared to the basin states further from the mainstem of the Chesapeake Bay.

This optimization effort results in a plan to guide implementation of restoration actions by all stakeholders to achieve measurable success. Finally, using this information, the restoration opportunities were aligned with USACE authorities and programs to demonstrate how and where USACE could assist the Partnership in the implementation of restoration actions.

Cost Development: Conceptual Unit Cost Estimates

The CBCP does not estimate a cost for how much funding would be required to achieve the 2014 Bay Agreement goals and outcomes due to significant investment and progress already underway and a range of implementation options, partnerships, and cost-saving measures available to stakeholders. However, planning-level cost ranges are presented for aggregated management measures.

The Chesapeake Bay Watershed is vast—there is a wide range of variability in the temporal, spatial, and type of restoration actions that could be implemented—and the geospatial analysis was conducted on a large, baywide scale. Therefore, cost estimates and ranges should be considered "order of magnitude" costs for planning and/or budgeting purposes only.

The concept cost estimates were based on research of past USACE projects, and outreach to stakeholders regarding management measures not typically implemented by the USACE. Costs are provided as a range and were escalated to fiscal year 2017 (FY17). The Planning Analyses Appendix provides a discussion and further details on the development of cost estimates. More precise costs should be developed during site-specific analyses leading to implementation. It would be necessary to incorporate costs incurred for planning, engineering, design, permitting, real estate acquisition, construction management, operation and maintenance, and monitoring and adaptive management.

AGENCY COORDINATION AND PUBLIC INVOLVEMENT

Stakeholder and agency coordination, along with the opportunity to share information with the public, occurred throughout the development of the CBCP. NFWF staff, along with USACE staff participating in Partnership activities, assisted with identifying interagency points of contact and subject matter experts with whom to collaborate. An extensive stakeholder list was prepared for email distributions used to communicate watershed assessment updates, data or information requests, and invitations to participate in planned periodic webinars for soliciting input and feedback on specific topics of interest. Stakeholders included representatives from the Partnership; federal, state, and local governmental agencies; U.S. Department of Defense (DOD); NGOs; contractors; academia; and affiliated organizations such as watershed committees and Silver Jackets teams[3].

Agency and stakeholder collaboration occurred through a stakeholder meeting and periodic webinars. Interested stakeholders and subject matter experts were invited to an initial working meeting hosted by the Maryland Department of the Environment (MDE) on November 7, 2016, in Baltimore, MD. Three webinars were hosted to present the CBCP's analyses status and provide opportunities for stakeholder input. Documentation was made available to the public on the CBCP webpage http://www.nab.usace.army.mil/Missions/Civil-Works/Chesapeake-Bay-Comprehensive-Plan/. **Table 5** presents the CBCP webinars, topics, and participation. The Agency Coordination and Public Involvement Appendix has further details on the collaboration efforts.

Table 5. CBCP Webinar Events

Webinar	Date	Participation
Planning Analyses Overview	February 27, 2017	65
Preliminary Results of Planning Analyses	April 20, 2017	46
Presentation of the Draft CBCP	May 7, 2018	73

On October 11, 2016, USACE submitted letters to the U.S. Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS), U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), and USFWS to inform them of the initiation of the CBCP (Agency Coordination and Public Involvement Appendix). The letter requested each agency's participation in the CBCP development. The letter was intended to ensure the CBCP provides value to an agency's water resources planning and management efforts and complements and supports its ongoing initiatives.

Following federal and state agency and NGO reviews of the draft CBCP, letters of support of the recommendations contained in the CBCP were submitted and are presented in **Table 6**. These federal and state agencies and NGOs are listed because they are listed under the authority provided by the U.S. Senate Committee on Environmental and Public Works, Committee Resolution, adopted September 26, 2002.

3 Silver Jackets teams—state-led interagency teams supported by USACE through its Flood Risk Management Program—bring together multiple federal, state, and local agencies and Indian tribes to learn from one another as part of a collaborative approach to address challenges associated with hazard mitigation, emergency management coordination, floodplain management, natural resources management, and conservation actions. More information is available at https://silverjackets.nfrmp.us/.

Table 6. Supporting Agencies and Jurisdictions

Agency or Organization	Letter of Support Received
NFWF	TBD
EPA	TBD
NOAA NMFS	TBD
USFWS	TBD
USDA	TBD
Chesapeake Bay Commission (CBC)	TBD
CBP	TBD
District of Columbia	TBD
State of Delaware	TBD
State of Maryland	TBD
State of New York	TBD
Commonwealth of Pennsylvania	TBD
Commonwealth of Virginia	TBD
State of West Virginia	TBD

Findings

The planning analyses consisted of geospatial investigations to evaluate ongoing activities, conditions, restoration and conservation strategies, and future threats. The electronic CBCP products provide a detailed database (available at http://www.nab.usace.army.mil/Missions/Civil-Works/Chesapeake-Bay-Comprehensive-Plan/) of the *Opportunity Assessments* including potential strategies for implementation; a spatial range; cost projections and identification of potential benefits; whether USACE has implementation capabilities and if so, relevant programs and authorities; implementation barriers; and other relevant data for developing site-specific projects.

The Restoration Roadmap is a compilation of the *Opportunity Assessments*. Building on the information presented in **Table 4**, the estuarine subwatersheds could have been identified in the *Opportunity Assessments* a maximum of 16 times (i.e., in 16 different geospatial analyses) while the maximum potential score for non-estuarine subwatersheds is 10.

The Restoration Roadmap is a geographic optimization demonstrating where co-benefits can be developed in tidal and nontidal subwatersheds based on the overall intersection of the 2014 Bay Agreement goals. For example, there are many subwatersheds in Pennsylvania, Virginia, and New York where opportunities exist to holistically undertake stream and nontidal wetland restoration; restore forested riparian buffers; remove fish passage blockages; increase connectivity to healthy habitats through conservation; take actions to benefit resident fish, brook trout, and RTE species; and, in some cases, address toxic contaminant and 303(d) list impairments; and reduce nutrients. In some cases, future threats could be addressed. Local area planning goals for pollutant load reductions could be linked to those areas that would provide co-benefits identified in the CBCP restoration opportunities analyses.

Tidal subwatersheds, particularly those on the Eastern Shore of Maryland and in Virginia, exhibit opportunities to restore and enhance tidal and nontidal wetlands, potentially with dredged material and added benefits to avian wildlife or critical species; address shoreline erosion; provide for marsh migration routes; restore oysters; address watershed stressors to improve water quality and habitat for SAV and oysters; undertake stream and forested riparian buffer restoration to benefit anadromous and resident fish and manage nutrient inputs; and build resilience to meet future risks. These are not an exhaustive list of opportunities, but are provided as an example of findings from the planning analyses.

Restoration and conservation efforts should integrate public access opportunities as practicable and opportunities for access by at-risk populations. Specifically, consideration of the human element, including access opportunities, introduces how restoration success could promote new markets for ecosystem goods and services by linking markets to existing communities. Ecosystem goods and services are socially valued aspects of ecosystems, which could provide monetary benefits to a community (or for an innovative financing opportunity to generate a private market or a return on an initial investment into conservation or restoration actions).

Results are presented at three scales in the CBCP, and the following section describes the watershed-wide results. An example analysis is provided for each of the strategies investigated (as listed in **Table 3**). The Restoration Roadmap (**Figure 6**) depicts how many times a subwatershed was identified as an *Opportunity* for both estuarine and non-estuarine subwatersheds. The darker-colored subwatersheds represent the subwatersheds with the highest amount of *Opportunities*.

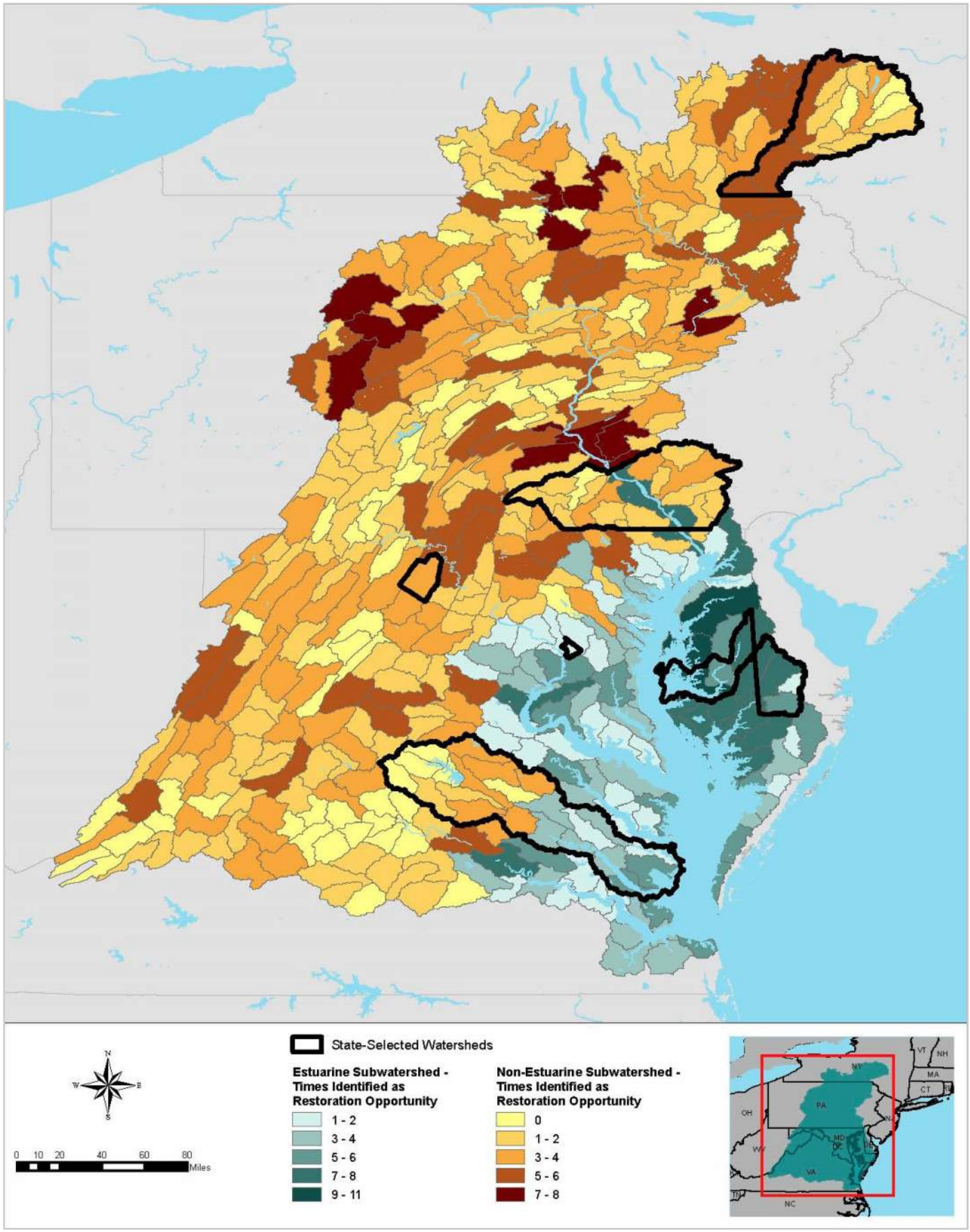


Figure 6. Restoration Roadmap

Habitat Restoration

There are various needs for habitat restoration in the Chesapeake Bay Watershed. Investigations were completed for riparian buffers, stream restoration, eastern brook trout habitat, nontidal wetland restoration and enhancement, tidal wetland restoration and enhancement, black duck habitat, avian habitat, oysters, and SAV (see the Planning Analyses Appendix for additional details). The stream restoration results are presented as an example below. All other results are provided in the Planning Analyses Appendix and the State and District of Columbia Annex. Using the composition analyses and available geospatial data (**Figure 5**), *Opportunity* maps highlight subwatersheds holding the greatest potential to address the need investigated in each map. USACE has the capability to align its aquatic ecosystem restoration mission with needs to improve degraded habitats thereby bringing value to the watershed. The CBCP presents many opportunities for stakeholders to partner with USACE to restore the quality and quantity of habitat and improve the ecosystem's function.

The CBCP investigated opportunities to address fish passage blockages using past work completed by the CBP's Fish Passage Workgroup. However, that dataset does not include blockages for New York or West Virginia. To not bias the results, fish passage is not counted in the Restoration Roadmap. To be included, data had to cover the entire watershed. The State and District of Columbia Annex presents the results for each of the seven jurisdictions at a state scale and includes a detailed discussion of fish passage blockages.

USACE completed a Native Oyster Restoration Master Plan (USACE 2012) with the Virginia Marine Resources Commission (VMRC) and Maryland Department of Natural Resources (MD DNR) to guide large-scale native oyster restoration efforts. The current 2014 Bay Agreement oyster outcome is to restore 10 tributaries by 2025. The master plan evaluated the tributaries that historically supported oyster reef habitat into two tiers. Tier 1 tributaries were determined capable of supporting large-scale restoration efforts in their current conditions. Tier 2 tributaries presented current issues, such as water quality, that prevented a Tier 1 determination. The master plan is a living document, and as updated information is available, tributaries can be changed from Tier 2 to Tier 1 and vice versa. The CBCP analyses include the tributaries selected in the master plan for large-scale restoration efforts or proposed for efforts.

Stream Restoration Opportunity Map. The stream restoration analysis identifies subwatersheds in which to focus stream restoration efforts to benefit resident fish, brook trout, and anadromous species. The National Fish Habitat Assessment (moderate risk), subwatersheds supporting brook trout (as defined by Eastern Brook Trout Joint Venture), and the extent of anadromous fish habitat were compiled with the watershed stressors analysis developed in the CBCP planning analyses to identify subwatersheds where stream restoration could be implemented to address existing watershed stress and provide long-term benefits. **Figure 7** compiles the stream restoration analysis with fish passage blockages and the Trout Unlimited Eastern Brook Trout Conservation Portfolio strategies. Each individual component of this compilation is available in the Planning Analyses Appendix and the State and District of Columbia Annex. The compiled habitat analyses are presented in **Figure 7** to demonstrate how an integrated exploration of measures could be developed to provide co-benefits. Using this information at a finer scale, an investigation was completed to identify measures to benefit brook trout at the subwatershed scale (see Planning Analyses Appendix).

