SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

and

FINDING OF NO SIGNIFICANT IMPACT

SHALLOW WATER OYSTER RESTORATION IN HARRIS CREEK OYSTER SANCTUARY, MARYLAND

U.S. ARMY CORPS OF ENGINEERS, BALTIMORE DISTRICT

JUNE 2014

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EXECUTIVE SUMMARY

The Baltimore District of the U.S. Army Corps of Engineers (USACE-Baltimore) is proposing to extend oyster reef restoration into shallower water depths than has previously been performed by the USACE. Previously, National Environmental Policy Act (NEPA) documentation in 1996, 1999, and 2009 evaluated the impacts of oyster reef restoration at water depths that maintain at least an 8 foot water column above restored reefs, including many proposed sites in Harris Creek. These documents are incorporated by reference in the report as *USACE, 1996. Chesapeake Bay Oyster Recovery Project Report, January 1996; USACE, 1999. Supplemental Environmental Assessment For The Construction Of Seed Bars In Eastern Bay As Part Of The Chesapeake Bay Oyster Recovery Project, Maryland, July 1999;* and *USACE 2009. Final Environmental Assessment and Finding of No Significant Impact: Chesapeake Bay Oyster Restoration Using Alternate Substrate Maryland.*

Currently, one foot of material is placed on the bottom to restore reef habitat which limits restoration to water depths deeper than 9 feet mean lower low water (MLLW). USACE has prepared this supplemental environmental assessment (EA) evaluating impacts of expanding oyster restoration and rehabilitation activities for reef bar construction and seeding by USACE into water depths between 6 to 9 feet. This would maintain at least a 5 foot water column above restored reefs within the Harris Creek oyster sanctuary. Prior to large-scale restoration efforts, maintaining a standard 8 foot navigational clearance was a straightforward way to address and avoid navigational conflicts, and there was sufficient habitat in deeper waters for restoration efforts. However, with the understanding of the necessity to undertake large-scale oyster restoration to achieve system-wide impacts (USACE 2012), shallower water depths are needed to utilize areas for restoration that historically were oyster habitat in order to maximize habitat coverage and diversity.

The proposed reef restoration would be accomplished using alternate substrates such as stone and non-oyster shell. The USACE proposed action evaluated in the supplemental environmental assessment is part of a larger multi-agency restoration in Harris Creek, and the Maryland Department of Natural Resources (MD DNR) has previously received a permit from the Regulatory Branch of USACE-Baltimore (CENAB-OP-RMN (MD DNR Fisheries/Harris Creek/Oyster Restoration/Alternate Materials & Oyster Shell) 2012-61332-M24) to construct all the sites being evaluated (74 acres across 34 sites) between 6 to 9 ft.

In 1996, USACE-Baltimore District produced a report entitled *Chesapeake Bay Oyster Recovery Project, Maryland* that identified six Oyster Recovery Areas (ORA's) including the Choptank River complex. Three years later, a 1999 supplemental EA was conducted to evaluate the impacts associated with constructing 18 acres of seed bar habitat in Eastern Bay located in Queen Anne's County, Maryland. In May 2002, the Baltimore District prepared an additional decision document to include project construction beyond 2000 and to increase the total project cost. This construction, known as Phase II, continues today. In May 2009, the Baltimore District completed a separate stand-alone EA that evaluated the use of alternate substrate materials for constructing reef habitat due to the shortage of fossilized shell entitled *Chesapeake Bay Oyster Restoration Using Alternate Substrate, Maryland*.

This project is authorized under Section 704(b) of the Water Resources Development Act (WRDA) of 1986, as amended by Section 505 of WRDA 1996, Section 342 of WRDA 2000, Section 113 of the Energy and Water Development Appropriations Act (EWDA) of 2002, Section 126 of the EWDA of 2006, and Section 5021 of WRDA 2007.

Based on the analysis conducted here and through the previously completed process to provide MD DNR a permit, it is concluded that there would be no direct navigational impacts from the proposed project. Any proposed restoration sites that appeared to pose a navigational conflict were removed from the proposed plan or revised throughout the permitting review process.

Recreational boaters and commercial watermen are the primary users of the waterway; commercial shipping is not a concern in Harris Creek. There are 139 registered boats in Harris Creek. Of the boat owners surveyed, four transit Harris Creek daily, 27 weekly, and 16 monthly. Most use the waterway during the daytime. Drafts from 109 of the 139 registered boats were determined to have an average draft is 2 ft, with a range of 0.5−5 ft.

There are two federally-maintained channels in the area, Dogwood Harbor and Knapp's Narrows. Knapp's Narrows has the largest amount of commercial activity in the area and has a reported depth of five feet. Dogwood Harbor is the furthest away from the project areas and has a reported depth of 7 feet. The proposed work would not restrict navigational clearances in the location of substrate reefs past the maximum boat draft depth identified. The proposed work would not alter the water depths in any maintained navigational channel. At all other restoration locations, water clearance depths would continue to be greater than 5 ft.

Project impacts would be primarily positive. Oyster restoration efforts are expected to improve water quality including reducing sedimentation, enhancing and expanding habitat, and increasing fisheries resources. There would be a short-term impact to turbidity during restoration activity, as well as an increase in noise in the vicinity of the restoration activity. The only negative impact or trade-off identified by public coordination was the potential to negatively impact commercial crabbers who fish using trotlines. Commercial crabbers identified a concern that alternate substrate reefs posed a problem for crabbing with trotlines and could lead to a negative impact on that industry. Large stone was identified as posing the greatest problem for trotliners. Crabbers were asked to identify any specific locations that should be avoided for restoration. To minimize the potential impact, mixed shell has been utilized to the maximum extent possible for reef restoration. To incorporate limited amounts of mixed shell into reef design and still achieve desired reef height, many sites are planned to receive a base of stone with shell placed on top to prevent trotlines from snagging.

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT FOR SHALLOW WATER OYSTER RESTORATION IN HARRIS CREEK OYSTER SANCTUARY, MARYLAND

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Acronyms

ACHP- Advisory Council on Historic Preservation
CBP- Chesapeake Bay Program
CFR- Code of Federal Regulations
CERCLIS- Comprehensive Environmental Response, Compensation and Liability Information System
DO- dissolved oxygen
EA- environmental assessment
EFH- Essential Fish Habitat
E.O.- Executive Order
ERDC- Engineering Research and Development Center
ESA- Endangered Species Act
EWDA- Energy and Water Development Appropriations Act
GIT- Goal Implementation Team
HAPC- habitat area of particular concern
MD DNR- Maryland Department of Natural Resources
MGS- Maryland Geologic Survey
MHT- Maryland Historic Trust
MIW- Maryland Interagency Workgroup
MLLW- mean lower low water
MRC- Midshore Riverkeeper Conservancy
MSFCMA- Magnuson-Stevens Fishery Conservation and Management Act
NEPA- National Environmental Policy Act
NMFS- National Marine Fisheries Service
NOAA- National Oceanic and Atmospheric Administration
NOB- natural oyster bar
ORA- oyster recovery area
ORP- Oyster Recovery Partnership
OMW- Oyster Metrics Workgroup
ppt- parts per thousand
RCRA- Resource Conservation and Recovery Act
RCRIS- Resource Conservation Recovery Information System
SAV- submerged aquatic vegetation
SHPO- State Historic Preservation Officer
SLR- sea level rise
NAAQS- National Ambient Air Quality Standards
USACE- United States Army Corps of Engineers
USCG- United States Coast Guard
WRDA- Water Resources Development Act

1.0 INTRODUCTION

The Baltimore District of the U.S. Army Corps of Engineers (USACE-Baltimore) began oyster restoration efforts in 1996 and is proposing to extend oyster reef restoration into shallower water depths than has previously been performed by USACE. Previously, National Environmental Policy Act (NEPA) documentation evaluated the impacts of oyster reef restoration at water depths that maintain at least an 8 foot water column above restored reefs, including many proposed sites in Harris Creek (USACE 1996, 1999, and 2009). Currently, one foot of material is placed on the Bay bottom to restore reef habitat which limits restoration to water depths greater than 9 feet mean lower low water (MLLW). This supplemental environmental assessment (EA) has been prepared for the Harris Creek Oyster Sanctuary in Talbot County, MD. USACE-Baltimore proposes to allow for oyster restoration and rehabilitation activities for alternate substrate reef bar construction with a spat-on-shell planting in shallower depths of the sanctuary between 6–9 ft MLLW. Reef construction at these depths would maintain at least a 5 foot water column above restored reefs. By permitting oyster reef restoration into additional water depths, science-based oyster restoration goals for this tributary could be achieved; ultimately restoring native oyster populations and improving local habitat conditions throughout the tributary. The USACE proposed action evaluated in the supplemental environmental assessment is part of a larger multi-agency restoration in Harris Creek, and the Maryland Department of Natural Resources (MD DNR) has previously received a permit from The Regulatory Branch of USACE-Baltimore (CENAB-OP-RMN (MD DNR Fisheries/Harris Creek/Oyster Restoration/Alternate Materials & Oyster Shell) 2012-61332-M24) to construct all the sites being evaluated (74 acres across 34 sites).