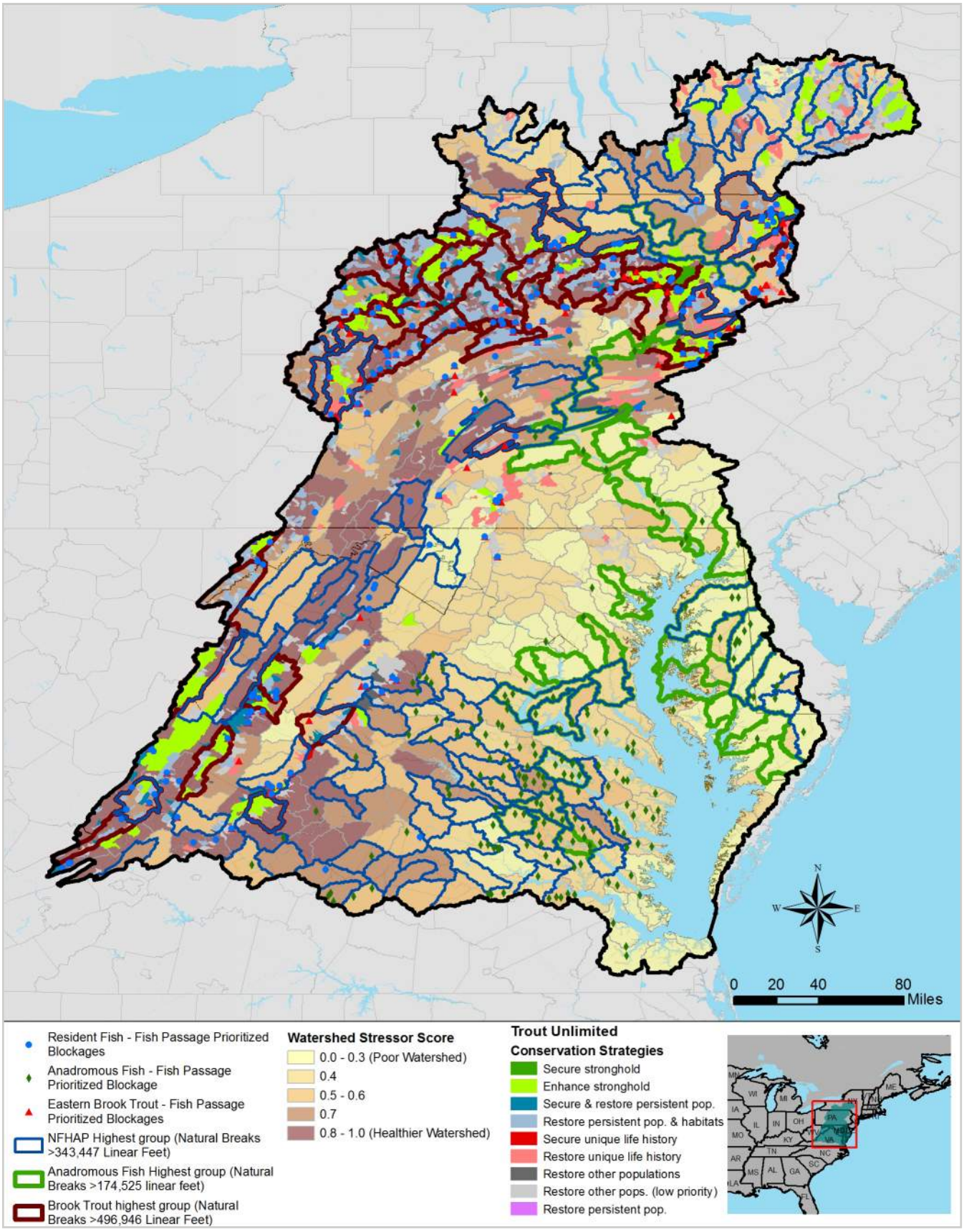


Figure 7. Compiled Habitat Analyses: Stream Restoration Opportunities with associated fish passage blockages including the Trout Unlimited Conservation Portfolio strategies and fish passage blockages prioritized for brook trout

Wetland Restoration

The CBCP examined wetland restoration from many different perspectives. *Opportunity Assessments* were completed for tidal and nontidal wetlands restoration and enhancement to benefit avian wildlife including American black duck; use dredged material; consider future tidal and nontidal threats; consider potential for marsh migration; and match restoration and enhancement with species of concern (see Planning Analyses Appendix for additional details). The results of the potential to beneficially use dredged material for wetlands restoration are presented as an example below. All other results are provided in the Planning Analyses Appendix and the State and District of Columbia Annex.

The geospatial analyses used the high-resolution land cover dataset completed in 2016 and provided to USACE by NFWF, the USGS Digital Elevation Model, and the CBP hydric soils layer. Wetland restoration opportunities are areas where restoration currently does not exist but could exist based on current elevations and soil characteristics. Wetland enhancement opportunities are current wetlands based on land cover data. Wetland restoration and enhancement opportunities were identified and incorporated with habitat data (avian nesting locations, Audubon Important Bird Areas, American black duck habitat, species of concern supporting subwatersheds) to provide focused results.

Wetland Restoration Opportunity Map to Beneficially Use Dredged Material. Navigation channels require periodic maintenance to remove material that collects in the channels and ensure depth of the channels allows for passage of vessels. USACE has studied, designed, and constructed (i.e., restored) remote island and wetland habitat throughout the Chesapeake Bay using dredged material from navigation channels. Projects have been implemented at various scales from individual wetlands to large islands. As remote island habitat and wetlands continue to be lost to sea level rise and erosion, beneficially using dredged material can provide multiple benefits.

The Maryland Port Administration (MPA) and the Port of Virginia have partnered with USACE for navigation projects to ensure safe passage of vessels in channels and into terminals. There is an interest in identifying innovative opportunities that beneficially use dredged material, promote good stewardship and provide resilient solutions. MPA is the non-federal sponsor for the Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island and its expansion, which is using material dredged from 50-foot-deep channels in Maryland waters of the Chesapeake Bay to develop more than 1,700 acres of remote island habitat, both upland and wetland, and an embayment. When Poplar Island can no longer accept dredged material by approximately 2030, dredged material from the Port of Baltimore Approach Channels is proposed to be transported to James Island as part of the Mid-Chesapeake Bay Island Ecosystem Restoration Project in Dorchester County, Maryland, pending final approvals and federal funding. Restoration of Barren Island is part of this project, but it will be constructed using material from local small navigation projects. The Mid-Chesapeake Bay Island Ecosystem Restoration Project is critical for not only ensuring the safe navigation of commercial vessels into the Port of Baltimore, but also restoration of 2,070 acres of remote island and wetland habitat.

Additionally, smaller project opportunities are possible when USACE dredges existing navigation channels. Funding of regularly recurring maintenance of federal and state navigation channels will generate dredged material, which is a resource that can be made available to support wetland restoration projects. Currently, the need to dredge and maintain channels is much greater than the funding available in the operations and maintenance budget. **Figure 8** presents the CBCP proximity analysis of wetland restoration opportunities within three miles of existing navigation channels.

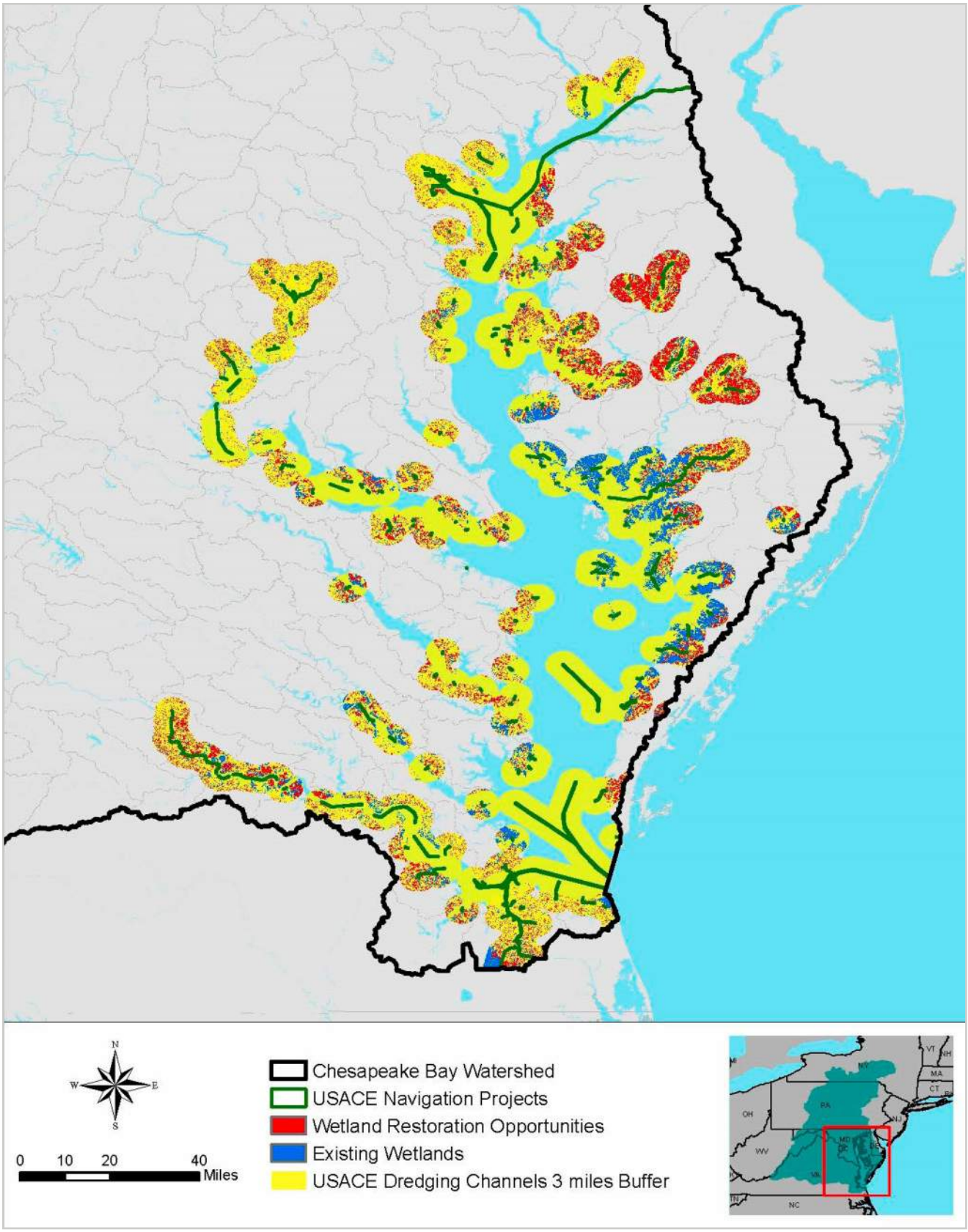


Figure 8. Wetland Restoration Opportunities in Proximity to Navigation Channels

Connectivity

The connectivity analyses focused on identifying opportunities within the watershed to improve habitat connectivity by considering existing core and connector habitats, regional flow, fish passage blockages and road crossings, existing healthy habitat locations and their relation to proposed restoration opportunities, risks to those resources from future threats, and opportunities to improve human connectivity to healthy habitats (see the Planning Analyses Appendix for additional details). The example provided below evaluated future threats to existing healthy/high-value habitats that raise concerns for loss of connectivity. All other results are provided in the Planning Analyses Appendix and State and District of Columbia Annex.

The geospatial analyses for connectivity incorporated the healthy/high-value habitat and socioeconomic compilations developed by the CBCP with results from the habitat and restoration opportunity analyses. Nature's Network datasets provided valuable information for the connectivity analyses and is a collaborative effort facilitated by the USFWS Science Applications Program. The vision of Nature Network is to identify and map a connected network of resilient and ecologically intact habitats that will support biodiversity under changing conditions. The datasets used by CBCP characterize existing core and connector habitats and regional flow. Regional flow data represent the ability of flora and fauna to move across the landscape and range from constrained flow to high diffuse flow.

Healthy/High-Value Habitats At Risk to Future Threats. The loss of existing healthy/high-value habitats to future threats will result in loss of connectivity in the watershed. CBCP evaluated whether existing healthy/high-value habitats are at risk to future threats from climate change, anticipated increases in flooding and coastal storms, and projected development in the watershed. **Figures 9–10** present the risks to habitats from both tidal and nontidal threats. Further explanation of the healthy/high-value habitats and threats compilations are provided in the Planning Analyses Appendix.

Conservation

The analyses completed for conservation focused on identifying opportunities to increase conserved lands, identifying connections between habitat and wetland restoration and conservation opportunities, and determining if conservation opportunities are situated to add societal benefits (see Planning Analyses Appendix Section 3.6). The example provided below describes the investigation used to develop the habitat conservation *Opportunity* map. All other results are provided in the Planning Analyses Appendix and State and District of Columbia Annex.

Entities typically have missions focused on either conservation or restoration, but not both. Restoration or enhancement actions could occur in these unprotected healthy/high-value habitats to ensure critical habitat and target species (RTE species) are sustained in the face of future stressors. The CBCP highlights the opportunity to pair restoration and conservation efforts and therefore the need for strategic collaboration between groups focused on conservation and groups focused on restoration.

Opportunity Map to Conserve Unprotected Healthy/High-Value Habitats. The CBCP identified areas of healthy/high-value habitat (see the Planning Analyses Appendix for additional details). Of those healthy/high-value habitats, the CBCP identified those that are not protected as targets for conservation actions (**Figure 11**). The protected lands layer from CBP was used to represent the extent of existing conservation. Conservation of existing habitat is a primary tool for protecting healthy/high-value habitats from future stressors and expanding habitat connectivity through state land conservation programs.