1.1 Authority

This project is authorized under Section 704(b) of the Water Resources Development Act (WRDA) of 1986, as amended by Section 505 of WRDA 1996, Section 342 of WRDA 2000, Section 113 of the Energy and Water Development Appropriations Act (EWDA) of 2002, Section 126 of the EWDA of 2006, and Section 5021 of WRDA 2007. The authorization for the program is codified at 33 U.S.C. 2263, 'Study of USACE Capability to Conserve Fish and Wildlife'. Section 505 of WRDA 1996 increased the authorization limit from $5 million to $7 million. Section 342 of WRDA 2000 further increased the project authorization limit to $20 million, as well as provided guidance on allowable project activities. Section 113 of the EWDA modified the authorization to permit the non-Federal interest to provide its cost-share, including the provision of suitable shell stock, as in-kind services, and permits USACE to consider such services provided on or after October 1, 2000. Section 126 of EWDA of 2006 increased the project authorization to $30 million prior to WRDA 2007 increasing the project authorization to its current limit of $50 million. The provisions of WRDA 2007 provides USACE with authority to 1) construct, restore and rehabilitate habitat for fish, including native oysters, in the Chesapeake Bay and its tributaries in Maryland and Virginia, and 2) to evaluate and use appropriate alternative substrate materials to construct oyster reef habitat projects.

This supplemental EA has been prepared as a separate and concise document that builds upon the 1996 EA. The scope, however, is a tributary-level assessment of impacts, including project alternatives for federal oyster restoration to occur within State designated natural oyster bars (NOBs) of the Harris Creek Oyster Sanctuary. Targeted restoration involving reef construction, seeding, and monitoring are proposed for 377 acres throughout the tributary based on the tributary plan developed by the Maryland Interagency Workgroup (MIW) (Appendix A).

1.2 Study Area

The study area for this project is Harris Creek, a tidal estuarine system located on Maryland's Eastern Shore in Talbot County; specifically within the portion of Harris Creek designated as an oyster sanctuary by MD DNR (Figure 1). Harris Creek is a tributary on the north shore of the Choptank River, near its confluence with the Chesapeake Bay's mainstem. Harris Creek is east and slightly south of Washington, D.C. St. Michael's is the closest town, followed by Easton, MD. The Harris Creek watershed is one of the main subwatersheds draining the lower Choptank River. Historically, Harris Creek was a major source of oysters, fish, and other aquatic wildlife. Harris Creek is 6.8 miles long and drains approximately 37.5 square miles. Harris Creek comprises an area of 6,029.4 ac (24.4 x 10^6 m^2) and a volume of 71 x 10^6 cy (54.3 x 10^6 $m^{3)}$ (MLLW) (Wazniak et al. 2009). Populations of native Eastern oyster, *Crassostrea virginica* were once abundant throughout the Harris Creek system. Today, *C. virginica* stocks and biogenic reef systems in Harris Creek and the larger Chesapeake Bay have been significantly reduced from historic levels due to overfishing, habitat destruction, water quality, sedimentation, and consequences of disease (Rothschild et al. 1984; Beck et al. 2011). Due to the severity of the situation, targeted oyster restoration will be implemented in the State of Maryland-designated Harris Creek Oyster Sanctuary.

Harris Creek is one of three initial tributaries selected for federal restoration work to be implemented by USACE-Baltimore in collaboration with the National Oceanic and Atmospheric Administration (NOAA) and MD DNR. The target is to restore 377 acres of bottom habitat throughout the tributary. The sanctuary itself covers approximately 4,302 acres. Contained within the sanctuary limits is 1,993 acres of State designated NOBs. The NOBs represent locations and classifications of legally defined oyster bars formally adopted in 1983 by the State of Maryland. The goal of the restoration work within the NOBs is to facilitate large-scale oyster recovery and long-term sustainability of *C. virginica* populations throughout Harris Creek. Typical restoration and rehabilitation actions include constructing reef habitat on hard non-oyster substrate within the boundaries of historic oyster habitat, seeding with spat-on-shell (hatchery-produced young oysters set onto oyster shell) on areas that currently support low density oyster populations, seeding newly constructed reef habitat with spat-on-shell and monitoring; all of which are part of a comprehensive management approach aimed at recovering this keystone species. USACE's typical role is to construct reef habitat; MD DNR is the usual lead for seeding the reef habitat once constructed.

1.3 Recent and Proposed Federal Actions

In 1996, USACE-Baltimore produced a report entitled *Chesapeake Bay Oyster Recovery Project, Maryland* that identified six Oyster Recovery Areas (ORAs) including the Choptank River

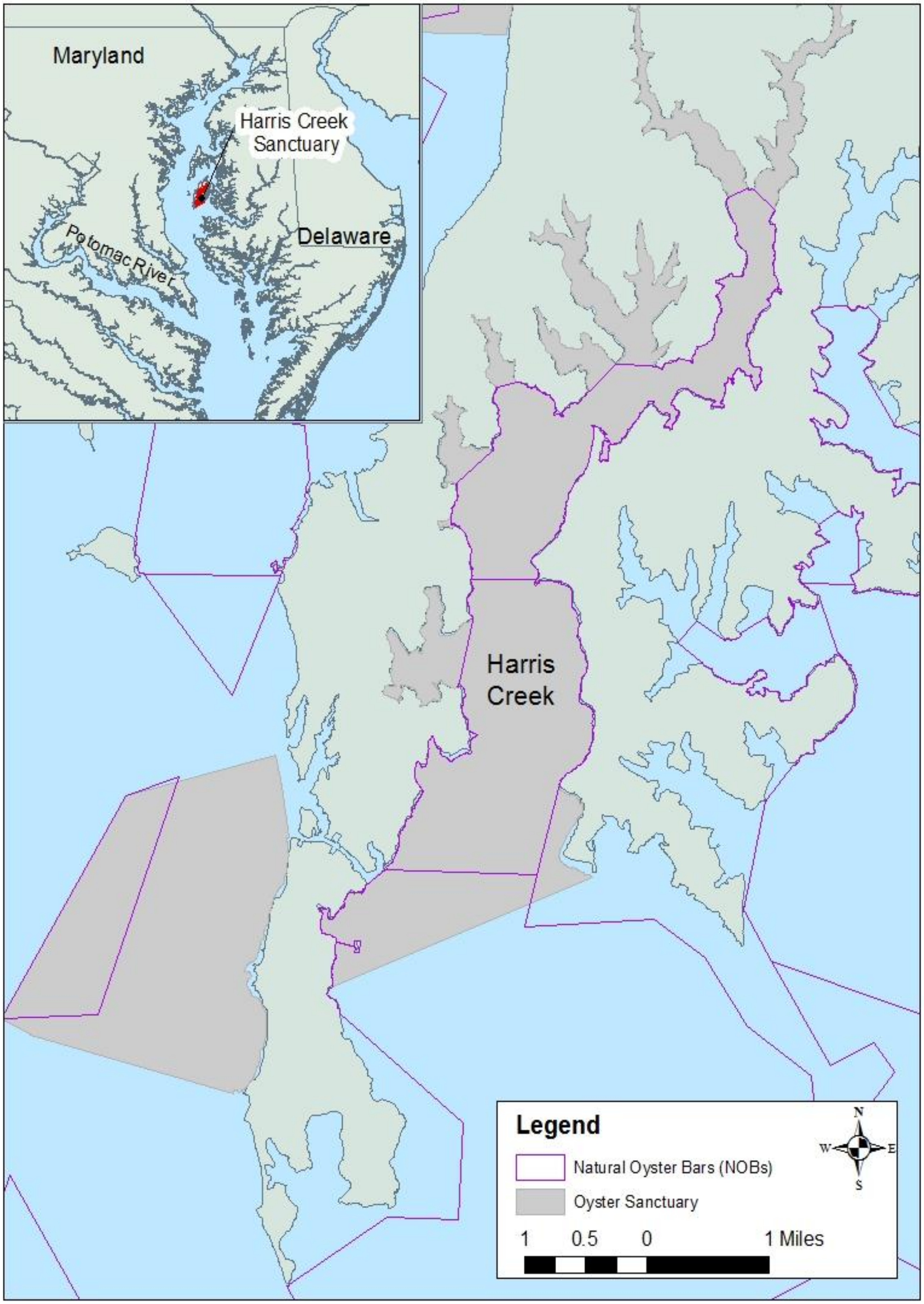

Figure 1. Study Area

complex. Three years later, a 1999 supplemental EA evaluated the impacts associated with constructing 18 acres of seed bar habitat in Eastern Bay located in Queen Anne's County, Maryland. In May 2002, USACE-Baltimore prepared an additional decision document to include project construction beyond 2000 and to increase the total project cost. This construction, known as Phase II, continues today. In May 2009, USACE-Baltimore completed a separate, standalone EA that evaluated the use of alternate substrate materials for constructing reef habitat due to the shortage of fossilized shell entitled *Chesapeake Bay Oyster Restoration Using Alternate Substrate, Maryland*.