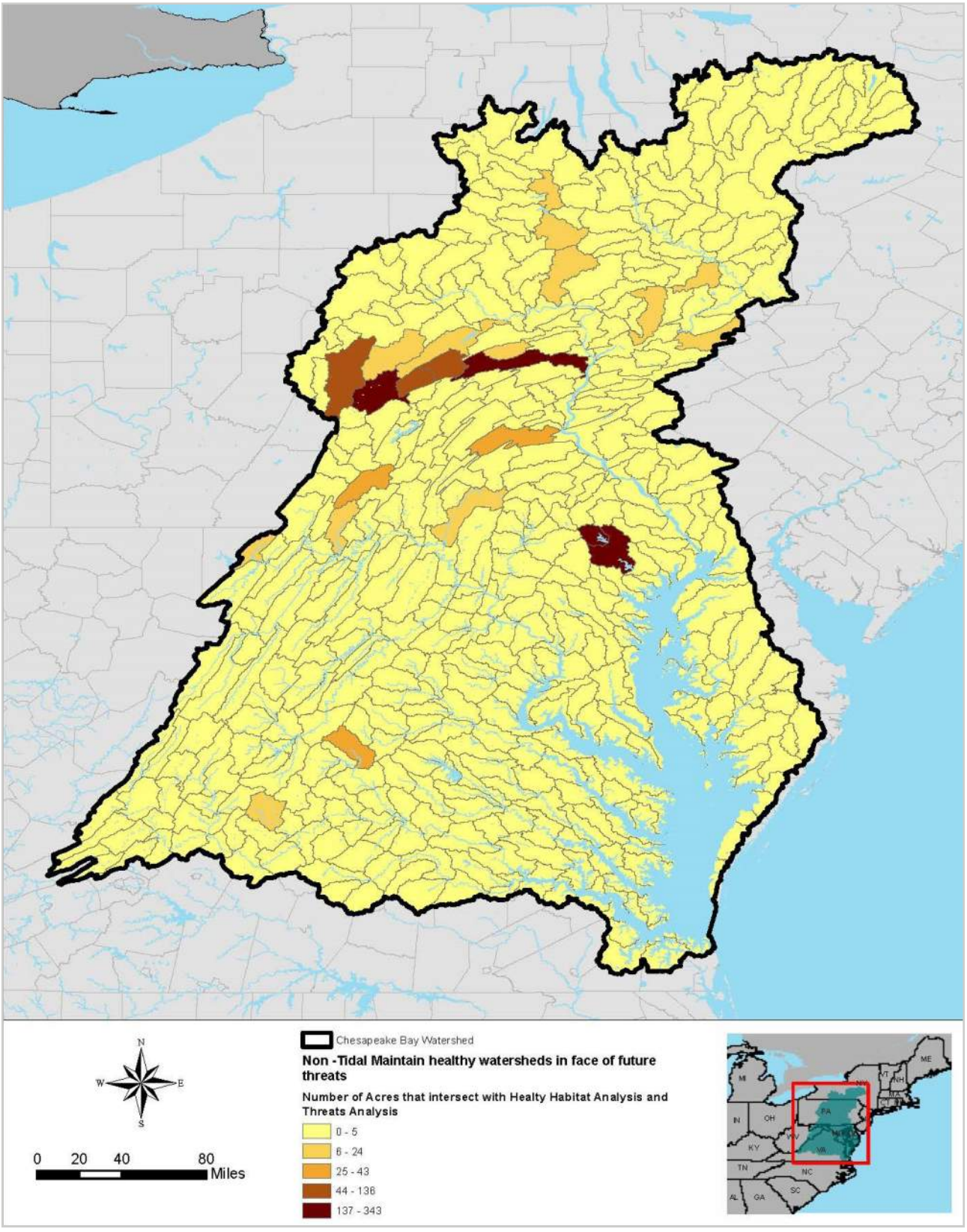


Figure 9. Healthy/High-Value Habitats At Risk to Nontidal Threats

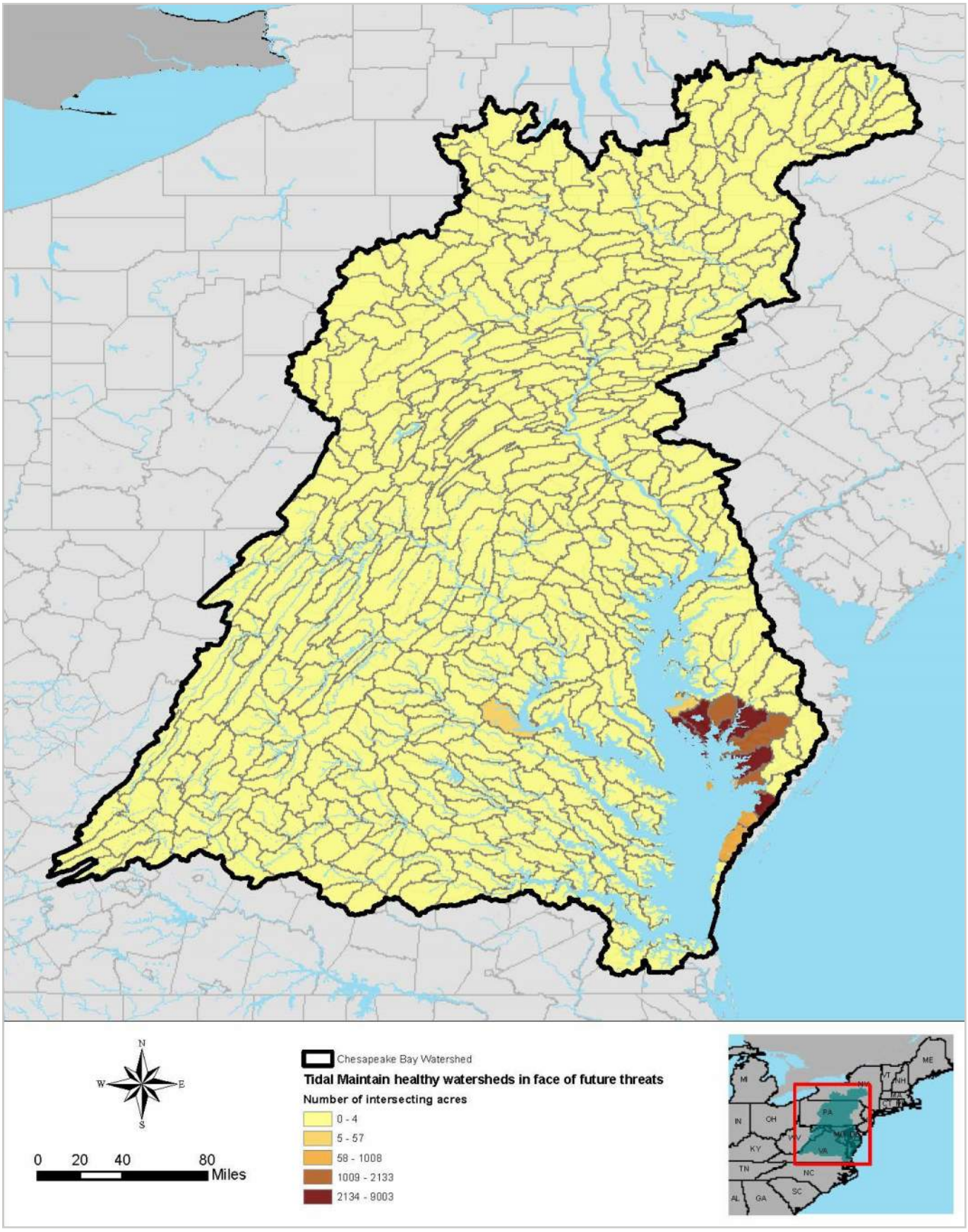


Figure 10. Healthy/High-Value Habitats At Risk to Tidal Threats

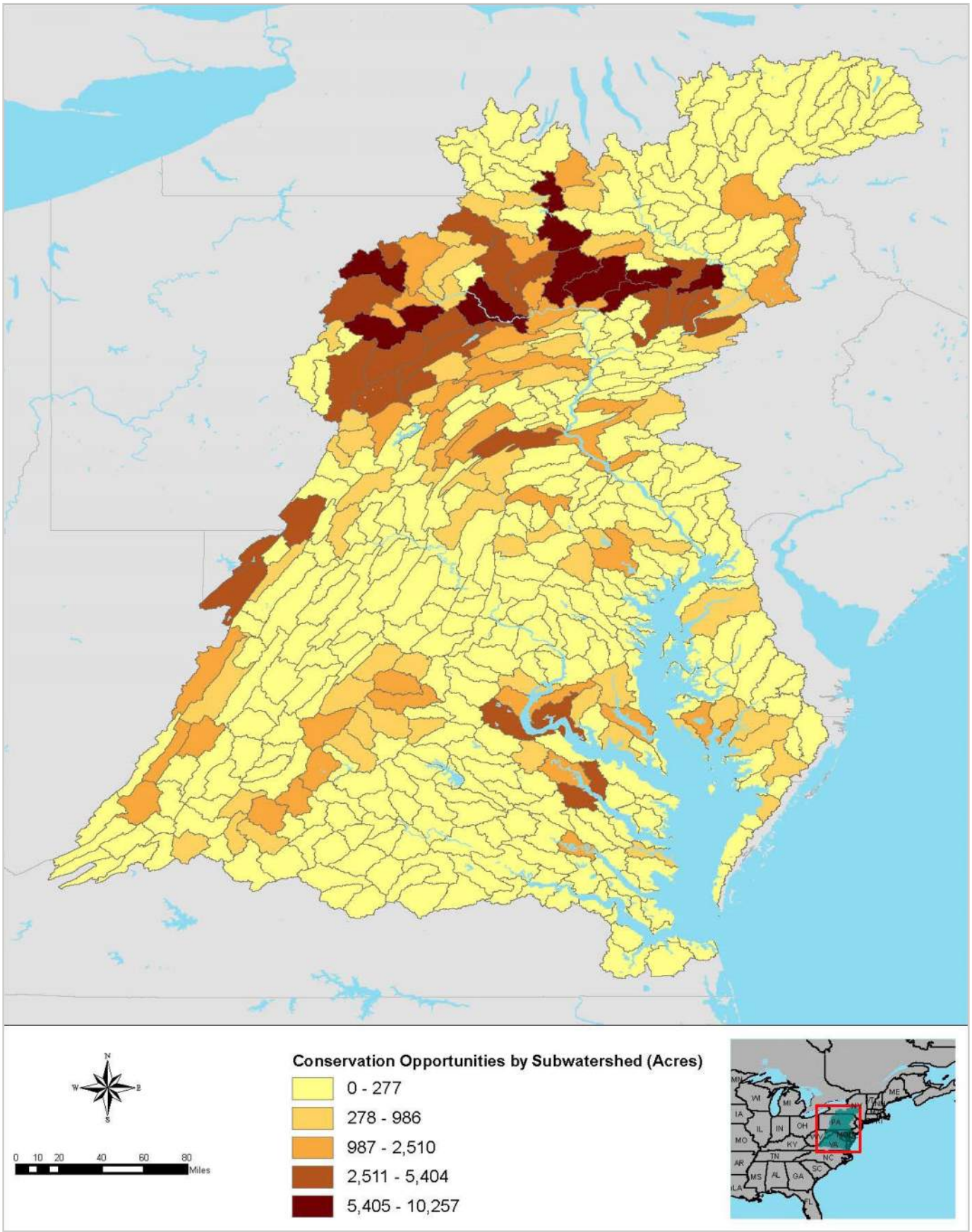


Figure 11. Conservation Opportunities.

Shorelines and Stream bank Stabilization

Shoreline and stream bank erosion is a significant concern in the Chesapeake Bay Watershed. Substantial portions of the bay's shoreline have been hardened to prevent further losses. Efforts to harden shorelines are associated with negative impacts to the nearshore environment. Stream banks throughout the watershed have been incised (i.e., severely eroded and causing disconnection of the stream from its floodplain) due to land use alternations affecting hydrologic processes and habitat. Incised stream banks contribute sediment to stream courses, become disconnected from floodplains, and impair riparian and stream habitats.

CBCP analyses characterized the areas most affected by shoreline erosion utilizing the Virginia Institute of Marine Science (VIMS) shoreline inventory. Subsequent evaluations investigated where habitat and wetland restoration and conservation opportunities are located adjacent to eroding shorelines to understand where actions could be taken to address erosion of shorelines and protect habitat (see the Planning Analyses Appendix for additional details). Alternatively, the evaluation provides information to understand where potential projects are in areas at risk to shoreline erosion. The example provided below identifies the subwatersheds exposed to shoreline erosion. All other results are provided in the Planning Analyses Appendix and State and District of Columbia Annex.

Initially, the intention was to incorporate stream bank erosion along with shoreline evaluations. However, no comprehensive dataset focused on eroding stream banks was identified. Therefore, the stream bank analyses focused on evaluating whether the stream restoration opportunities are in subwatersheds at risk to future threats (tidal and nontidal). Future threats from climate change, developmental pressures, and increased flooding may lead to further stream bank erosion. Alternatively, stream restoration could be undertaken with a focus to address stream bank erosion and future threats.

Opportunity Map to Address Eroding Shorelines. The VIMS shoreline inventory was used to represent the location of eroding shorelines. The eroding shorelines data was categorized differently for Maryland and Virginia. From the Virginia dataset, the data defined as high and unstable was used to represent eroding shoreline. The data defined as high and undercut was used from the Maryland dataset. A 100 m buffer was generated around those locations to capture the extent of erosion impacts. **Figure 12** depicts the total acreage of eroding shoreline (acres exposed) in each subwatershed within this buffer.

Toxic Contaminants

There are vast needs for chemical contaminant remediation within the watershed. CBCP analyses focused on compiling datasets to characterize toxic problems spatially and investigate whether restoration and conservation efforts could be undertaken in conjunction or following remediation (see the Planning Analyses Appendix for additional details). The example provides a view of toxic contaminant locations with habitat and wetland restoration opportunities. All other results are provided in the Planning Analyses Appendix and State and District of Columbia Annex. Data compiled to characterize toxic contaminants are the National Priorities List (NPL) or Superfund Site locations and Pennsylvania's Department of Environmental Protection (PADEP) abandoned mines and abandoned mine problem areas (areas containing public health, safety, and welfare problems created by past coal mining). This compilation is not expected to be an exhaustive collection of all contaminant problems and was limited to areas on the landscape. The CBP maintains additional contamination data compiled for the mainstem of the bay.

Toxic Remediation Opportunities Map. **Figure 13** depicts the compilation of toxic contaminant restoration and conservation opportunities. **Figure 13** shows that there are broad habitat restoration and conservation opportunities in contaminated areas in Pennsylvania. However, a complete acid mine drainage data layer that includes data for all states in the watershed would be useful to compile. An analysis at a finer scale is required to determine the exact relationship between a contamination point and restoration/conservation opportunities. Acid mine drainage is a continuing problem in the legacy coal mining area of the watershed in Pennsylvania, Maryland, and West Virginia. Heavy metals and low pH affect the water quality of lower-order streams in areas with vast conserved lands. (Stream order is used to describe the size of streams and rivers. Lower-order streams are typically smaller streams

in the headwaters of a watershed.) EPA, in coordination with the states and the District of Columbia, is sequencing remediation efforts with restoration efforts to augment co-benefits in areas identified on the NPL along the bay shoreline or shoreline in the Lower Susquehanna River; Baltimore, MD; District of Columbia; and Norfolk, VA.

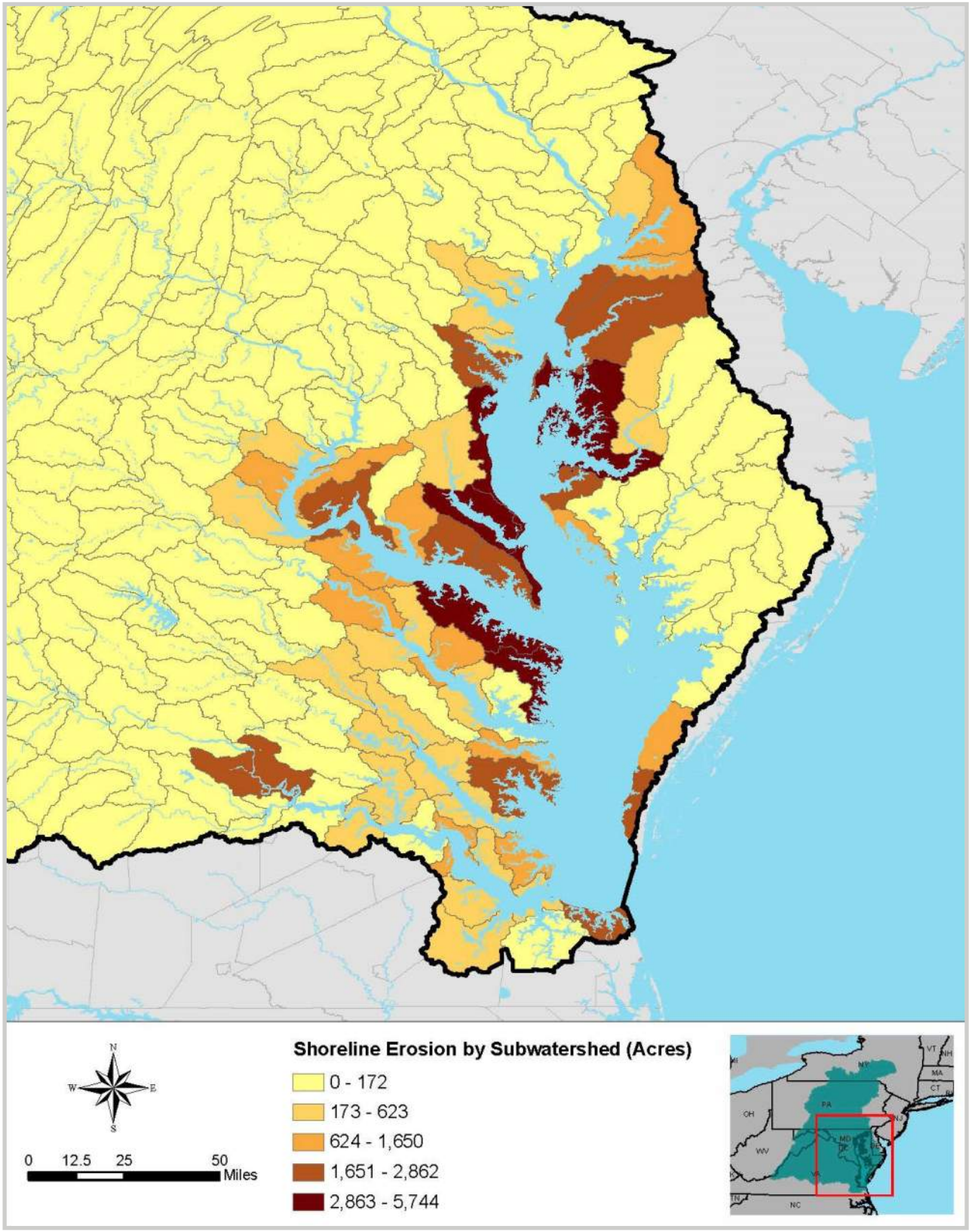


Figure 12. Opportunities to Address Eroding Shorelines

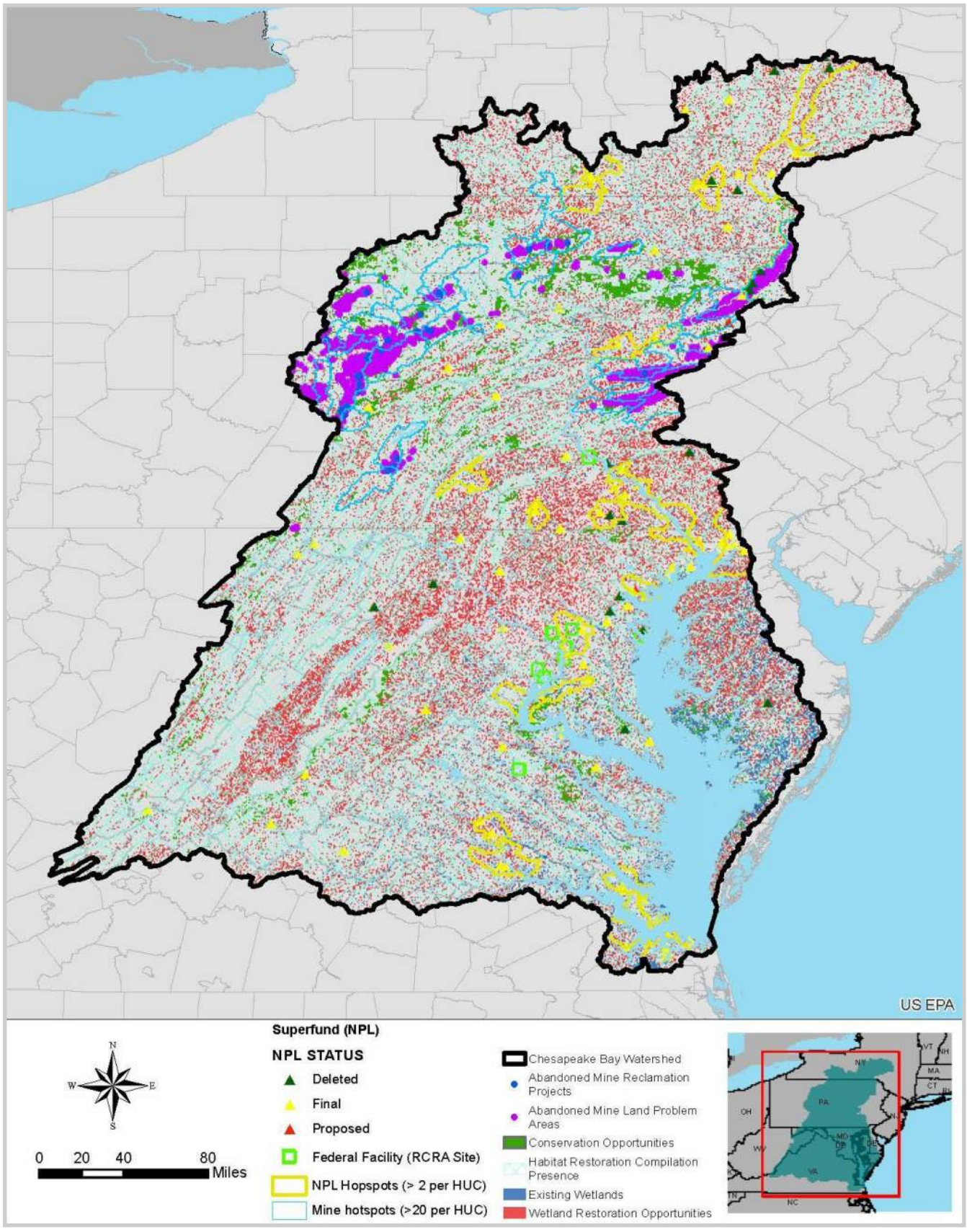


Figure 13. Toxic Contaminant Data Depicted with Conservation and Restoration Opportunities

Findings and Recommendations

In collaboration with the Partnership, the CBCP identifies where there are opportunities to implement specific strategies or combinations of strategies to address the 2014 Bay Agreement goals and outcomes. Progress is being made, but more work is needed—particularly when considering future stressors associated with development pressures and uncertainty surrounding climate change impacts. The *Opportunity* maps can guide various stakeholders and focus efforts. The Restoration Roadmap, a compilation of the *Opportunity Assessments*, highlights co-benefits and the potential to address multiple problems with an integrated water resources management approach. The Restoration Roadmap can help broaden partnerships, leverage resources, and implement problems in a strategic manner. Action plans were also developed for state-selected watersheds to demonstrate the refined planning, which must be undertaken to identify sites for design and construction.

USACE may be underutilized in its capability to assist with meeting the 2014 Bay Agreement goals and outcomes, particularly as related to watershed planning, technical services, support to the CBP[1] , the Section 510 Program, and the Continuing Authorities Program (CAP). The following sections present the findings and recommendations based on the results of the analyses.

Findings by State and District of Columbia Jurisdiction

The results of the watershed-wide analyses are summarized in the State and District of Columbia Annex. The purpose of the annex is to ensure the states have the opportunity to use the CBCP information to inform the conservation and restoration actions as part of the Phase III watershed implementation plans (WIPs). It is envisioned that the CBCP analyses could inform subsequent iterations of the 2014 Bay Agreement biennial work plans and the EPA Phase III WIPs. There are opportunities for action within each subwatershed, even if not specifically highlighted on the opportunity maps. The CBCP analyses were completed with enough granularity to identify opportunities that USACE could support for further investigation or further consideration for implementation by other entities. The size of the watershed (64,000 square miles), 2-year time line, and a $2.8 million budget limited the scale of the analyses and level of detail for the results. It should be noted that as a recommendation from this effort, USACE can provide technical assistance to any community or the states and District of Columbia to develop a subwatershed action plan following the CBCP.

State-Selected Watershed Action Plans and Candidate Projects

Each state and the District of Columbia identified a watershed for development of an action plan. These areas are outlined on **Figure 6**. The action plans provided in the State and District of Columbia Annex serve as examples of what could be completed throughout the bay watershed. The action plans outline specific strategies and opportunities for restoration and conservation. They will be refined following stakeholder and public review to provide a list of specific projects for potential implementation. Additionally, stakeholders have provided lists of candidate projects within their jurisdictions (not limited to subwatershed action plan boundaries) for inclusion in the CBCP. A candidate restoration project can be any conceptual strategy or site-specific location where a project is envisioned, is undergoing active planning or design, or is ready for construction. All candidate projects are documented in the Candidate Restoration Project Database and summarized in **Table 7**. This list will enable partners and resources to be leveraged such that agencies are not duplicating effort, projects can take advantage of adjacent cost-efficiencies and benefits, and Chesapeake Bay Watershed restoration can be expedited. Implementation options will be suggested for all projects to invigorate partnerships and collaboration. Finally, the CBCP and candidate restoration projects area a snapshot in time. Therefore, any project that is not yet identified

1 USACE participation in the CBP is dependent on funding appropriated by Congress in the Investigations Account of the USACE, Civil Works Budget, which is submitted to Congress by the Department of the Army, Office of the Assistant Secretary of the Army (Civil Works). Under the Investigations Account, a programmatic funding amount is appropriated under the line item Coordination Studies with Other Agencies, Other Coordination Programs, and Coordination with Other Water Resource Agencies. These funds are used for USACE staff at the Baltimore and Norfolk Districts to coordinate with the CBP and attend meetings including recurring meetings for GITs; CBP executive and management boards; federal office directors; Principals' Staff Committee; Scientific, Technical Assessment and Reporting Committee; and Department of Defense Chesapeake Bay action team. Additionally, the funding allows for USACE staff to participate in P3 coordination and engagement activities related to new financing strategies.

or is unknown at this time is not excluded from implementation programs. The full list of projects is provided as an electronic product to the CBCP and is depicted in **Figure 14**. This list will be revised as additional information is provided by stakeholders during the draft report public comment period.

Table 7. CBCP Candidate Restoration Project Summary

Jurisdiction	Candidate Projects			Types of Projects
	Candidate Projects identified	Projects Within USACE Mission Areas	Projects Outside USACE Mission Areas	
D.C.	316			Stream, wetland, and SAV restoration; stormwater management; living shoreline; fish passage
NY	5			Riparian buffer, stream, and wetland restoration; fish passage; agricultural BMPs
PA	881			Riparian buffer, stream, and wetland restoration; conservation; acid mine drainage' agricultural BMPs; fish passage
MD	2,592			Oyster, SAV, riparian buffer, stream, and wetland restoration; living shorelines/ shoreline stabilization; agricultural BMPs; conservation; fish passage
VA	43			Oyster, SAV, riparian buffer, stream, and wetland restoration; living shorelines/ shoreline stabilization; agricultural BMPs; conservation; fish passage
DE	1			Riparian buffer, stream, and wetland restoration; conservation; fish passage; agricultural BMPs
WV	2			Riparian buffer, stream, and wetland restoration; fish passage; wastewater management; conservation

*Projects included are those submitted by stakeholders, potential (currently unfunded) USACE projects, or those previously identified in USACE-led watershed plans. This project inventory will be updated with additional stakeholder input and to include projects identified through the CBCP in the state-selected watershed action plans. In response to Implementation Guidance for Section 4010(a) of the WRRDA 2014, at least one candidate project has been identified, thus far, in each jurisdiction.

**This information will be completed for the final report.

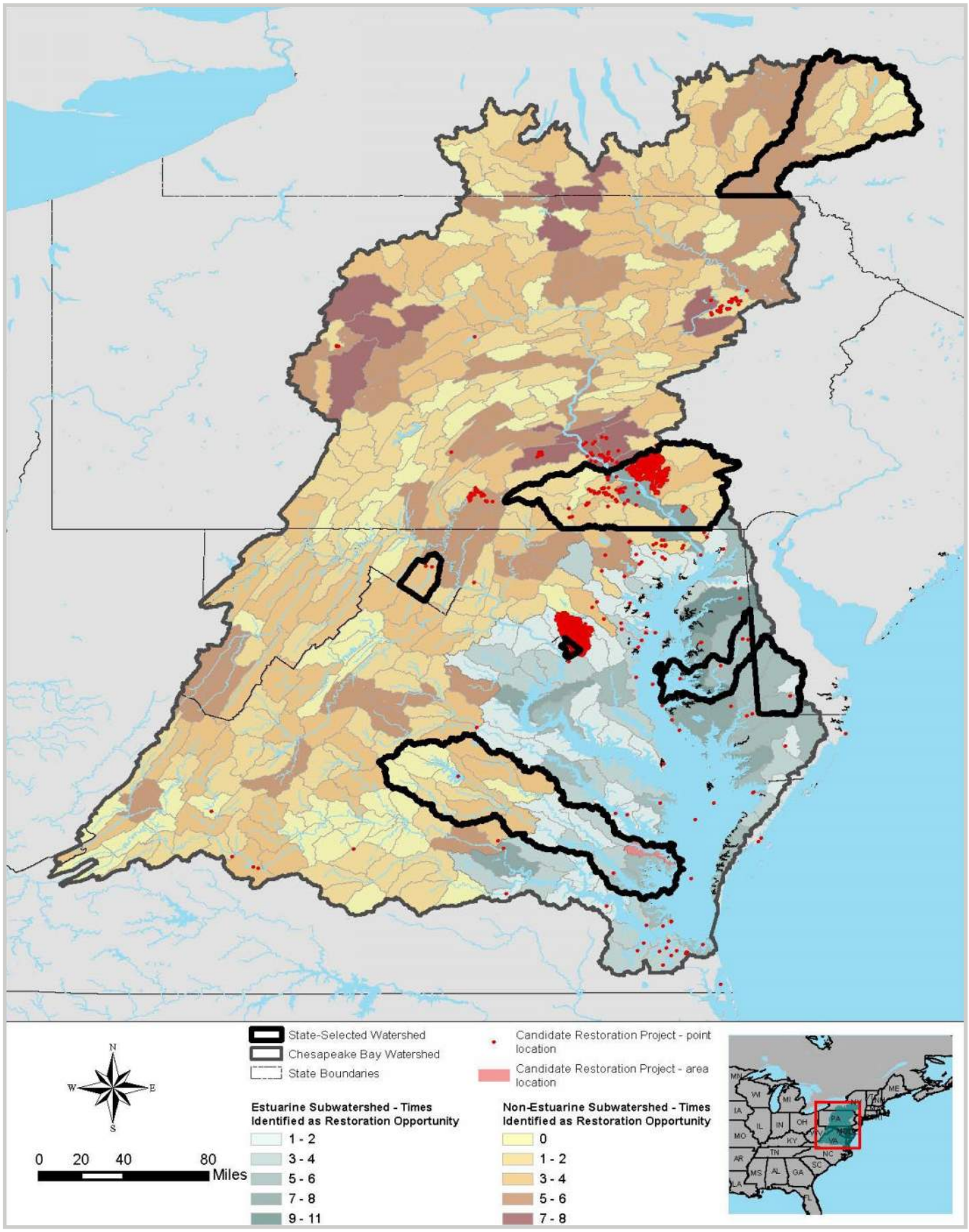


Figure 14. Candidate Restoration Projects

Specific Findings

The previous section provided one example of the geospatial analyses completed under each of the six CBCP strategies investigated (**Table 3**). **Table 8** presents significant findings from those evaluations as well as the composite analyses (**Figures 7–13 and Planning Analyses Appendix**). Where applicable, figures are referenced that depict the information provided.