Also in 2009, the *Chesapeake Bay Protection and Restoration Executive Order* (E.O. 13508) was issued. Among other activities, the E.O. instructed all federal agencies involved in Chesapeake Bay oyster restoration to formulate comprehensive strategies and to set clear and measurable goals for restoring native oyster habitat and populations in 20 tributaries by 2025. In response to E.O. 13508, the USACE-Baltimore recognized that a more coordinated Bay-wide approach throughout the Maryland and Virginia portions of the Chesapeake Bay was needed to guide USACE's future oyster restoration efforts and the investment of federal funding. As a result, the 2012 USACE *Native Oyster Restoration Master Plan* (Master Plan) evaluated problems and opportunities for oyster restoration in tributaries of the Chesapeake Bay, formulated broad plans, and offered recommendations for implementation of large-scale oyster restoration. A summary of past USACE restoration actions prior to 2011 is included in the Master Plan (USACE 2012).

The Chesapeake Bay Program's Sustainable Fisheries Goal Implementation Team (GIT) is charged with advancing the oyster goal of E.O. 13508. The GIT convened the Oyster Metrics Workgroup to establish definitions and metrics to use in determining if restoration projects have met goals and tributaries have been successfully restored (OMW 2011). The GIT then established interagency workgroups in Maryland and Virginia to plan restoration work in each state, in consultation with appropriate partners. The MIW is composed of representatives from NOAA, MD DNR, USACE-Baltimore, and the Oyster Recovery Partnership (ORP). The MIW is charged with developing and implementing large-scale oyster restoration plans to meet the oyster goal of E.O. 13508 and the MIW's respective agencies' goals. Based on consideration of salinity levels, available restorable bottom, protection from harvest, historical spat set, and other factors, MIW, in consultation with Maryland oyster restoration partners, selected Harris Creek as its first tributary for large-scale oyster restoration. The Little Choptank River is a the second tributary selected for restoration by the MIW, followed by the Tred Avon River.

The oyster metrics report (OMW 2011) defined a successfully-restored tributary as one where 50 to 100% of currently restorable bottom, constituting at least 8% of historic oyster habitat, consists of restored reefs. The Harris Creek Oyster Sanctuary Restorable Bottom Assessment and Data Summary (NOAA 2011) identified approximately 600 acres (598.4 ac) of currently-restorable bottom habitat based on data from the USACE Master Plan, the oyster sanctuary boundaries, water quality data, and bottom survey data from Maryland Geological Survey (MGS) and NOAA (Appendix B). Within the sanctuary limits, data collected by MGS in the winter of 2009 and by the NOAA in 2011 identified existing bottom conditions, the quality of the bottom, and its ability to support restoration actions. The bottom habitat types that were included as potentially suitable for restoration in the bottom assessment are patch reef, sand and scattered shell, sand, muddy sand, aggregate patch reef, artificial reef, and fringe reef. Table 1 provides the acreages of each habitat type mapped by the bottom assessment. Figure 2 shows the map of bottom habitats.

Table 1. Summary of acreages by habitat type within the Harris Creek Oyster Sanctuary. Habitat characterization based on acoustic and ground truthing data collected by MD Geological Survey and the NOAA Chesapeake Bay Office 2010-2011. Bottom types shown in bold are those included as potentially suitable for restoration activities. Recreated from Appendix B.

Bottom Type	No. Habitat Segments	Minimum Area (Acres)	Maximum Area (Acres)	Average Area (Acres)	Total Area (Acres)
Patch reef	12	0.1	14.2	2.2	26.1
Sand and scattered shell	6	1.4	9.1	4.4	26.2
Unclassified	7	1.4	16	7.5	52.6
Sand	3	0.1	58.1	20.3	61
Sandy mud	8	0.1	24.6	8	64
Muddy sand	4	3.8	44.1	18.2	72.8
Aggregate patch reef	5	1.6	43.2	15.6	78.1
Mud and scattered shell	19	0	30	6.3	119.1
Artificial reef	10	1.6	63.7	15.2	151.5
Fringe reef	36	0	30.6	5.1	182.7
Mud	13	0	327	72.6	944.1

Sum of all bottom=	1778.2
Sum of restorable bottom =	598.4

In order to meet the 50–100% of currently-restorable bottom goal, 300–600 acres would need to be restored in Harris Creek. The second part of the Oyster Metrics goal is that this amount, 300–600 acres, must constitute at least 8% of historic oyster habitat. The Yates Survey of 1913 identified 3,479 acres of historic oyster habitat in the river; 8% of that is 278 acres. Therefore, restoring between 300 and 600 acres would meet both parts of the Oyster Metrics goal. These 600 acres were analyzed in GIS to make uniform polygons that could be feasibly constructed. For example, this process removed very small, odd-shaped appendages to larger polygons and long thin slices bordering unsuitable bottom that would be difficult to plant. This process winnowed the 600 acres to 490 acres. One final adjustment was made to reach the final Harris Creek restoration target. Ground truthing performed by divers has shown that sonar surveys may overestimate the area of hard bottom suitable for placing substrate and/or spat-on-shell (MIW 2013). Based on restoration field experience, the MIW assumed that the suitable area as determined by sonar will be reduced by 30% upon examination by divers. A 30% reduction of the 490 acres resulted in a total target restoration area of 377 acres (See Appendix A for full