Table 8. Summary of Significant Findings from Geospatial Analyses

Integrated Water Resources Management	◆ There are broad baywide opportunities to contribute to meeting 2014 Bay Agreement goals and outcomes. The CBCP has identified *Opportunities* for specific restoration and conservation and a comprehensive Restoration Roadmap (Figure 6). ◆ Opportunities exist to integrate solutions for future threats, strategies for improving habitat connectivity and building resiliency, and considerations for incorporating species of concern into implementation.
Aquatic Ecosystem Restoration	◆ The Restoration Roadmap and *Opportunity* maps represent a range of local or regional actions that could be achieved with focused investments. ◆ There are riparian buffer opportunities spanning all jurisdictions (see the Planning Analyses Appendix for additional details). Concentrated areas are located in eastern New York, northern and south-central Pennsylvania, West Virginia, western Maryland, Maryland's Eastern Shore, western Virginia, and the James River in southern Virginia. As buffer projects can be undertaken to address various objectives (brook trout, resident fish, nitrogen and phosphorus management), prime locations for implementation will depend on project objectives. ◆ Incorporating Trout Unlimited Eastern Brook Trout Conservation Strategies (Fesenmyer et al. 2017) with CBCP analyses has potential as a useful method for siting riparian buffer, stream restoration, and fish passage projects to benefit brook trout in follow-up investigations (Figure 7). ◆ Fish passage blockages that were previously prioritized by the CBP Fish Passage Workgroup are concentrated in the upper Susquehanna River in Pennsylvania, the West Branch Susquehanna in Pennsylvania, the Chester-Sassafras watershed on Maryland's Eastern Shore, and throughout the York, Rappahannock, and James rivers watersheds in Virginia (See the Planning Analyses Appendix for additional details). Prioritized fish passage blockages were matched with stream restoration opportunities to identify areas where the fish passage blockage removal and stream restoration measures could be undertaken jointly. Separate prioritizations have been previously completed by the workgroup for anadromous fish, resident fish, and brook trout. ◆ The potential to restore nontidal wetlands is highest in the lower Susquehanna River corridor in Pennsylvania, the upper Eastern Shore of Maryland and Delaware (Chester River, upper Choptank River, Marshyhope Creek, and upper Nanticoke River), the middle Potomac River basin (Conococheague Creek, and Antietam Creek in Pennsylvania and Maryland, and Opequon Creek in Virginia and West Virginia), and North Fork Shenandoah in Virginia (See the Planning Analyses Appendix for additional details). Tidal wetlands restoration Opportunities are situated on the middle Eastern Shore of Maryland: Little Choptank River, Honga River, Blackwater River, and Transquaking River; the lower Choptank River, Manokin River, and lower Tangier Sound in Maryland; Mobjack Bay and Back River in the lower Chesapeake Bay; and Pungoteague Creek in Virginia (See the Planning Analyses Appendix for additional details). ◆ Areas flanking the mainstem of Chesapeake Bay, and notably the Delmarva Peninsula, provide wetland restoration Opportunities for both nesting water bird sites and black duck. Specific to black duck, wetland restoration potential is high in the upstream portions of the York and Rappahannock rivers, Chester River, Nanticoke River, Wicomico River, Transquaking River, and Pungoteague Creek (lower Chesapeake Bay) (See the Planning Analyses Appendix for additional details). ◆ USACE is a primary partner in large-scale oyster restoration efforts. There are diverse opportunities to address watershed stressors that contribute to degraded water quality in oyster restoration tributaries (See the Planning Analyses Appendix for additional details). ◆ Watershed stressors to potential SAV restoration areas should be considered during site selection, and for efforts to provide suitable conditions for SAV establishment (See the Planning Analyses Appendix for additional details).
Military Lands	◆ Use the previously completed Army Chesapeake Bay Comprehensive Plan (USACE 2013) to focus efforts on a critical mass of Army property within the watershed. Opportunities exist to benefit RTE species and address water quality and habitat improvements. ◆ USFWS completed a Planning Aid Report focused on identifying and evaluating threats to RTE and critical species. Developing projects to consider the presence of these species and their habitat needs could leverage USFWS restoration funds.
Toxic Contaminants	◆ Although chemical contaminants from wastewater, stormwater, agriculture, and air pollution are pervasive throughout the Chesapeake Bay Watershed, there is not one consolidated dataset of all contaminant problems. For the content compiled, contamination points are distributed throughout the watershed, but are minimal on the Delmarva Peninsula, in western Virginia, and in West Virginia (Figure 13). ◆ There are habitat restoration and conservation opportunities associated with lands impacted by acid mine drainage, but a finer-scale analysis is needed to identify specific projects (Figure 13). A complete acid mine drainage data layer that includes information for all states in the watershed would be useful.
Integrating Navigation	◆ Opportunities exist throughout the Chesapeake Bay to leverage dredged material for wetlands restoration (Figure 8). Currently, the need for dredging exceeds available funding in the operations and maintenance budget. The Tangier Sound/ Blackwater region on the lower Eastern Shore of Maryland is a prime area to incorporate dredged material into wetlands projects. ◆ Channels dredged at the head of rivers provide significant opportunities to use dredged material to restore nontidal wetlands, particularly in the Potomac, James, Choptank, Wicomico, and Nanticoke River systems.

Table 8. Summary of Significant Findings from Geospatial Analyses

Future Threats and Resiliency	◆ In general terms, the northern and western portions of the watershed are at minimal risk to future nontidal threats such as flooding, development pressures, and climate change (except for currently identified flood-prone areas). Subwatersheds along the mainstem of the Bay below the Bay Bridge crossing in Maryland face the greatest risk to future threats in the tidal zone, including flooding, sea level rise, coastal storms, and development. (See the Planning Analyses Appendix for additional details.) ◆ Existing tidal wetlands and tidal wetlands restoration opportunities along the eastern shore of the Bay (south of Choptank River) and along the western shore of the Bay in Virginia are at greatest risk to future tidal threats. This location has the unique Island Refuge Complex, which is facing climate change impacts, land subsidence, increased human populations, and habitat fragmentation. (See the Planning Analyses Appendix for additional details.) ◆ Wetlands in the central portion of the Chesapeake Bay Watershed are at greatest risk to future nontidal threats. These subwatersheds are primarily located in the lower Susquehanna River, upper Chesapeake Bay (western shore), and middle Potomac River basins. There are also subwatersheds of concern spread across the watershed: middle Pamunkey River, lower North River in the upper Potomac River, Middle Chickahominy River of the James River, and Spring Creek in West Branch Susquehanna River. (See the Planning Analyses Appendix for additional details.) ◆ Blending NOAA's marsh migration corridor analysis with CBCP evaluations has identified many areas where restoration and conservation could be pursued to provide a corridor for wetlands migration with sea level rise, to enable habitats to persist. (See the Planning Analyses Appendix for additional details.) ◆ USFWS data identifying habitat for federally threatened and endangered species (See the Planning Analyses Appendix for additional details) and critical species habitat were used to relate subwatersheds to the presence of these species of concern with stream restoration, wetlands restoration, and conservation opportunities. This information could be incorporated into a finer-scale analysis to develop projects to benefit these species and their habitat. (See the Planning Analyses Appendix for additional details.) ◆ Shorelines exposed to erosion are generally located between Eastern Bay on the mid-Eastern Shore of Maryland and the southern shore of the Potomac River in Virginia. Shoreline erosion concerns extend along the Bay proper from above the Chester River south to Norfolk (Figure 12). Wetland restoration and conservation Opportunities were identified as strategies for addressing shoreline erosion (See the Planning Analyses Appendix for additional details.)
Conservation	◆ Areas prioritized for conservation by stakeholders have been focused in the New York and West Virginia portions of the basin, the lower Susquehanna River corridor, the Delmarva Peninsula, and the Potomac River watershed south of the District of Columbia (See the Planning Analyses Appendix for additional details). Conservation prioritizations have not captured the broad opportunities in the Upper Susquehanna River Basin in Pennsylvania or the West Branch Susquehanna in Pennsylvania (Figure 11). ◆ Typically, a stakeholder group or agency has a mission to undertake conservation or restoration, but not both. The CBCP highlights the opportunity to pair restoration and conservation efforts and the need for greater partnerships between groups focused on conservation and those focused on restoration to leverage resources and restoration benefits. (See the Planning Analyses Appendix for additional details.)
Connectivity	◆ Nature's Network regional flow data characterizes the ability of flora and fauna to move across the landscape. There is an opportunity to incorporate this data in finer-scale analyses to improve connectivity. Additionally, with finer-scale analyses, there are opportunities to match restoration efforts (e.g., stream, riparian buffer, wetlands) with existing healthy/high-value habitat to provide larger patches of healthy habitat. (See the Planning Analyses Appendix for additional details.)
Policy	◆ Regulations, laws, and policies vary across Bay jurisdictions. There are opportunities to focus planning and zoning policy on preserving high ranked healthy habitats (Figures 9-10) and important socioeconomic areas that are at risk.
Implementation	◆ Stakeholders are engaged and motivated. Extensive plans and priorities have been identified. Primary interest is focused on how to identify technical assistance and funding to implement projects. Planning efforts could be improved by considering conditions and implementation plans across an entire subwatershed (regardless of jurisdictional boundaries) to leverage effort and coordinate plans. ◆ Action plans, similar to those developed for the state-identified watersheds in the CBCP, are critical for every subwatershed in the bay. ◆ Cost efficiencies, innovative financing, and expanding partners and markets will be key to getting projects in the ground at a faster pace and at a larger scale than what has been done to date. ◆ Encourage, develop, and support relationships including innovative financing partnerships.

RECOMMENDATIONS

1. Optimize Actions Geographically to Maximize Benefits and Contributions toward the 2014 Bay Agreement Goals and Outcomes

   Utilizing the Restoration Roadmap, implementation to meet conservation and restoration goals should be prioritized in the geographic areas that maximize benefits and collaborative approaches, focusing on subwatersheds at a scale sufficiently fine to align with EPA Phase III local area planning goals.

2. Promote Conservation/Enhancement Opportunities Adjacent to Existing Healthy/High-Value Habitat

   Conservation of healthy and high-value habitat, critical habitat areas, and riparian buffer connectivity and enhancement of existing habitat structure will be needed to reduce the impact of future stressors from climate change and preserve previous investment into the restoration efforts. By preserving healthy habitats and critical areas that support RTE species, species of concern, and indicator species, the long-term sustainability and resiliency of the restoration and protection of the Chesapeake Bay Watershed would be maintained by anticipating potential impacts from climate change or future stressors and adaptively managing those resources.

3. Address Watershed Stressors in Degraded Areas

   Improvements in the Chesapeake Bay's health must focus efforts to manage stressors within the watershed and avoid additional future stressors; the Chesapeake Bay is the endpoint for any pollutants that enter the stream network throughout the watershed. To have a healthy bay, there needs to be a healthy watershed and stream network.

   With the completion of EPA's Phase II implementation actions, waste load allocations for point sources of pollutants (wastewater treatment plants [WWTPs], combined sewer overflows [CSOs]) have been reduced substantially to meet the 2025 TMDL target for point sources (EPA 2018). Pollutant load allocations from non-point source sectors are the next incremental benefit to achieve water quality goals, particularly in those areas of highest effective nitrogen (N) and phosphorus (P). Employing BMPs that provide opportunities for habitat restoration in both urban and rural areas within those effective N and P areas (watersheds in relative closer proximity to Chesapeake Bay), such as riparian buffers, stream restoration/floodplain reconnection, and wetlands/infiltration, would contribute to the TMDL target and the 2014 Bay Agreement's habitat restoration goals.

   The CBCP analyses were completed to identify where potential restoration opportunities exist to maximize co-benefits notwithstanding, restoration actions implemented in any of the 425 subwatersheds would have benefits associated with that action. All the stakeholders interested in having a restored Chesapeake Bay Watershed have a vested interest in maintaining the momentum of restoration efforts achieved to date.

4. Promote Integrated Water Resources Management and Plan for Future Threats

   Watershed stressors and impacts from climate change will continue to affect the environmental resources in the Chesapeake Bay Watershed despite the ongoing efforts to achieve the 2014 Bay Agreement goals and outcomes. Sustainable strategies, including conservation and restoration actions, along with project designs that incorporate robust and resilient features, will maintain the restoration investments made to date and minimize impacts from the continuing threats primarily associated with climate and sea level change and the increasing population within the watershed.

   Additionally, considerations of community resilience and the ability of communities to manage economic and social benefits with the environmental benefits of the natural landscape may be needed. When extensive areas of tidal influence within the Chesapeake Bay experience impacts from climate and sea level change,

shorelines, habitats, and coastal cities, towns, and communities will be affected. USACE offers technical services to investigate how communities may be at risk and how to manage that risk to support community resilience, potentially employing natural or nature-based features that provide ecosystem goods and services.

5. Encourage, Develop, and Support Relationships That Lead to Restoration Success

Successful implementation of actions needed to achieve conservation and restoration goals requires cooperation among all stakeholders in the form of partnerships, including with private landowners, and will likely require innovative incentives and new markets to support P3s between all levels of government, NGOs, and private interests. Governments at all levels have a role to play to incentivize private landowners to participate in the restoration effort, which will lead to the development of markets to support P3s.

6. Employ Tracking Actions to Manage Implementation of Restoration Actions

Efforts to compile a database of all projects implemented toward restoration in the past 10 years were not fruitful. There is great opportunity and need to develop one repository for documenting all implemented projects utilizing EPA's National Environmental Information Exchange Network (NEIEN) database or ChesapeakeProgress. This repository would include either a point location for the project or at least a subwatershed or county designation. Compiling this information would enable stakeholders to understand where investments are occurring and what type of efforts are being undertaken. In turn, this information could be used to identify gaps in implementation toward meeting the 2014 Bay Agreement goals and outcomes and assist in focusing resources in those areas contributing to local planning goals to maximize measurable benefits.

There are numerous planned restoration projects by local government agencies that may not have been included in the CBCP, although data calls were sent to obtain such information. Biennial work plans and data calls among the states to prepare state WIPs could be used as a forum and online platform for submitting opportunities to be considered for implementation by various entities. This data could be made available to the Partnership, which would help align EPA's Phase III habitat restoration opportunities in areas of relatively well-controlled non-point source pollutants, including sediment and nutrients. Biological responses then could be measured with the improved water quality from the watershed actions in conjunction with geomorphic restoration, which would align those restoration and conservation project opportunities in a geographic priority to sustain and augment co-benefits in those areas.

Implementation Strategy

Based on the findings and recommendations presented in the CBCP, and as coordinated with stakeholders throughout the effort to complete the watershed assessment, there are numerous opportunities to leverage existing authorities, policies, and programs to achieve the 2014 Bay Agreement goals and outcomes. With past and ongoing commitments, the Partnership continues to make progress to restore the Bay watershed to achieve the vision of an environmentally and economically sustainable and resilient watershed.

Based on the CBCP geospatial analyses, the results of the Restoration Roadmap present focused opportunities to leverage partnerships and resources to maximize co-benefits and meet 2025 milestones identified in the 2014 Bay Agreement. The following sections present the existing funding and implementation mechanisms available to the Partnership to guide the future direction of the restoration effort, including USACE authorities and programs. However, in an era of constrained resources, innovative partnerships and financing opportunities will be needed to complement the existing restoration funding and implementation mechanisms. Furthermore, following completion of the site-specific restoration actions, the onset of benefits from the restoration and conservation efforts will be achieved over years to come. An integrated water resources management approach must continue so as to ensure the sustainability and resilience of past, present, and future restoration investments.