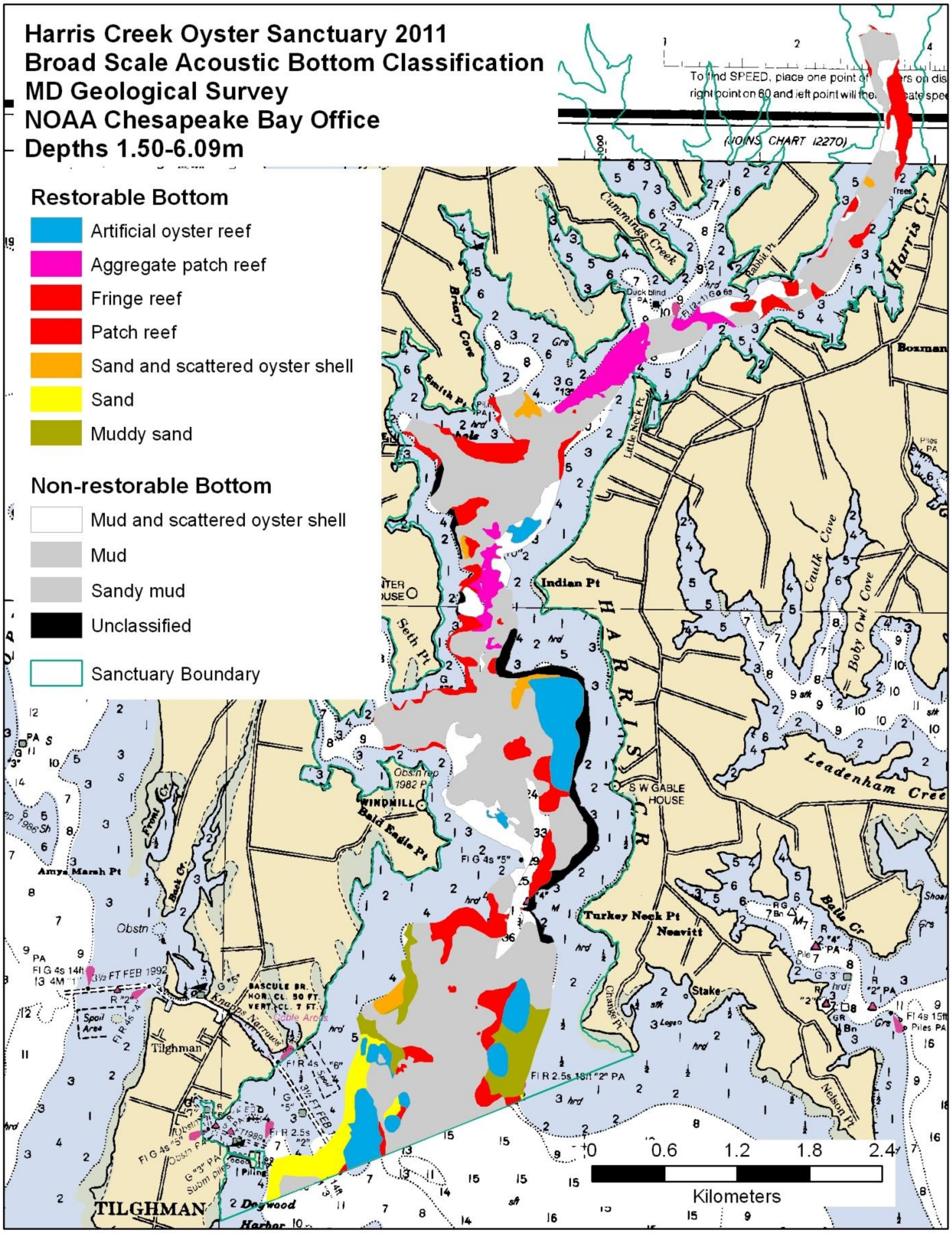

Figure 2. Harris Creek Bottom Habitat Classification

explanation of targets. Restoration actions were taken on 22 acres while the tributary plan was being developed resulting in the 30% reduction not being applied to the entire 490 acres.) A total of 157 of the 377 acres are planned as seed only treatment due to the presence of existing reef habitat and 5–50 oysters/m^2. Seed only treatment areas will only receive spat-on-shell plantings as part of restoration efforts. Three acres met oyster metric success criteria of 50 oysters/ m^2. The remaining 217 acres are planned as alternate substrate reefs. USACE's primary role in oyster restoration is construction of alternate substrate reefs, and therefore its focus in Harris Creek is these 217 acres. Since 2012, USACE-Baltimore has constructed 79 acres of 1-foot high oyster reef using alternate substrates, primarily mixed shell and granite. Reefs restored, thus far, by USACE-Baltimore are consistent with existing NEPA documentation for the Oyster Recovery Project due to being at water depths greater than 9 feet. Restoration partners have also seeded 133 acres resulting in restoration of 212 acres of the 377 target (56%). There are 136 acres of shallow water reef habitat being planned including work by MD DNR and work proposed here by USACE-Baltimore. Additional fine-scale surveys acquired since establishing the target of 377 acres have identified that some of the acreage initially deemed restorable is not suitable for restoration. Therefore, restoration partners are working to restore all suitable acreage, but may not fully reach the 377 acre target. To reach 377 acres, an additional 29 acres of seed only habitat would need to be identified and planted with spat-on-shell, but only 19 acres of potential habitat are believed to remain. Therefore, maximum restoration of 367 acres is the current anticipated achievable target. Build-out for the entire project is estimated to take up to 6 years from initial construction in 2012.

2.0 PURPOSE, NEEDS, and OBJECTIVES

Previously, NEPA documentation evaluated the impacts for USACE implementation of oyster reef restoration at water depths that maintain at least an 8 foot water column above restored reefs, including many proposed sites in Harris Creek (USACE 1996, 2009). Currently, 1 foot of material is placed on the Bay bottom to restore reef habitat which limits restoration to water depths greater than 9 ft MLLW. This supplemental EA has been prepared for the Harris Creek Oyster Sanctuary to expand oyster restoration and rehabilitation activities for reef bar construction and seeding by USACE-Baltimore into shallower depths of the sanctuary between 6–9 ft MLLW. The potential impacts of expanding restoration work into shallower depths have not been evaluated under existing NEPA documentation. As a result of removing an 8-foot minimum navigational depth clearance to allow restoration work to proceed in areas with a 5-foot minimum navigation depth clearance, the procedures imposed by NEPA require USACE-Baltimore to evaluate the affects of this action on the quality of the human environment. There was no scientific basis for the existing requirement to maintain an 8-foot depth clearance. Rather, it was a generic approach to avoid navigational issues. However, given the focus on large-scale tributary based restoration, it is necessary and appropriate to consider restoring oyster reef habitat across broader depth contours within the historic oyster habitat footprint. By removing the 8-foot minimum navigation depth clearance, science-based oyster restoration goals for this tributary could be achieved; ultimately restoring native oyster populations and improving local habitat conditions throughout the tributary.

2.1 Purpose

The purpose of this project is to replace the 8-foot minimum navigational depth clearance for previously authorized activities under the 704(b) Program with a 5-foot minimum navigational clearance. This issue only applies to reefs that require substrate placement for restoration. Seed only sites (where no substrate is placed prior to spat-on-shell planting) do not have any limitations placed on them for maintaining navigational clearances. Reefs rehabilitated using alternate substrate will also receive a planting of spat-on-shell in Harris Creek. The proposal would expand the potential area for restoration, and thus enable restoration goals to be met.

2.2 Needs

The overall tributary plan for Harris Creek has targeted 377 acres for oyster restoration between 4–20 feet MLLW (Table 2). Although the restoration plans are limited to depths between 4 and 20 ft MLLW, the natural range of oyster habitat extends from intertidal zones in southern portions of Chesapeake Bay to waters greater than 30 ft MLLW. The targeted acreage includes areas that have some degree of exposed shell that will only require planting of oyster seed (between depths of 4 and 20 feet MLLW) as well as acreage that will need placement of reef substrate and oyster seed (between depths of 6 and 20 feet MLLW). There are 217 acres of the 377 acre target that are designated as areas for reef construction and seed planting. Of the 217 acres, only 81 acres are at depths greater than 9 ft and are currently permitted to be restored. A significant portion (136 acres) of the sites targeted for reef construction, USACE-Baltimore's primary role in Maryland oyster restoration, is within water depths between 6–9 feet. Therefore, it is necessary to expand the water depths where oyster reef habitat restoration can occur to reach the restoration target of the tributary plan and provide the greatest likelihood that restored oyster resources will have a system-wide response and become self-sustaining. Restoration of alternate substrate reefs at water depths greater than 9 feet will be complete by early 2014. There are

Table 2. Summary of Restoration Acreage

Restoration Type	Depth Interval	Total Acres	Number of Sites	Mean Acres	Min. Acres	Max. Acres
Substrate and Seed	6-9 ft.	136	34	4.0	0.5	25.5
Substrate and Seed	9-20 ft.	81	33	2.4	0.7	7.7
Seed Only	4-20 ft.	160				
Total Restorable Bottom	4-20 ft.	377				

some seeding only sites remaining, but the major focus to reach the target will be the shallow water areas. MD DNR has received a permit from USACE in 2013 (Appendix C) to restore all the shallow water habitat, and plans to construct 62 of the 136 acres. The remaining 74 acres are the focus of this evaluation. Figure 3 shows the restoration areas as identified by the tributary plan.

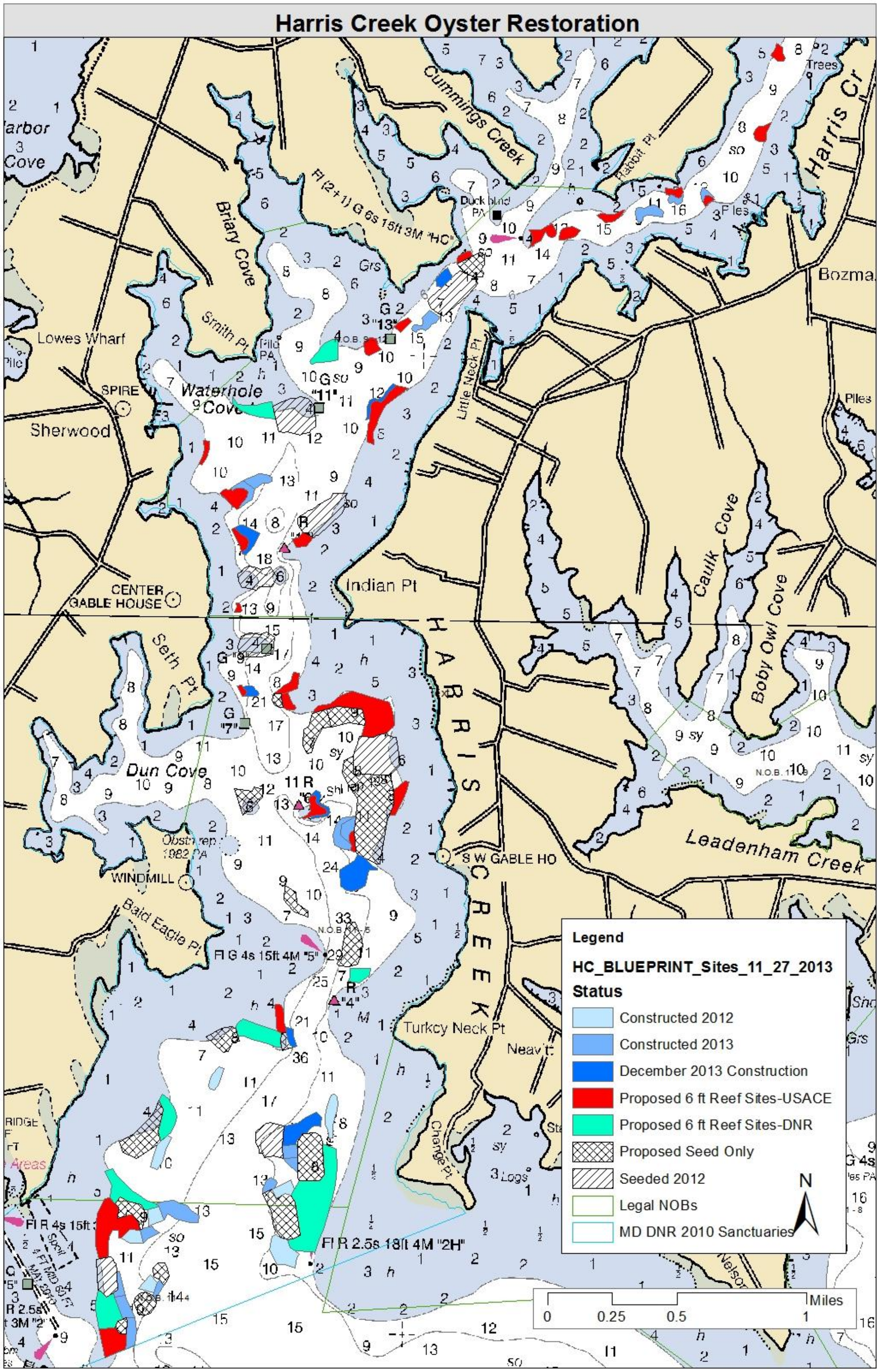

Figure 3. Harris Creek Restoration Plan

2.3 Problem Identification

Chesapeake Bay oyster resources have been classified as "poor" (Beck et al. 2011) which equates to a 90–99% habitat loss with partial or complete fishery collapse. While some bars remain, their long-term viability is questionable. The demise of Chesapeake Bay oyster populations can be attributed to four main causes: loss of habitat (substrate), oyster diseases, water quality degradation, and commercial harvesting. Further discussion of the problems facing oysters and historic oyster decline in the Chesapeake Bay is available in USACE (2009) and USACE (2012). Oyster restoration efforts prior to signing of E.O. 13508 were geographically scattered and too small in scale to have a system-wide impact. The current Maryland strategy to address these past problems is to work within large, designated sanctuaries, take a tributary approach and work throughout all feasible water depths within that tributary to restore habitat in order to provide the appropriate scale. Given the current limitation of placing substrate materials for reef construction in locations where 8-ft of water depth must be maintained above the reef structure, the spatial scale at which additional reef habitat could be constructed would be substantially limited to a degree that would jeopardize project objectives.

Restoration at diverse depths throughout Harris Creek will increase the spatial extent and connectivity of restoration actions to maximize habitat and support larval retention and settlement success, a particular focus of USACE's Master Plan. Previous restoration efforts in the Chesapeake Bay tributaries have been limited in scope and spatial connectivity (USACE 2012). By removing the 8-ft minimum navigational depth clearance, two identified goals for a successfully-restored tributary are met in addition to expanding federal activities into historically recognized zones of oyster spawning, transport, and larval setting. Work in depths at 6–20 ft MLLW provides the best circumstances for influencing stock/recruit relationships and for promoting the development of disease resistance, which, in turn, will make on-the-ground restoration more likely to achieve ecological success (USACE 2012).

Shallower areas may allow oyster larvae to take full advantage of flood tidal currents by timing their vertical swimming activity (Boicourt 1982). Further, shallow-water oyster beds have a lower risk of exposure anoxic conditions (Seliger et al. 1982).

Research supports expanding oyster restoration activities at the 6-foot bathymetric contour. Seliger and Boggs (1988) studied oyster populations in Broad Creek and the Tred Avon River; both are neighboring tributaries to Harris Creek. Their investigation determined that the 6-foot MLLW depth contour was a zone that was highly supportive of oyster habitat where it was associated with steep bathymetric gradients. Bathymetric gradients promote successful restoration due to continuous influx of food and efflux of sediment and waste and are a targeted area for construction of individual reefs and rehabilitation (USACE 2012). The 6 ft depth contour environment of Harris Creek is expected to be similar to those areas in Broad Creek and the Tred Avon River given their similar position as tributaries in the lower Choptank River system. This area would be included in the 6-9 ft MLLW zone where the proposed actions are targeted.

In the absence of removing the depth restriction, the Maryland oyster restoration partners (including USACE–Baltimore) would be unable to reach restoration goals due to a shortage of available restorable bottom. Removing the 8-foot minimum navigation depth clearance permits the co-habitat goals (based on Yates and restorable bottom) to be met and allows for increased restoration acreage to be obtained (77 acres) above the minimum target. This, in turn, is anticipated to support habitat diversity and higher reproduction levels within the tributary contributing to a more sustainable restoration project long-term.

2.3.1 Brief Description of the Project

Harris Creek was selected as the first candidate for large-scale oyster restoration by MIW. The selection is predicated on the findings of the Master Plan, fall survey data collected by MD DNR, existing Chesapeake Bay Program water quality monitoring data, Maryland oyster sanctuary designations, and bottom survey data obtained by MGS and NOAA. Following identification of a tributary for restoration, a detailed tributary plan is developed to determine the restoration target and specific locations for restoration within the tributary. Restoration efforts are then carried out in subsequent years until the restoration target is reached. Monitoring and adaptive management occur in the years following completion of initial restoration efforts. Typical roles of oyster restoration partners follow:

- NOAA- pre- and post-restoration bottom surveying and GIS analysis,
- USACE-Baltimore- alternate substrate reef construction, monitoring,
- MD DNR- hatchery operation/spat-on-shell production, monitoring, alternate substrate reef construction, and
- ORP- spat-on-shell plantings, pre-restoration surveys, post-planting surveys.

Surveys were conducted to develop the tributary plan and identify specific restoration locations. Initially, MGS and NOAA conducted side-scan sonar surveys for Harris Creek in 2009 that provided baseline data identifying bottom type. A more detailed investigation of the riverbed was completed by NOAA to determine the quality of the bottom habitat and its ability to support restoration actions in 2011 (NOAA 2011, Appendix B). Only the areas between 4–20 feet MLLW were considered suitable for restoration since deeper waters typically experience lower dissolved oxygen (DO) levels and higher sedimentation rates that are not conducive to reef community structure. Water depths in the range of 4–6 ft MLLW were unsuitable for substrate additions due to concerns about navigational use conflicts on the waterway and for safe vessel operation needed to place reef materials. Thus, only water depths between 6–20 ft MLLW are considered suitable for reef construction.

2.3.2 Harris Creek Oyster Populations

Historically the Harris Creek system supported large productive reefs where free-swimming oyster larvae could colonize on oyster shell or other hard substrate habitats. Roughly 3,479 acres of oyster beds were mapped by the 1913 Yates Bars survey (Yates 1913). In comparison, the most recent Harris Creek population survey identified 160 acres with >5 oysters/m^2 (Versar 2012; MIW 2013). Oyster population decline in Harris Creek was typical of declines documented Bay-wide (Rothschild 1994). Initially, extensive harvests impacted resources, followed by loss of habitat, declining water quality, and finally disease after 1960. Historic spat set data compiled by Merritt and Krantz (1977) depict a reduction in spatset from 203.6 spat/bushel during 1939–1965 to 37.3 spat/bushel between1966-1975, an 82% decline. These documented reductions in spatset predate the impact of disease after 1980. Spatset data has also been recorded by the MD DNR Fall Survey spatset at five locations in Harris Creek: Tilghman Wharf, Mill Point, Eagle Point, Wild Cherry Tree, and Little Neck. Consistent records are not available for all stations, but the complete data record for Harris Creek spans 1980 through 2010. The last significant spat set was recorded in 1997 (168 spat/bushel at Eagle Point/Mill Point and 472 spat/bushel at Tilghman Wharf). Since that time, there is only one recorded spat set that exceeded 50 spat/bushel in 2010. These losses could have been significantly higher in the absence of extensive work conducted by the Oyster Management Program and the Maryland Department of the Environment (Biocourt 1980). Even with the reduced populations, Harris Creek was recognized as a sound oyster production area up until the time of its closure and designation as a sanctuary (Jones and Rothschild 2009).

A patent-tong survey was completed in January and February 2012 in Harris Creek (Versar 2012). Twelve Yates Bars were sampled. The survey estimated a total population of 7,718,280 oysters in Harris Creek and an average density of 0.36 oysters/m^2. Survey data for each bar investigated is summarized in NOAA (2012). High concentrations of oysters are distributed throughout Harris Creek. Reefs with the highest concentration of live oysters include Mill Point reef, the southeastern edge of Turkey Neck reef, throughout Change reef, and throughout the Tilghmans Wharf reef complex. The reef with the highest average live oyster densities in Harris Creek was Mill Point reef with 6.8 oyster/m^2. Mill Point also exhibited the largest population of live oysters in Harris Creek with an estimated 2,500,645 oysters. A map of the oyster population in Harris Creek is included in the appendices of the Harris Creek Tributary Plan (Appendix A).

The more recent decline in overall Chesapeake Bay oyster populations has been attributed primarily to the introduction of two exotic diseases to which the Eastern oyster had no resistance: Dermo and MSX. Harris Creek has been selected as part of an overall salinity-based strategy to address disease and promote the development of disease resistance. Disease pressure and mortality of adult oysters increase with increasing salinity (USACE 2012). Since Harris Creek is classified as a mesohaline tributary, salinity levels support good reproduction and make it a prime candidate to promote disease resistance in the wild population. Focusing ecological restoration efforts in a large-scale, interconnected fashion (river system wide) is the strategy most likely to allow large populations of oysters to persist in the face of disease and other stressors (USACE 2012).