USACE FUNDING AND IMPLEMENTATION MECHANISMS

Funding requirements to support the restoration effort across the 64,000 mile Chesapeake Bay Watershed and within the six states and District of Columbia will require continued support to meet and sustain the 2014 Bay Agreement goals and objectives. Almost $2 billion was invested in fiscal year 2017, including approximately $569 million from seven of the agencies that comprise the Federal Leadership Committee (FLC) of the Chesapeake Bay[1] and approximately $1.41 billion from the seven watershed jurisdictions (ChesapeakeProgress 2018).

Investments are producing visible results. In 2017, the total acreage of SAV exceeded 100,000 acres for the first time since restoration efforts began. An estimated 104,843 acres were documented by aerial surveys, marking a third year of increasing SAV coverage. SAV are a good indicator of Bay health because they are sensitive to pollution and respond quickly to improved water quality. Other indicators of improving Bay health are blue crab abundance, nitrogen and phosphorus reductions, and broader achievement of water quality standards.

The CBCP is intended to support future investments made by the Partnership to meet the 2014 Bay Agreement goals and outcomes and to maintain gains from those investments to promote the long-term sustainability and resiliency of the Chesapeake Bay Watershed. To acknowledge the ongoing efforts and avoid duplication, USACE activities would serve to complement ongoing conservation and restoration programs and actions associated with the FLC and each of the states and Washington, D.C. The State and District of Columbia Annex presents this extensive list of these existing programs and authorities that are available to states and local jurisdictions.

1 The FLC for the Chesapeake Bay includes the EPA and Departments of Agriculture, Commerce, Defense, Homeland Security, and the Interior.

The CBCP watershed assessment identified potential opportunities that may be implemented by any and all stakeholders including USACE. Specific USACE authorities include the Continuing Authorities Program, Section 510 Program, and technical assistance through the Floodplain Management Services (FPMS) and Planning Assistance to States (PAS) Programs. The CBCP is not an exhaustive list of the possible restoration opportunities, but does demonstrate extensive actions that can be taken to meet the 2014 Bay Agreement milestones. Future project opportunities will arise and should be equally considered for action. The CBCP is a guide and intended to allow partners the flexibility to implement projects in a manner that best supports their missions, goals and needs. USACE stands ready to support new policies and programs and is ready to respond to emerging stressors or threats. The USACE Environmental Operating Principles are incorporated, by reference, as part of the integrated water resources management approach used in the CBCP. This flexibility allows for USACE to offset uncertainty with a risk management approach within the USACE portfolio of authorizations and programs[2]. As problems, needs, and opportunities evolve, a collaborative approach throughout the life cycle of projects and programs will be required.

SERVING LOCAL COMMUNITIES THROUGH TECHNICAL ASSISTANCE PROGRAMS

USACE has far-reaching technical assistance capabilities and cost-sharing opportunities to meet a broad range of water resource projects. The primary technical assistance programs available to stakeholders across the Chesapeake Bay Watershed are the PAS[3] and FPMS[4] Programs. The PAS Program supports two primary planning assistance services: technical assistance supporting state water resources management plans and comprehensive water resource planning. The work conducted under the PAS Program is cost-shared 50 percent federal and 50 percent with the non-federal project sponsor. Voluntarily contributed funding may be accepted to support the project, and in-kind services may be completed by the project sponsor.

Comprehensive water resource plan assistance provided under PAS would evaluate the development, use, and conservation of the water and related resources of drainage basins, watersheds, or ecosystems. Broad engineering and planning analyses may be undertaken as part of the plan's development, including analyses that support the respective state's water resources management and related resources development plans, or other planning documents such as state hazard mitigation, preparedness, response, and recovery plans. This work may incorporate changing hydrologic conditions, climate change, long-term sustainability, and resilience (i.e., climate change adaptation planning). The scale of those analyses may be comparable to the analyses completed for the CBCP subwatershed analyses (see State and District of Columbia Annex). Detailed plans and specifications and construction would have to be accomplished under other USACE Civil Works authorities or by the non-federal sponsor. The following are recent efforts conducted through the PAS Program:

- Stormwater infrastructure assessments
- Feasibility studies for stormwater management programs and establishment of stormwater authorities
- Support to meet MS4 permit requirements and compliance on a regional level
- Assistance to develop, implement, and operate a sustainable program to manage countywide stormwater resources
- GIS assistance/creation of databases
- Condition assessment of sewer facilities

2 The Environmental Operating Principles espouse a strong emphasis on sustainability that is translated to the USACE commitment to meet the evolving and complex water resources challenges.

3 The PAS program, also referred to as the Section 22 program, is authorized under Section 22 of the WRDA of 1974, as amended (42 U.S.C. Section 1962d-16). A factsheet is available at https://planning.erdc.dren.mil/toolbox/library/FactSheets/PAS_FS_June2017.pdf.

4 The FPMS is authorized under Section 206 of the 1960 Flood Control Act (PL 86-645), as amended.

- Watershed management studies
- Water resources plans and studies
- Water control plans
- Flood inundation mapping and evaluations
- Hydrologic Engineering Center hydrologic modeling

The FPMS Program offers broad authority for USACE technical assistance to foster public understanding of options for dealing with flood hazards and to promote the prudent use and management of floodplains. The FPMS Program does not require cost-sharing by the non-federal sponsor. Like the PAS Program, the non-federal sponsor may voluntarily contribute funding to expand the scope of the services provided for the project. Detailed plans and specifications and construction would have to be accomplished under other USACE Civil Works authorities or by the non-federal sponsor. Examples of recent studies include:

- City of Hampton, VA, Sanitary Sewer Pump Station Vulnerability Assessment – Analyze the vulnerability of pump stations to flooding and sea level rise
- City of Portsmouth, VA, Flood Plain Management Plan Update – Review of sea level rise impacts to city
- FEMA, Region III – Partner in the development of non-regulatory products used to manage and communicate risk, participate in Open Houses to educate citizens regarding changing Flood Insurance Rate Maps
- Southern Maryland – Investigate flooding issues in many southern Maryland counties, evaluate alternatives, develop flood risk management plans, conduct hydraulic modeling, complete stormwater management plans, and field surveys
- South Central Pennsylvania – Conduct flood risk analyses and develop flood risk management alternatives for various communities

For more information on how the PAS and FPMS technical assistance programs can serve local communities, please visit the Baltimore District and Norfolk District technical services program webpages.

Installation Support

USACE serves as the U.S. Army's engineer and as a member of the U.S. Army's installation management team (USACE 2018b). For military installations, including U.S. Department of the Army and other DOD agencies, USACE can support many initiatives, ranging from public works management to master planning to engineering and construction services. USACE has supported U.S. Army installations residing within the Chesapeake Bay Watershed in numerous capacities to meet the installations' Phase I and Phase II WIP requirements, including stormwater infrastructure survey and mapping, pollutant reduction computations, low-impact development retrofit opportunities assessments, and design of stormwater management retrofits leading to construction.

Army Chesapeake Bay Comprehensive Plan, 2013

In 2013, USACE completed an Army Chesapeake Bay Comprehensive Plan focused on strategically identifying Army projects and opportunities to contribute to bay protection and restoration. Military lands cover 231,485 acres (0.5 percent) of the Chesapeake Bay Watershed. Adopting findings of the 2013 Army Chesapeake Bay Comprehensive Plan (USACE 2013 – unpublished document), there are eight subwatersheds where the U.S. Army owns over 10 percent of the land by acreage. Within these eight subwatersheds, there are five facilities—Fort Indiantown Gap, Hershey Readiness Center, Letterkenny Army Depot, Fort A.P. Hill, and Aberdeen Proving Ground—that collectively cover 65 percent of the total acres of Army property in the Chesapeake Bay Watershed. As outlined in the 2013 plan, restoration efforts focused on habitat, and controlling watershed pollutants at these five facilities would provide a significant positive impact. With respect to broader restoration efforts on military lands, other DOD agencies regularly participate in CBP activities to coordinate ongoing restoration actions based on respective WIPs for various facilities.

INTERAGENCY AND INTERNATIONAL SUPPORT

USACE can provide technical support to other non-DOD federal agencies, state and local governments, and tribal nations on a reimbursable basis. The Interagency and International Support Program is reserved for those circumstances when USACE is uniquely qualified to perform work that otherwise could not be reasonably or quickly available through ordinary business channels. For support to other federal agencies, typically a determination and findings assessment is completed for legal review pursuant to the Economy Act. For support to state and local governments, USACE is authorized to perform such work under Section 211 of WRDA 2000, as amended by Section 109 of the Energy and Water Development Appropriations Act of 2002 (USACE 2018c).

DESIGN-BUILD ENVIRONMENTAL INFRASTRUCTURE AUTHORITIES

Design-build authorities are one way to directly support actions identified in Phase III WIPs, such as those associated with environmental infrastructure projects to protect surface water. USACE may assist communities with design and construction of water, wastewater, and surface water protection and development projects, collectively referred to as environmental infrastructure projects (authorized in WRDA 1992) (Congressional Research Service 2014). Typically, environmental infrastructure design-build projects are authorized based on a specific geographic location. Within the Chesapeake Bay Watershed, there are several such authorities. Despite the environmental infrastructure programs not being included in the President's budget since 1992, citing a low priority for USACE, budgets and work plans passed by Congress have occasionally included appropriations for the programs (Congressional Research Service 2014). Unless specifically identified as another cost-sharing requirement in its authorization, design-build authorities typically include a 75/25 (federal and non-federal) cost-sharing requirement for design and construction activities.

Section 219 – Northeast Pennsylvania Infrastructure Program, PA

Section 219 of WRDA 1992, as amended, authorizes USACE to provide technical assistance to non-federal interests for the planning, design, and construction of environmental infrastructure projects in all or parts of Bradford, Monroe, Susquehanna, Wayne, Lycoming, Sullivan, Wyoming, Lackawanna, and Pike Counties in Pennsylvania. No projects have been funded since 2010 because the projects did not conform to the traditional USACE mission areas and therefore were considered to be congressional earmarks

Section 313 – South Central Pennsylvania Environment Improvement Program

The Section 313 Program was authorized in WRDA 1992, as amended. The intent of the program is to provide design and construction assistance for water-related environmental infrastructure and resource protection projects for non-federal interests in several counties in South Central Pennsylvania within the Chesapeake Bay Watershed, including Cambria, Bedford, Blair, Fulton, Huntingdon, Juniata, and Franklin Counties. The projects include wastewater treatment and related facilities, water distribution, and other surface water resource protection and development projects.

Section 567 – Regional Action Strategy for the Upper Susquehanna River Basin, PA and NY

WRDA 1996, Section 567, as amended by Section 5126, WRDA 2007, authorizes a study and development and implementation of a strategy for using wetland restoration, soil and water conservation practices, and nonstructural measures to reduce flood damages, improve water quality, and create wildlife habitat in the upper Susquehanna River and Chemung River Basins in Pennsylvania and New York and Juniata River Basin in Pennsylvania. With identification of a non-federal sponsor, future funding could be pursued.

Section 571 – Central West Virginia Environmental Infrastructure Program

The Central West Virginia Environmental Infrastructure Program was authorized by Section 571 of WRDA of 1999 (Public Law 106-53). This law provides a program of federal assistance through USACE that allows for design and construction assistance to non-federal interests, including nonprofit entities, for environmental infrastructure and resource protection and development, including projects for wastewater treatment, water supply, and surface water resource protection and development. Projects are selected for implementation from a competitive application process administered by USACE and the West Virginia Infrastructure and Jobs Development Council (WVIJDC). Section 571 has a $20 million authorized program limit with approximately $5 million in remaining capacity. Cost sharing is set at 75 percent federal and 25 percent non-federal funding. The program includes 18 counties in central West Virginia located within the 2nd Congressional District. Various project locations can be found throughout central WV within the geographic boundaries of the Baltimore, Pittsburgh, and Huntington USACE Districts. The counties include Mason, Jackson, Putnam, Kanawha, Roane, Wirt, Calhoun, Clay, Braxton, Lewis, Upshur, Randolph, Pendleton, Hardy, Hampshire, Morgan, Berkeley, and Jefferson, West Virginia. Project stakeholders include the WVIJDC, West Virginia Department of Environmental Protection regional planning and development councils, and communities in central West Virginia.

CHESAPEAKE BAY ENVIRONMENTAL RESTORATION AND PROTECTION PROGRAM, SECTION 510

The Chesapeake Bay Environmental Restoration and Protection Program, as authorized by Section 510 of WRDA 1996, as amended, is a design-build program that offers technical design and/or construction assistance for environmental projects that support the restoration and protection of the Chesapeake Bay estuary. WRRDA 2014, Section 4010(a) amended the Section 510 authorization, and linked project implementation via the Section 510 program to the CBCP. Additionally, Section 4010(a) identified the categories of potential projects that could be considered for implementation via the 510 Program, pending funding specifically appropriated under the Section 510 program. The categories of projects include: sediment and erosion control; protection of eroding shorelines; ecosystem restoration, including restoration of SAV; protection of essential public works; beneficial uses of dredged material; and other related projects that may enhance the living resources of the estuary. The types of projects previously constructed under the Section 510 Program include:

- Prince Georges County, MD – Lower Sligo Creek low impact development
- Smith Island, MD – Wastewater Treatment Plant (WWTP) upgrades at Tylerton and Ewell
- Taylors Island, MD – Shoreline protection
- Middle Branch, Patapsco River, MD – Trash interceptor and tidal wetlands
- Chesapeake Bay Oyster Programmatic Environmental Impact Statement, MD and VA
- Rappahannock River, VA – Oyster restoration
- Scranton, PA – WWTP upgrade

The Section 510 authority, as amended, identifies a 75 percent federal and 25 percent non-federal cost-sharing requirement and the program is currently authorized by Congress at $40 million, of which approximately $28.5 million is available for appropriations. Due to the direct link of the CBCP to Section 510 implementation, the process is detailed here. **Table 9** presents the steps, considerations, and timeframes to coordinate the implementation of a design-build project via the Section 510 Program.

Such environmental infrastructure projects include low-impact development projects that imitate natural features or hydrological features or systems to infiltrate rainwater into the groundwater table. Infiltration reduces the amount of pollutants that reach streams and waterways, ultimately reducing the amount of pollutants entering the Chesapeake Bay. These projects enhance the living resources of the bay and numerous infiltration projects

were identified in the Anacostia Restoration Plan (ARP) (USACE 2010). Following completion of the ARP, Prince George's County, MD, partnered with USACE Baltimore District to design and construct infiltration projects at a local elementary school under the design-build authority referred to as the Section 510 Program.