2.4 Objective

The objective of this EA is to enable full implementation of the Harris Creek Tributary Plan. Full implementation of the Harris Creek Tributary Plan would provide 377 acres of restored oyster reef habitat in Harris Creek. This level of implementation would provide for the greatest potential scale of oyster restoration. Oyster restoration efforts in Maryland prior to the tributary-based outcomes established by E.O. 13508 were scattered and too small in scale to make a system-wide impact (ORET 2009). Broodstocks and reef habitat are currently below levels that can lead to sustainable restoration projects in Harris Creek. Although there is no definitive answer available to the exact amount of scale required to provide sustainability, Harris Creek appears to provide a sufficient scale to achieve sustainability, and the plan devised for Harris Creek follows the scale recommendations of the USACE Oyster Restoration Master Plan (USACE 2012). USACE (2012) utilized the most current science available to lay out a strategy for addressing scale. The approach of MIW is to restore all habitat that is deemed restorable given available resources because habitat is drastically degraded and reduced from historic levels.

3.0 ALTERNATIVES

Alternative development and analysis is focused on the 74 acres identified in the Harris Creek Tributary Plan for alternate substrate reef development in water depths between 6–9 ft.

3.1 Alternatives Considered

The alternatives considered are summarized in Table 3. (See Section 1.3 for a discussion that explains the expected feasible restoration of a maximum of 367 acres due to projected limits on suitable seed-only acreage.)

Table 3. Alternatives Considered

Alternative	Description
Alternative 1: No Action	No shallow water alternate substrate habitat would be constructed by USACE-Baltimore. USACE-Baltimore restoration would be limited to 79* acres of restoration in 9–20 feet of water. Restoration partners would restore areas identified as seed only sites and MD DNR would restore 62 acres of shallow water reef habitat. Total efforts would provide for up to 293 acres of reef habitat.
Alternative 2: Partial shallow water restoration	Restore 59-67 acres of shallow water reef habitat.
Alternative 3: Full shallow water restoration	Restore all 74 acres of shallow water reef habitat.

*79 acres is full deep water construction. Initially 81 acres were identified, but further surveys reduced the area suitable for restoration.

Alternative 1: No Action

This alternative would not replace the current 8 foot water depth navigational clearance with a 5 foot water depth navigational clearance. USACE-Baltimore would continue activities to restore the 79 acres identified for alternate substrate reefs in water depths greater than 9 ft MLLW. Seeding of existing impaired oyster reef would occur by MIW partner efforts.

Alternative 2: Partial shallow water restoration

This alternative would replace the current 8 foot water depth navigational clearance with a 5 foot water depth navigational clearance, thereby expanding the footprint of alternate substrate reefs to a diversity of water depths. USACE-Baltimore would continue activities to restore the 79 acres identified for alternate substrate reefs in water depths greater than 9 ft MLLW and undertake restoration of 59-67 acres slated for alternate substrate placement in water depths between 6–9 ft MLLW. Alternative 2 represents a situation where unforeseen circumstances arise that prevent full implementation to achieve the Tributary Plan goals. Unforeseen issues that could jeopardize completing the 74 acres and achieving the Tributary Plan goal are limitations in the availability of suitable alternate substrate or new information that identifies that some of the targeted bottom is not suitable for restoration. The range targeted, 59-67 acres, represents a situation where 10-20% of the bottom is determined to be not suitable for alternate substrate reef restoration at the time of construction. This is the mostly likely risk to full implementation. The Bay bottom is a dynamic environment that can undergo short-term, year-to-year, compositional changes. Alternatively, initial data may not have been interpreted accurately, leading to misidentification of bottom type as suitable in original plans. Seeding of existing impaired oyster reef and any reefs restored under this alternative would occur by MIW partner efforts.

Alternative 3: Full shallow water restoration

This alternative would replace the current 8 foot water depth navigational clearance with a 5 foot water depth navigational clearance, thereby expanding the footprint of alternate substrate reefs to a diversity of water depths. USACE-Baltimore would continue activities to restore the 79 acres identified for alternate substrate reefs in water depths greater than 9 ft MLLW and undertake restoration of 74 acres of reef habitat at water depths between 6 and 9 ft. Seeding of existing impaired oyster reef and any reefs restored under this alternative would occur by MIW partner efforts.

3.2 Ecosystem Benefits

There are many ecosystem benefits provided by oysters and their associated reef habitat. Grabowski and Peterson (2007) have identified 7 categories of ecosystem services provided by oysters:

(1) production of oysters;
(2) water filtration and concentration of biodeposits (largely as they affect local water quality);
(3) provision of habitat for epibenthic fishes (and other vertebrates and invertebrates- (Coen et a1. 1999; ASMFC 2007);
(4) sequestration of carbon;
(5) augmentation of fishery resources in general,
(6) stabilization of benthic or intertidal habitat (e.g. marsh); and
(7) increase of landscape diversity (see also reviews by Coen et a1. 1999, Coen et al. 2007, Coen and Luckenbach 2000, ASMFC 2007).

Further, Ulanowicz and Tuttle (1992) identified how oyster restoration would promote beneficial food web dynamics in the Chesapeake system. These benefits are discussed in further detail in USACE (2012).

Given existing knowledge, ecosystem benefits are closely tied to the acreage restored. Therefore, the greater the acreage restored, the greater the connectivity of the oyster resources in a tributary, and the greater the ecosystem benefits. Additionally, the intent of large-scale oyster restoration is to increase oyster biomass such that restoration projects become self-sustaining and able to provide oyster recruits to suitable surrounding oyster habitat outside the restoration project area.

There is no existing model to adequately quantify the diverse benefits and value of oyster restoration. However, USACE-Norfolk and USACE's Engineer Research and Development Center (ERDC) in coordination with the Virginia Marine Research Commission (VMRC) are working to develop a model to estimate ecosystem benefits and services from oyster restoration. Preliminary results have identified the high ecosystem outputs generated by sanctuary reefs in Virginia (Swannack, personal communication). USACE (2012) also provides a summary of documented efforts made toward quantifying the economic value of restored oyster habitat.

In addition to ecosystem benefits from oyster restoration, another significant benefit that can be expected from restoring a protected network of oyster reefs throughout the Bay is spillover of reproduction to oyster bed leases and wild harvest areas, thereby augmenting oyster stocks for harvest.

3.3 Evaluation of Alternatives

Alternative 1: No action

Under the No action alternative, restoration work by MIW partners would achieve restoration of 274–293 acres of reef habitat in Harris Creek. The total acreage restored will depend on how many acres of the remaining seed-only acreage is suitable for planting based on pre-construction groundtruthing. This level of restoration would satisfy the goal set to restore a minimum of 8% of historic habitat (278 acres), but would not fulfill the restorable bottom goal (300–600 acres) or the tributary plan target. This alternative would provide for the fewest ecosystem benefits as the lowest level of reef restoration would be undertaken. Reef habitat diversity would not be maximized. Restoration of alternate substrate reefs would be limited to deeper parts of the water column that are at greatest risk to low DO and the 62 acres of shallow water habitat to be constructed by MD DNR. There would be no change to the navigational clearance of the waterway to boaters in Harris Creek. Although, larval transport is not entirely understood in Harris Creek, implementation of this level of restoration would minimize habitat that would provide for spat settlement and broodstock for reproduction, and therefore minimize reproductive connectivity. Project objectives would not be met.

Alternative 2: Partial shallow water restoration

Restoration work completed under Alternative 2 would achieve restoration between 333 and 360 acres of reef habitat in Harris Creek depending on the degree of project implementation and further surveys of seed-only acreage. Alternative 2 represents the situation where unforeseen circumstances arise that prevents full restoration (Alternative 3). In the event that any issue arises that affects the degree of implementation, environmental benefits would still be achieved by any additional restoration completed and the restored acreage would add diversity and connectivity to the acreage already restored. However, the multi-agency Tributary Plan goal that maximizes restoration effort would not be achieved. This level of restoration would satisfy the goal to restore a minimum of 8% of historic habitat (278 acres) and would fulfill the restorable bottom goal (300–600 acres). This alternative would provide for some diversity and resiliency in the project design as well as increased reproductive connectivity and habitat. Alternative 2 would provide greater ecosystem benefits than Alternative 1. The tributary plan target would not be met. Project objectives would not be met. Alternative 2 would affect the navigational clearance in Harris Creek at proposed restoration sites. Implementation of any amount of shallow water reef habitat will reduce the water depth by 1 foot at the restoration site, thereby reducing the navigational clearance for boaters.

Alternative 3: Full shallow water restoration

Restoration efforts completed under Alternative 3 would achieve restoration of the full 377 acres targeted in the tributary plan in Harris Creek (or as close to the target as possible based on current surveys of suitable bottom). This level of restoration would satisfy the goal set to restore a minimum of 8% of historic habitat (278 acres) and the restorable bottom goal (300–600 acres). The tributary plan target would be met. Maximizing restoration effort in this first large-scale oyster restoration effort is important to provide the best foundation for long-term success and sustainability. This alternative would provide for maximum habitat restoration and thereby, maximize ecosystem benefits, resiliency, habitat diversity, and reproductive connectivity. Alternative 3 would affect the navigational clearance in Harris Creek to the greatest extent. The water depth would be reduced by 1 foot at 34 sites across 74 acres, thereby reducing the navigational clearance for boaters throughout Harris Creek.

Table 3 provides a summary of the alternatives evaluation.

3.4 Preferred Alternative

The preferred alternative is Alternative 3. This alternative is the only option that fulfills all goals, targets, and objectives. This alternative calls for maximum reef habitat restoration, which will provide for the greatest likelihood of achieving sustainability, provide the greatest ecosystem benefits, maximize diversity, resiliency, and reproduction potential. No other alternatives are capable of achieving the Tributary Plan target.

Table 4. Evaluation of Alternatives

Alternative	Alternative 1: No Action	Alternative 2: Partial shallow water restoration	Alternative 3: Full shallow water restoration
Meet proposed objective	N	N	Y
Meet both restoration goals set by Oyster Metrics Workgroup	N	Y	Y
Meet Tributary Plan Target	N	N	Y
Maximize diversity and resiliency in design	N	N	Y
Maximize reproductive connectivity	N	N	Y
Maximize ecosystem benefits	N	N	Y

3.5 Implementation

The tributary plan would be implemented by the USACE-Baltimore, NOAA, and MD DNR. USACE-Baltimore's role is to provide beneficial reef material and to place the substrate at discrete locations (Figure 2) in addition to mapping and surveying activities.

Combined restoration techniques for Harris Creek would be system-wide to aid in the rehabilitation of oyster habitat and the re-establishment of an abundant and self-sustaining population. The implementation timeframe would depend primarily on the availability of funds and resources such as materials for reef construction and seed. The total project costs are estimated at $31.7 million to be executed over a period of six years by multiple partners. Approximately $15.6 million of this figure is to purchase and place approximately 350,000 cubic yards of substrate material over 217 acres of the sanctuary. $15.7 million is for hatchery-produced seed (an estimated 2 billion larvae) and the placement of seed at constructed reef sites. The oyster seed costs are around $5,000 per million seed planted (Oyster Restoration Partnership July 2013). Purchasing and placing reef material (1,613 cubic yards per acre) 1-foot in height would cost approximately $84,000 per acre. Monitoring is estimated at a cost of $333,000 over 6 years. All material cost estimates are based on deploying granite; however, costs could be higher or lower depending on availability of other suitable materials such as mixed shell, fossilized oyster shell or reclaimed oyster shell. USACE-Baltimore plans to construct the shallow water habitat in Harris Creek in winter 2015 (using FY14 funds). This would complete alternate substrate reef construction in Harris Creek. Thus far, USACE-Baltimore has expended $5.64 million to construct 79 acres by placing 120,743 cy of granite/stone and mixed shell reef base. Costs would be close to that for the proposed 74 acres in shallow water. Both MD DNR and NOAA also anticipate contributing funds in future years for the seeding activities. The timeline for USACE-Baltimore to complete the shallow water work in 2015 is dependent upon available funding and the availability of suitable alternate substrate. If either of these are not available in the quantities needed to completed efforts in 2015, the remaining acreage would be completed in 2016.

4.0 AFFECTED ENVIRONMENT AND GENERAL EFFECTS

This section describes in more detail the relevant environmental areas that would likely be affected by implementing the alternatives in Section 3.0 including the proposed action. The affected environment is therefore the existing environmental conditions of the area forming the baseline from which each project alternative including the "no-action" alternative is evaluated. The relative severity of the environmental consequence accrued to the ecosystem is later discussed in Section 5 of this report forming the basis for the USACE Baltimore District decision making process.

The following documents are incorporated by reference in the report:

USACE 2009. Final Environmental Assessment and Finding of No Significant Impact: Chesapeake Bay Oyster Restoration Using Alternate Substrate Maryland. (Appendix F)

USACE. 2009. Final Programmatic Environmental Impact Statement for Oyster Restoration in Chesapeake Bay Including the Use of a Native and/or Nonnative Oyster. (http://www.nao.usace.army.mil/Portals/31/docs/civilworks/oysters/FinalPEISOysterRestoration.pdf)

USACE 2012. Chesapeake Bay Oyster Recovery: Native Oyster Restoration Master Plan, Maryland and Virginia. (http://www.nab.usace.army.mil/Missions/Environmental/OysterRestoration/OysterMasterPlan.aspx)

MIW 2013. Harris Creek Oyster Restoration Tributary Plan: A blueprint for sanctuary restoration. (Appendix A)

4.1 Physical Environment

4.1.1 Substrate

Physical substrate conditions and quality are important determinants of oyster recruitment and growth. In general, oysters survive best on bottoms that are firm, such as those of shell, rock, and firm or sticky mud (Kennedy 1991).

To determine the existing physical substrate conditions occurring within Harris Creek, seafloor conditions were mapped using sonar technology in conjunction with various ground-truthing methods. Within the sanctuary limits, data collected by MGS in the winter of 2009 and by the NOAA in 2011 identified existing bottom conditions, the quality of the bottom, and its ability to support restoration actions. In addition to establishing a baseline from which to evaluate restoration progress, hard substrates that will support the weight of the reef material must be identified for alternate substrate placement. Hard benthic habitat was defined as areas that, per the acoustic surveys, were found to have the Coastal and Marine Ecological Classification Standard (CMECS)[1] classifications of artificial reef, aggregate patch reef, fringe reef, patch reef, sand and scattered oyster shell, sandy mud, sand, and muddy sand. Survey results were then field verified with data collected by MD DNR patent tong surveys. Based on these spatially explicit data sets, areas suitable for seed-only restoration are classified as dense biogenic and anthropogenic oyster shell rubble. The results of the Harris Creek bottom mapping are provided in Appendix B. The results of the bottom classification were provided previously in Table 1 (NOAA 2011).

Bottom surface sediments tend to be primarily artificial reef, fringe reef, and mud. The finer sediments such as mud are found within the mainstem of the river channel, with sandier sediments toward the shoreline and oyster rubble. There are increasing amounts of sand and muddy sand near the mouth.

4.1.2 Sedimentation

Sedimentation is not only important to the growth rate in *C. virginica*, but to the species survival. Rates of high sedimentation can blanket oyster bars and other hard bottom sediments essentially smothering existing oyster communities and precluding free swimming larvae from finding suitable hard bottom habitat to settle on (USACE 2012). The high sedimentation rates have been shown by researchers to be a major contributing factor to the historic loss of biogenic reefs (Rothschild et al. 1994). It has also been hypothesized that siltation may be contributing to the susceptibility of the Eastern oyster to disease due to flattening of oyster bar profile (Rothschild et al. 1994). Thus the remaining low profile reefs existing today may be substantially poorer in quality and possibly suboptimal for adults or new recruits (Rothschild et al. 1994). USACE (2012) further discusses sedimentation and its negative impacts on oyster reefs.

Shell sedimentation in Harris Creek was investigated by Versar surveys in January 2012 and the Paynter Labs in January 2012. Sediment was classified as high, medium, or low on all existing oyster bars by the Versar survey. The results of these surveys were used to select restoration sites (Appendix A).

4.1.3 Water Depths and Circulation

Water depths in the sanctuary range from 1 to 32 feet MLLW. Harris Creek's central channel varies from 9.8 − 23.0 ft (3−7 m) (Figure 2). Channel water depths at the southern end of the sanctuary are shallower, ranging from approximately 12-16 ft. The greatest depth is mid-channel between Bald Eagle Point and Turkey Point. Bottom depths are shallower than 12 ft outside Dun Cove, but then increase northward to a maximum of 20 ft in the area adjacent to Indian Point. Above Indian Point there is an area where water depths are reduced to a maximum of 12 ft. Northward of there, is an area of deeper channel waters off Little Neck Point (18-23 feet), but typical depth of channel waters in the northern part of the sanctuary are 13-16 feet (Source: USACE-Regulatory Charts).

[1] A full definition of Chesapeake Bay-CMECS is provided in Appendix A.

Tides are semi-diurnal but sustained strong winds, both locally and over the Chesapeake Bay, affect tidal frequency and amplitude in the river. The tidal range is 1.2 ft (0.37 m). Harris Creek is considered a trap estuary. Trap estuaries by definition have strong retention and long residence times. Wazniak et al. (2009) determined Harris Creek to have an adjusted tidal prism flushing time of 4.26 days. Pre-restoration larval transport modeling projects that larvae produce in the Harris Creek sanctuary has the potential to enhance oyster populations in Harris Creek, as well as in the lower Choptank, Broad Creek, and the mouth of the Little Choptank River (North et al. 2009). Reefs in the southern and central portion of the sanctuary below Little Neck Point and Waterhole Cove performed best when rated on a number of larval transport parameters. These reefs rated highest for transport success, catching success, and self-recruitment and are projected to have the greatest potential to promote successful larval transport.