Table 9. Section 510 Program Process

Step	Consideration	Time Frame
1: Contact USACE	Discuss with USACE staff what authority or program would be best suited to consider for project development and implementation.	Annually (fall) a year prior to scheduled implementation and non-federal funding availability to align federal and non-federal budgeting cycles
2: Submit a Letter of Intent	A letter of intent is a non-binding agreement that confirms the non-federal entity's understanding of cost-sharing requirements.	Anytime, but required annually (spring) to confirm interest and the need to identify federal funding requirements for that respective fiscal year
3: USACE Prepares Project Acceptance Report	The acceptance report describes project boundaries, scope, objectives, federal interest, known risks/constraints, and estimated project cost and confirms that it is appropriate to provide support under the Section 510 authority. This report, along with a letter from the non-federal sponsor expressing intent to proceed, is then approved by USACE authorities.	1 month
4: Feasibility-level Analysis	Upon approval, a limited feasibility-level analysis and report using 100 percent federal funds is completed, which includes recommendations as to how the project should be implemented and all appropriate environmental documentation. This funding request includes funding for development of a Project Management Plan (PMP) and coordination of the Project Partnership Agreement (PPA) between USACE and the non-federal sponsor.	12–18 months for feasibility, analysis, depending on the project 3–9 months to develop the PMP and the PPA, depending on sponsor responsiveness and approval levels
5: Design and Construction	Upon receipt of both federal and non-federal implementation funds, the PPA between USACE and the non-federal sponsor is executed. Federal costs incurred prior to executing the PPA are included in the 75 percent federal and 25 percent non-federal project cost share. Project lands, easements, and operation and maintenance are requirements for the non-federal sponsor as part of the project. Cash contributions are required to achieve the 25 percent non-federal cost share should there be insufficient credits associated with lands and easements to achieve the 25 percent cost-sharing requirement.	12–24 months

USACE CONTINUING AUTHORITIES PROGRAM

The CAP is a group of legislative authorities under which USACE can plan, design, and implement certain types of water resources projects without additional project-specific congressional authorization. The CAP authorities cover a range of mission areas from aquatic ecosystem restoration to navigation improvements to flood risk management.

Recently completed or ongoing CAP projects include:

- James River Bank Stabilization, Section 14 – Emergency stream bank and shoreline protection
- Lidy Creek, Section 14 – Emergency stream bank stabilization project in DuPont Borough, Luzerne County, PA
- Town of Union Bridge, MD, Section 14 – Stream bank and shoreline erosion protection of public works and non-profit public services along Little Pipe Creek
- Janes Island, MD, Section 103 – Shoreline erosion
- Southeast Crisfield, Section 103 – Coastal storm risk management
- Honga River, Dorchester County, MD - Shallow draft navigation
- St. Jerome Creek, St. Mary's County, MD, Section 107 – Shallow draft navigation
- Rhodes Point, Somerset County, MD, Section 107 – Shallow draft navigation

- Ocean City Harbor and Inlet, Worcester County, MD, Section 107 – Shallow draft navigation
- Ocean City, MD Inlet and Coastal Bays, Section 204 – Regional sediment management
- Windsor Borough, York County, PA, Section 205 – Flood risk management
- Athens Borough, Bradford County, PA, Section 205 – Flood risk management
- Hurst Creek, Dorchester County, MD, Section 206 – Restoration of tidal wetlands and the stabilization of adjacent shoreline areas including the peninsula area at the mouth of Hurst Creek
- Paint Branch, Section 206 – Stream restoration and fish passage blockage project in Prince George's County, MD
- Northwest Branch, Section 206 – Stream restoration project in Montgomery County, MD
- Belle Isle State Park, Section 206 – Aquatic ecosystem restoration
- York River State Park, Section 206 – Aquatic ecosystem restoration

A summary of CAP authorities is depicted in **Table 10**.

Table 10. Summary of CAP Authorities

Purpose	Authority	Feasibility Cost Share Federal/Non-Federal (percent)	Implementation Cost Share Federal/Non-Federal (percent)	Federal Project Limit
Emergency Stream Bank and Shoreline Protection	Section 14, 1946 Flood Control Act, as amended	100 / 0 for initial $100,000; 50 / 50 remaining cost	65 / 35[1]	$5,000,000
Hurricane and Storm Damage Reduction (Beach Erosion)	Section 103, 1962 River and Harbor Act, as amended	100 / 0 for initial $100,000; 50 / 50 remaining cost	65 / 35	$10,000,000
Navigation Projects	Section 107, 1960 River and Harbor Act, as amended	100 / 0 for initial $100,000; 50 / 50 remaining cost	Varies, based on water depth	$10,000,000
Mitigation to Shore Damage Attributable to Navigation Works	Section 111, 1968 River and Harbor Act, as amended	100 / 0 for initial $100,000; Shared in same proportion as project causing damage	Shared in same proportion as project causing damage	$10,000,000
Regional Sediment Management	Section 204, 1993 Water Resources Development Act, as amended	100 / 0	65 / 35[1,2]	$10,000,000
Flood Damage Reduction	Section 205, 1948 Flood Control Act, as amended	100 / 0 for initial $100,000; 50 / 50 remaining cost	65 / 35[1,2]	$10,000,000
Aquatic Ecosystem Restoration	Section 206, 1996 Water Resources Development Act, as amended	100 / 0 for initial $100,000; 50 / 50 remaining cost	65 / 35	$10,000,000
Snagging and Clearing for Flood Damage Reduction	Section 208, 1954 Flood Control Act, as amended	100 / 0 for initial $100,000; 50 / 50 remaining cost	65 / 35[1]	$500,000
Project Modifications for Improvements to the Environment	Section 1135; 1986 Water Resources Development Act, as amended	100 / 0 for initial $100,000; 50 / 50 remaining cost	75 / 25	$10,000,000

[1]For structural flood damage reduction purposes, non-federal share is 35 percent up to 50 percent (based on cost of land, easements, right-of-ways, relocation, and disposal areas [LERRDs]), plus a 5 percent cash requirement.

[2]For non-structural flood damage reduction purposes, non-federal share is limited to 35 percent, with no 5 percent cash requirement.

SPECIFICALLY AUTHORIZED INVESTIGATION AND CONSTRUCTION

Feasibility studies associated with the USACE Civil Works mission areas, including navigation, aquatic ecosystem restoration, and flood risk management are cost-shared 50 percent federal and 50 percent non-federal. The non-federal partner provides its share as cash, in-kind services, or a combination of both.

Specifically authorized studies require specific line item appropriations in the General Investigations account in the federal budget. Following completion of the feasibility study, the design and construction phases require further congressional authorization and corresponding appropriations in the Construction General account. The following are a sample of recent investigations and construction projects:

The Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island (Poplar Island)

Poplar Island, located in Talbot County, Maryland, through a partnership with The Maryland Port Administration (MPA) serving as the non-federal project sponsor, is a project focused on restoring and expanding remote island habitat to provide hundreds of acres of wetland and terrestrial habitat for fish, shellfish, reptiles, amphibians, birds, and mammals through the beneficial use of approximately 68 million cubic yards of clean dredged material from the Chesapeake Bay Baltimore Harbor Approach Channels in Maryland and the Chesapeake and Delaware Lower Approach Channels. The project provides a long-term strategy for providing placement alternatives to the dredging needs of the Port of Baltimore while maximizing the use of dredged material as a beneficial resource. The dredged material will be used to restore approximately 1,715 acres of remote island habitat consisting of 829 acres of upland habitat, 776 acres of wetland habitat (low and high marsh), and approximately 110 acres of open water embayment plus 10 acres of tidal gut. Construction is ongoing.

Chesapeake Bay Oyster Recovery, MD and VA

USACE conducts oyster restoration activities primarily under Section 704(b) of WRDA1986, as amended. USACE has been involved in oyster restoration efforts in Maryland since 1996 and in Virginia since 2000. To date, USACE has rehabilitated 633 acres of oyster reef habitat in Maryland and 399 in Virginia. The non-federal sponsor for the Maryland portion is the MD DNR; the sponsor for the Virginia portion is the VMRC. USACE is working with restoration partners (NOAA, MD DNR, VMRC, The Nature Conservancy, and Oyster Recovery Partnership [ORP]) to implement large-scale oyster restoration in select tributaries within the Chesapeake Bay. Under EO 13508, USACE is co-lead with NOAA to achieve oyster restoration in 20 tributaries of the Chesapeake Bay by 2025. The Chesapeake Bay Oyster Recovery: Native Oyster Restoration Master Plan was completed in September 2012 and is used to guide large-scale restoration.

Mid-Chesapeake Bay Island Ecosystem Restoration Project

Mid-Chesapeake Bay Island Ecosystem Restoration is an aquatic ecosystem restoration and beneficial use of dredged material project located on the islands of James and Barren in western Dorchester County, MD. The MPA is the non-federal sponsor. The project contributes to Chesapeake Bay restoration and a long-term strategy maximizing the use of dredged materials as a beneficial resource. The project received authorization for construction in WRRDA 2014.

Lower Susquehanna River Watershed Assessment

The Lower Susquehanna River Watershed Assessment focused on the lower Susquehanna River Watershed from Sunbury, PA, to the confluence with the Chesapeake Bay. The assessment was led by USACE and MDE (non-federal sponsor). In addition, both the USGS and USACE's Engineer Research and Development Center (ERDC) participated in major technical portions of the study along with SRBC, TNC, EPA, and MDDNR, including the MD Geological Survey. The study investigated the dynamics behind sediment transport in the lower Susquehanna River, through

a series of four reservoirs and into the Chesapeake Bay. The Lower Susquehanna River Watershed Assessment, MD and PA was completed in May 2015 and is being used by the Partnership in developing local and regional targets.

Susquehanna Low Flow

The Susquehanna River Basin drains an area of 27,500 square miles, covering half of Pennsylvania and portions of New York and Maryland, and encompasses over 43 percent of the Chesapeake Bay's total drainage area. Given increasing concerns over the growing demand for water, the study recommended a range of river flows that are necessary to meet aquatic ecosystem needs within the sub-watersheds of the Susquehanna River Basin, with emphasis on low-flow conditions. SRBC was the non-federal sponsor. Phase I was completed in June 2012 with the Susquehanna River Basin Ecological Flow Management Study Phase I Report.

Anacostia River Watershed Restoration Plan

Completed in February 2010, the ARP evaluated existing problems in the Anacostia River Watershed to identify restoration strategies and more than 3,000 projects to improve watershed conditions. The Metropolitan Washington Council of Governments (COG) served as the non-federal sponsor, with sub-agreements between COG and Prince George's County Department of Environmental Resources, Montgomery County Department of Environmental Protection, the District Department of the Environment, MD DNR, and MDE. The final ARP identifies several implementation project capabilities (under WRDA, Section 510 and Section 219, as amended) as well as two specific aquatic ecosystem restoration feasibility studies in Montgomery and Prince Georges Counties.

Lynnhaven River Basin Ecosystem Restoration Project

The Lynnhaven River Basin is in Virginia Beach, VA, on the south shore of the Chesapeake Bay. Concerns in the Lynnhaven River Basin include loss of SAV habitat, loss of reef habitat, reduced water quality, siltation, loss of tidal wetlands, increase in invasive wetland species and loss of bay scallops. The transformation of undeveloped land, associated with the settlement and growth of the City of Virginia Beach, along with overfishing, climate change, and other factors, has fundamentally and negatively altered the ecology of the Lynnhaven River. The feasibility study was completed in July 2013 and is currently in post-feasibility phase. The project has not been appropriated funding to begin the design phase. The project consists of restoration of approximately 38 acres of wetlands, 94 acres of SAV, reintroduction of the bay scallop on 22 acres of the SAV, and construction of 31 acres of reef habitat utilizing hard reef structures.

Elizabeth River Environmental Restoration

The Elizabeth River Environmental Restoration project encompasses the entire Elizabeth River Basin, which includes Portsmouth, Chesapeake, Norfolk, and Virginia Beach, within the Southside Hampton Roads area of southeastern Virginia. The recommended plan for addressing the environmental problems and needs in the Elizabeth River Basin, as presented in detail in the Final Feasibility Report and Environmental Assessment dated June 2001, consists of environmental restoration, including sediment restoration at Scuffletown Creek in Chesapeake, VA, and wetland restoration at seven different sites throughout the river system. A feasibility investigation at Paradise Creek, in Portsmouth, VA, also is included. To date, two wetland restoration projects have been constructed—one at Scuffletown Creek in Chesapeake and one at the Old Dominion Drainage Canal in Norfolk. The sediment restoration project at Scuffletown Creek is a component of the mitigation plan for the Craney Island Eastward Expansion Project. A construction initiation date has not been scheduled.

SEQUENCING ACTIONS AND PROJECT DEPENDENCIES

There are many sequencing considerations when proceeding to project implementation. Sequencing refers to considerations of steps or actions that precede project implementation. To achieve the intended outcomes, some efforts precede others. In general, water quality impairments and other stressors should be addressed prior to or in conjunction with USACE undertaking habitat restoration. The high-potential opportunity subwatersheds identified for stream health are marginally healthy with recognized watershed stressors. Consideration should be given to local stressors to determine if and how to address such stressors prior to habitat restoration. It is anticipated that water quality impairments will be addressed by local sponsors or other partners, since water quality improvement is not in the purview of USACE. Stream restoration with low stressors could be undertaken immediately for resident fish and brook trout.

Various restoration practices to improve and expand brook trout habitat have been identified for implementation. To achieve the intended outcomes, some efforts need to precede others. In streams where non-native trout are present, the non-native trout should be eradicated prior to removing a fish passage blockage where the removal of the blockage will connect to allopatric (brook trout only) patches. This will prevent non-native trout from inhabiting current allopatric patches. In patches designated as "enhance stronghold," stressors should be addressed prior to undertaking habitat restoration. Also, when undertaking connectivity projects in patches in the "restore persistent populations and habitats," habitat restoration should be undertaken to provide a supporting habitat prior to or in conjunction with fish passage blockage removal.

Various wetland restoration practices have been identified for implementation to restore and enhance wetlands. In sites contaminated with hazardous and/or toxic materials, remediation may be necessary prior to implementing wetland enhancement and restoration opportunities. In sites dominated by invasive species, control and repeated treatment along with wetland restoration and enhancement efforts may be needed to ensure long-term success.

Oyster restoration must be preceded by the development of a tributary plan that comprehensively looks at restoration opportunities within the river or river reach being restored. The presence of SAV and eroding shoreline is a consideration. Typically, in Chesapeake Bay, potential oyster restoration sites are too far from the shoreline to provide shoreline protection, but in southern parts of the bay, there may be opportunities to leverage oyster reefs to provide shoreline stabilization. Alternatively, eroding shorelines may be the source of sediment to oyster and SAV restoration areas. Those resources should be evaluated to understand potential negative impacts to restored oyster reefs in adjacent waters.

Various restoration practices have been identified to improve and expand upon existing SAV beds. Successful restoration of SAV in the bay depends on improved water clarity. In areas where SAV was historically present but is currently absent, water quality monitoring may need to be conducted to determine the factor(s) contributing to decreased SAV in the area; this monitoring should be compared to conditions in subwatersheds where SAV have rebounded or been restored. Implementation of water quality BMPs must occur if proposed SAV restoration areas do not meet water clarity standards for underwater grasses. If water clarity measurements indicate conditions conducive to SAV restoration, small-scale test plots should be planted in proposed restoration sites to determine feasibility for success of large-scale SAV plantings. If there is a nearby seed-base, SAV should return on its own if water clarity and conditions are favorable for underwater grasses.

The appropriate sequencing of actions must occur at the local scale to enable effective tracking and monitoring of project performance to ensure successful implementation and onset of benefits.

INNOVATIVE FINANCING IS THE FUTURE OF RESTORATION SUCCESS

For USACE projects, which generally requires federal funding matched with non-federal sponsor funding, there are opportunities for non-traditional partnerships and innovative financing to support restoration goals. In 2016, the Chesapeake Bay Environmental Finance Symposium noted that all participants in bay restoration, public and private, have a role to play in creating a set of key "enabling conditions" that set the stage for successful interaction with the market and private sector: (1) allowing flexibility in how projects are designed, financed, and implemented; (2) fostering consistency and predictability in market demand, permitting, procurement, and regulatory enforcement; (3) developing shared or integrated standards for the water quality and restoration marketplace; and, (4) boosting broad-scale demand for restoration.

The symposium highlighted the diversity in the private sector; the broad range of functions and benefits within that sector; and the readiness of the private sector to engage, invest, and advance restoration activities. Participants recognized that as important as water quality trading is, it is only one component of the financing solution. Across the region, there are examples of successful market-based financing programs and local and state governments creating the conditions for success. Actions identified in the CBCP, including those for USACE, create opportunities for establishing innovative financing processes and programs, including linking private capital with public sector investment through pay-for-success programs and P3s to reduce implementation costs.

Public-Private Partnerships

A P3 is typically a contractual agreement between a federal, state or local municipality/agency and a private organization or NGO. P3s will be an essential component for implementation of various CBCP measures, including those associated with restoration, water quality, recreation, stewardship, and conservation. For example, P3s have become a popular and effective method to meet stringent water quality standards required to meet stormwater initiatives in the Chesapeake Bay Watershed. Another successful and viable example of a P3 approach is the execution of voluntary, long-term real estate protections by local citizens in the Chesapeake Bay Watershed. Citizen water quality monitoring programs and programs where students grow oyster spat for reef restoration projects have been implemented within the watershed. P3s also exist where schools grow vegetation that they then plant at local restoration sites; this provides an environmental education opportunity for the school and promotes environmental stewardship and interpretation throughout the watershed.

Various programs could provide investment opportunities for entrepreneurs, possibly incentivized by grant makers that could generate co-benefits and establish markets generating revenue from environmental goods and services.

Smart BMPs

Cloud computing and National Weather Service forecasting can be used to convert existing stormwater BMPs into self-regulating instruments to measure and monitor water quality and quantities into the network of the contributing subwatershed. These data could be obtained for quantification of controls of stormwater and available thereafter for future studies and analyses. Not only could self-regulating BMPs increase the resident time of storm water to reduce the impacts of sediment and nutrient pollutants discharged from the facility, it may also generate data to inform flood risk management investigations. On-site precipitation gages and facility discharge rate datasets then could be used for hydrologic model calibration purposes. Over time, these data could be used to forecast potential impacts from changes in precipitation due to climate change impacts. Additional capital would be needed to retrofit and maintain these systems. However, the Chesapeake Assessment Scenario Tool could be queried to identify where concentrations of wet ponds exist, and focus investments in those respective counties or municipalities to implement pilot projects initially.

Insurance or risk management actions that support habitat co-benefits, such as Natural and Nature-Based Features in tidally influenced and riverine areas

Insurance and banking companies may have incentive to reduce risk to structures and contents of policyholders located in flood risk zones and coastal areas. Risk may be increasing over time due to climate and sea level change impacts. By implementing natural and nature-based features, those management measures to reduce flood risk while mimicking the natural features and providing corresponding ecosystem goods and services could be an investment market. By reducing risk, communities could be more resilient to future impacts and benefit from those goods and services generated, which would contribute toward 2014 Bay Agreement goals and outcomes.

Urban agriculture

Traditionally, land use changes (e.g., open space converted to developed areas and roads) have caused deleterious consequences to habitat and biological resources utilizing those receiving habitats. In urban areas, conversion of underutilized areas to open space, or specifically urban farming initiatives, could provide co-benefits, including reducing the impacts of watershed stressors on the contributing tributaries (assuming BMPs are employed for the agricultural practices). Additionally, removal of abandoned buildings could be replaced with community cooperatives, resulting in new markets, educational opportunities, and nutritional benefits to those living within the communities. Oftentimes urban areas experience grocery deserts where grocery stores may not be in communities and require lengthy commutes to other areas to buy groceries. The City of Detroit, MI has been a leader in the demolition of derelict buildings causing blight. Since 2014, the city has completed 14,025 demolitions (Detroit 2018). Urban agriculture entrepreneurs have acquired the parcels and converted the open space into active orchards and greenhouses. Sediment and pollutant loading allocations may need to be monitored in urban areas of the Chesapeake Bay Watershed should this practice result in extensive land use changes.

Community-based public-private partnerships

A community-based P3 (CBP3) is a partnership between a local government and a private entity with a goal to provide high-quality services cost effectively. By incorporating community revitalization needs, with a focus on green infrastructure for stormwater management, a CBP3 model evolves the standard P3 contractual mechanism into a true partnership that focuses on improving water quality and a community's quality of life (USEPA 2018). CBP3s are designed to provide flexibility, provide access to advanced technology, address dynamic community development trends and goals, and encourage long-term financial and regulatory commitments for integrating green infrastructure into stormwater management programs (EPA 2016). The EPA has developed a guide for local governments to review the capacity and potential to develop a CBP3 program to help "close the gap" between current resources and the funding that will be required to meet stormwater regulatory commitments and community stormwater management needs (EPA 2015).

All jurisdictions in the Chesapeake Bay Watershed have enabling legislation for P3s. However, the statutory variability between jurisdictions shows that the CBP3 model may be better suited for some jurisdictions. (EPA 2015). For example, some departments in New York may procure capital projects through design-build contracts—the simplest form of a P3—but these arrangements may limit the viability of CBP3s for stormwater management needs. The *Community Based Public-Private Partnerships and Alternative Market Based Tools for Integrated Green Stormwater Infrastructure Guide for Local Governments* (EPA 2015) provides legislative details for all Bay jurisdictions within EPA Region III (excludes New York).

Wetland and stream mitigation banking and trading

Mitigation banking is a system of credits and debits to ensure that ecological loss to wetlands and streams from human actions is compensated for by preserving and restoring wetlands and streams in other areas so that there is no net loss to the environment. Wetland or stream banks, which offer credits to offset ecological losses that occur in wetlands and streams, are regulated and approved by USACE and EPA. As of 2018, there are approximately 165 approved and 46 pending bank and in-lieu fee sites across the Chesapeake Bay Watershed listed in the Regulatory In-lieu Fee and Bank Information Tracking System https://ribits.usace.army.mil.

Stormwater trading

Stormwater credit trading programs enable property owners who are subject to an on-site stormwater retention requirement to meet a portion of their requirements by buying stormwater "credits" from other property owners. This trading can prevent the need for property owners to build all needed green infrastructure on their own property. These programs may introduce flexibility into cities' on-site retention rules and can create equal or better water quality outcomes compared to simple on-site retention requirements. The District of Columbia stormwater retention credit trading program is an example of this type of program within the Chesapeake Bay Watershed (https://doee.dc.gov/src).

Oyster shell recycling programs

Oyster shell is used to rebuild oyster reefs; however, it is in very short supply. Reclaimed oyster shells from restaurants and other seafood businesses allow shell that would otherwise be dumped in landfills to be recycled, cleaned, treated with oyster spat, and put back into the waters of the Chesapeake Bay. Through the ORP, over 33,000 bushels of shell is collected annually throughout the mid-Atlantic region. Since the ORP began recycling shell in 2010, about $300,000 has been saved by local businesses in waste collection fees and enough substrate has been recycled to support the planting of 725 million oysters. The State of Maryland also offers tax credits for businesses that recycle oyster shell.

BARRIERS TO RESTORATION SUCCESS

There are numerous factors influencing restoration progress. Of these factors, three of the most significant issues include funding availability; capacity of organizations to tackle issues within their jurisdiction; and consolidated tracking between local, state, and federal governments and NGOs to plan and implement projects. Some barriers may impede or prevent restoration outcomes success, while others only influence and limit the ease, speed, and effectiveness of those actions taken. The management strategies developed by CBP GITs are an additional resource to identify influencing factors and barriers specific to 2014 Bay Agreement outcomes.

Evolving Project Partnering Opportunities

There are current policy restrictions that inhibit the ability to leverage existing resources to completely fulfill commitments between federal agencies and state or local agency partnerships. For example, USACE projects require a cost-sharing contribution by non-federal sponsors for a potential project. Oftentimes, funding received as a grant to a state or local agency from a federal agency has limitations associated with using those funds as cost-sharing contributions for USACE projects. Only funds specifically made available by Congress with the stipulation for cost-share use with other federal efforts can be used for USACE projects.

There may be instances where policies and procedures for flood risk management, conservation, and restoration conflict. Specifically, property restrictions or easements provided for one purpose may not be conducive to other purposes. For example, when a property acquisition is made in flood-prone areas to remove and demolish structures that incur repetitive flood losses, that area could be used for habitat restoration and floodplain reconnection following clearing of the property. The re-established open space may not be available for a future aquatic ecosystem restoration project because of a restriction in the real estate acquisition process that precludes any structure on the parcel including an aquatic ecosystem restoration project feature.

Funding

Additional funding could improve the speed and scale of progress. Non-federal partners have been limited in their ability to undertake cost-shared restoration projects because of the need to devote limited resources to meet water quality regulatory requirements, thereby limiting their ability to partner on beneficial aquatic ecosystem restoration projects that provide improvements to species and their habitat. Flexibility to develop creative partnerships and innovative financing is critical. USACE technical assistance programs are a discretionary part

of the federal budget; however, they are some of the most popular and most valuable programs to assist local communities and states. These programs also include provisions to developed P3s.

Land Ownership

Thus far, implementation of projects on public lands (i.e., parks and schools) has been an easier process than doing so on private lands. Partnering with USACE entails setting aside project lands into a permanent easement. As a result, a number of issues related to land ownership lead to difficulties for private land owners to partner with USACE to implement projects on their lands:

- USACE policies require landowners to establish permanent easements for restoration projects.
- Implementation and maintenance costs may be cost-prohibitive to a private land owner.
- High density populations in urban areas result in the need to partner with multiple land owners for a single project.
- Large tracts of land are held by other Federal agencies.
- Significant portions of agricultural lands are owned by Amish and other Old Order groups, particularly in southern Pennsylvania. These groups have been resistant to accepting government assistance in the past due to their religious beliefs.

These challenges have the potential to limit restoration efforts. To meet 2014 Bay Agreement goals and outcomes, restoration efforts will require the active participation of private landowners and not rely solely on project opportunities located on public lands.

Potential Actions to Overcome Implementation Barriers

Although the Partnership has identified actions associated with the 2014 Bay Agreement management strategies and biennial work plans, there are opportunities to address existing barriers and further promote restoration opportunities based on the results of the CBCP analyses. The items below are not an exhaustive list of actions that could be taken to overcome implementation barriers, but are actions that became known during the CBCP coordination and evaluation efforts. Such actions could address technical barriers associated with knowledge gaps, technical capabilities, and preparing for future uncertainty.

Incorporation of CBCP Content into Phase III WIP Development. The Partnership could use the CBCP datasets, findings, and recommendations for the development of the Phase III WIPs, management strategies, and biennial work plans. Use of this information could assist with identifying of additional opportunities to focus resources.

Open Space Conservation Programs. Similar programs exist in each of the states and District of Columbia to acquire open space, such as forests and agricultural lands, to ensure the land is conserved and will not be developed. The CBCP datasets could be used to assist with these open space programs for targeted outreach in areas adjacent to healthy/high-value habitats. This action may be of greatest importance in Maryland and Virginia to ensure that open space is acquired for wetland migration corridors to allow natural conversion of open space into wetlands as sea level rise occurs over time. Additionally, agricultural areas of the watershed would present opportunities for conservation of riparian buffers to promote connectivity between ecological hubs, particularly critical habitat for RTE species.

Agricultural Sector. Focus on agricultural non-point sources of pollutants one of the largest contributing pollutant sectors—using riparian buffers, stream restoration, and wetland restoration opportunities in conjunction with agricultural BMPs, could provide a relatively higher incremental benefit toward meeting local area planning goals. Data generated from the CBCP for the opportunities identified for each restoration category could be overlaid with those counties with extensive agricultural land use. Further action would be required as part of

subwatershed analyses to identify specific opportunities or prioritization, and primarily in coordination with USDA Soil Conservation Service, to protect privacy of farming nutrient management plans.

Chesapeake Bay Sediment and Sediment Transport Study. Undertake a bottom sediment survey and sediment transport study to account for wetland shadow, understanding potential increasing erosive impacts in the mid-bay region (head-of-tide). Tidal rivers around the world can trap large quantities of sediment between the head-of-tide and mouth of the estuary, depositing sediment in both channel and wetlands, leading to meaningful reductions in sediment loading to estuaries (Meade 1982; Downing-Kunz and Schoellhamer 2015, Ralston 2017). This phenomenon of substantial trapping of sediment by tidal rivers has been called the 'sediment shadow' (Ensign et al. 2015), where contemporary sediment availability in tidal freshwater rivers is often minimal compared to upstream nontidal reaches and downstream oligohaline reaches. This concept is discussed further in the Planning Analyses Appendix. The need for this study was identified during the November 2016 stakeholder meeting. This study would further the shallow-water component of the broader Chesapeake Bay environmental model to potentially identify opportunities for areas of increased vulnerability for erosion in sediment starved areas and areas of relatively higher sediment resuspensions, which then could be used for a predictive SAV model.

Annual SAV Survey. The EPA is responsible for completing an annual survey of sea grasses in the Chesapeake Bay under Section 117 (i)(3) of the Clean Water Act (33 United States Code [U.S.C] Section 1267); however, the survey is not fully funded and the necessary survey is completed by funding contributed by other agencies and entities each year. SAV is a critical indicator for the annual monitoring and measurement of the restoration progress and is required annually to do so.

Water Distribution System Upgrades. As metropolitan areas within the watershed develop to account for forecasted population growth, additional analyses of water allocation budgets and upgrades to more efficient distribution systems (as aging infrastructure would need to be recapitalized) will be needed. Consumptive use of existing resources, compared to forecasted needs for both human and ecological purposes will change over time. Evaluating a range of possible future scenarios would be needed to inform decision-makers on how upgrades would be designed.

Septic Connections to WWTPs. Septic connections to municipal WWTPs, or best available technology, could be targeted based on CBCP analyses to achieve co-benefits in more rural areas. Maryland, Pennsylvania, and Virginia represent the states with the largest contribution of nitrogen pollution delivered by septic systems. However, other sparsely populated areas of the watershed are in areas that are not served by WWTPs and septic systems prevail. Subwatershed analyses could target those subwatersheds with multiple WWTPs for larger septic connections, or areas with septic systems in critical areas (e.g., within 1,000 ft of tidal areas) that may be opportunities for actions, such as wetland, oyster, and/or SAV restoration.

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Next Steps

The CBCP provides a Restoration Roadmap for integrated water resources management as the Partnership focuses on implementation and seeks to maintain the gains made on past investments. USACE is a leader in restoration and implementation, and opportunities exist to use a full suite of programs and technical assistance through construction, to assist in implementation.

The Chesapeake Bay Watershed is a dynamic system of systems, and the 2014 Bay Agreement acknowledged that progress must be made in a strategic manner and to maximize the benefits to ecosystems and communities across the region. The CBCP assists in the next steps to guide the implementation of actions, seeking to maximize co-benefits, and to identify how USACE can continue to support the Partnership.

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