4.2 Physiochemical Environment

4.2.1 Water Quality

Harris Creek is included in the segment designated as the Choptank River mesohaline mouth 1 (CHOMH1) on Maryland's 303(d) list of impaired waters[2]. This segment is listed as a 303(d) waterbody for nutrients (nitrogen and phosphorus), total suspended sediment, and biological impairments (benthics). Salinity and DO were investigated in USACE (2012) using Chesapeake Bay Program data. Temperature is not a limiting factor in Harris Creek for oysters. Table 5 summarizes data collected by the Talbot River Protection Association at two sites between 2001 and 2005 to characterize local water quality conditions (http://talbotrivers.org/water.shtml). Upstream and downstream DO and pH typically met desired levels; upstream water clarity (secchi depth) and upstream and downstream nitrogen did not except for downstream water clarity which is highly variable. Downstream phosphorus (P) met targets, but upstream P exceeded targets in 2004 and 2005. Nitrogen (N) typically exceeds acceptable and desired targets.

Table 5. Local Water Quality Monitoring Data

	Average Water Quality Values		Water Quality Criteria	
	Monitoring Station		acceptable	desirable
	downstream	upstream		
pH	7.8	7.6	6.5 < pH < 8.5	7.0 < pH < 8.0
DO (mg/L)	8.2	7.8	5 < DO < 10	6 < DO < 10
Secchi Depth (ft)	4.6	2.4	>3 ft	> 6 ft
N (mg/L)	0.4	0.6	<0.24	<0.12
P (mg/L)	0.03	0.05	<0.05	<0.03

Harmful algal blooms resulting from *Prorocentrum minimum* and *Karlodinium veneficum* blooms have been documented in the Choptank River (Brownlee et al. 2005; Glibert et al. 2001),

[2] The 303(d) list is the list of impaired and threatened waters (stream/river segments, lakes) that the Clean Water Act requires all states to submit to the Environmental Protection Agency. The list identifies those waters where required pollution controls are not sufficient to attain or maintain applicable water quality standards.

but Harris Creek has not been identified to have significant algal bloom problems or susceptibilities.

4.2.2 Dissolved Oxygen

It has been shown that hypoxia can directly affect shellfish via reduced recruitment and survival (Breitburg 1992) and indirectly by altering community structure through predation or competition (Lenihan et al. 1998). Initial analysis performed for the Master Plan determined that DO levels (mg/L – milligrams per liter) were at suitable concentrations throughout Harris Creek. For bottom and surface DO levels, data was quarried from the Chesapeake Bay Program at the closest monitoring station (EE2.1) to Harris Creek. A minimum threshold was set at an average summer DO level greater than or equal to 5 mg/L needed to support oysters and reef community structure. The 5 mg/L concentration does not represent a specific tolerance level for oysters, but rather defines those areas where DO concentration is a limiting factor to habitat value and broader restoration outcomes.

4.2.3 Salinity and Temperature

Harris Creek is classified as a mesohaline system, partially to well-mixed with surface salinities ranging from 5—18 parts per thousand (ppt), with salinity stratification in the tributary varying seasonally. USACE (2012) established suitable salinity criteria for oyster restoration to be > 5 ppt for the average growing season, both for surface and bottom salinity. Harris Creek met these criteria. Selection of these criteria is discussed in USACE (2012).

The same salinity dataset used to investigate DO levels was also used to evaluate Harris Creek for the potential risk from freshets. The risk of freshets to oysters increases with proximity to the headwaters and typically is a greater concern for oysters in low salinity waters. Based on available Chesapeake Bay Program data, it was determined that freshets do not pose a great risk for Harris Creek oyster populations.

Temperature in Harris Creek is not a limiting factor for oyster populations (USACE 2012).

4.3 Biological Resources

4.3.1 Submerged Aquatic Vegetation

Submerged aquatic vegetation (SAV) habitat, as designated by the Chesapeake Bay Program, exists in Harris Creek. However, there were no SAV beds documented from 2006 through 2010 (VIMS 2012). In 2011, SAV beds were present, mainly in the upper creek.

4.3.2 Wetlands

Based on the National Wetlands Inventory data, there are 1,216 acres of wetlands in the Harris Creek watershed.

4.3.3 Benthic Macroinvertebrates

Benthic communities play a central role in the transfer of materials from the water column to higher levels in the food web. Much of the productivity of fisheries in the Chesapeake Bay is linked directly to benthos through feeding (Holland et al. 1987; Diaz and Schaffner 1990). In the

Chesapeake Bay, the distribution and kinds of benthic organisms (> 500 µm) are strongly correlated with salinity and are further influenced by the kind of sediment, patterns of DO, and other physical factors in a given location (Diaz and Schaffner 1990; Llansó et al. 2002). The variety and density of organisms generally increase with increasing salinity. Generally mesohaline (5–18 ppt) regions of the Bay such as the Tred Avon exhibit higher densities of bivalves (e.g., clams, oysters), except where low oxygen conditions prevail; segmented worms (i.e., polychaete annelids), small crustacea, and suspension-feeding bivalves (*Rangia cuneata*, *Macoma* spp.) dominate these areas. Suspension feeding polychaetes and tunicates are important contributors to biomass in high-salinity environments of the Bay.

The Chesapeake Bay benthic index of biotic integrity (B-IBI) was developed to assess benthic community health and environmental quality in the Chesapeake Bay. Large portions of the benthic habitat of the Bay is considered degraded. The B-IBI annual average score for the Choptank River complex (based on a score <=2.0 to >=3.0) meets the goal set by the CBP.

Oyster habitat is a unique feature of Bay benthic habitats. The bars and reefs themselves provide unique hard structure used by a diversity of macroinvertebrates (e.g., blue crabs and soft-bottom benthos) and fish.

4.3.3.1 Eastern Oysters

Historic eastern oyster resources in Harris Creek are discussed previously in Section 2.3.2. There are three legal natural oyster bars (NOBs) designated in Harris Creek that together cover nearly all the bottom: 9-12, 11-5, and 11-4 (Figure 2).

4.3.3.2 Clams

There are three clam species in the Maryland portion of the Chesapeake Bay that are or have been of commercial importance: the soft-shell clam, *Mya arenaria*, the stout razor clam, *Tagelus plebeius*, and the hard clam, *Mercenaria mercenaria* (MD DNR 2013). No clam surveys are available for Harris Creek. *Mya arenaria* and *Tagelus plebulus* have both been identified in the adjacent waters of the Choptank River, and are expected to be in the project area. Salinity is too low for *Mercenaria mercenaria* in Harris Creek which is largely absent from areas above the Manokin River, on the lower Eastern Shore of Maryland, due to salinity (MD DNR- M. Tarnowski, personal communication).

4.3.3.3 Phytoplankton

Phytoplankton provides food for oysters and small invertebrate animals called zooplankton, which in turn provide food for fish and other animals in the Bay. Anthropogenic nutrients and sediment that enter the Bay have fueled excessive phytoplankton production (eutrophication) and altered the system from one dominated by benthic production and SAV to one heavily influenced by pelagic (water column) processes (mainly phytoplankton production). Although food for oysters is plentiful under these conditions, failure of a reef to accrete shell because of overharvesting, disease, and other factors allows otherwise favorable substrate to become covered with sediment from either natural or anthropogenic sources, rendering it unsuitable for oyster habitat. Concomitant increased suspended sediments and loss of SAV further degrades quality of the Bay as habitat for oyster.

Oysters interact with the phytoplankton community both directly and indirectly. The primary interaction is direct: selective feeding reduces phytoplankton biomass and alters the species composition of the community. Many studies have demonstrated that benthic suspension feeders exert top-down control on phytoplankton production in freshwater, estuarine, and coastal waters (Cohen et al. 1984; Riemann et al. 1988; Cloern and Alpine 1991).

4.3.3.4 Zooplankton

Zooplankton communities in the freshwater and oligohaline regions of Chesapeake Bay are diverse, and their abundance and biomass are usually high. Abundance, biomass, and diversity are generally lower in the mesohaline and polyhaline zones, although high densities of larval polychaetes, mollusks, and decapods occur in specific areas. Zooplankton communities in the Chesapeake Bay act as the middle step between the very productive phytoplankton and bacteria at the bottom of the food chain and the many economically important species at higher levels in the food chain (i.e., trophic levels).

4.3.3.5 Blue crab

Mobile predators such as the blue crab produce strong direct effects of predation and disturbance on the benthic communities in Chesapeake Bay (Hines et al. 1990). The blue crab occupies a variety of aquatic habitats ranging from the mouth of the Bay to fresher rivers and creeks and occupies different trophic levels during various stages of its life cycle. The blue crab is an important predator of bivalves, such as young oysters, in the Bay. Although adult oysters are too large for blue crabs to open and prey upon (White and Wilson 1996), crabs do feed readily and opportunistically on juvenile oysters (Eggleston 1990). Oysters attain a partial refuge from predation at low densities (Eggleston 1990), but predation by blue crabs might increase with increasing oyster abundance.

4.3.4 Fish

Approximately 350 species of fish can be found in the Chesapeake Bay (CBP 2013a). The fishes of the Bay are either resident or migratory. Migratory fish fall into two categories: (1) anadromous fish, which spawn in the Bay or its tributaries (striped bass, shad, herring), and (2) catadromous (American eel) fish, which spawn in the ocean. Other migratory fish use the Bay strictly for feeding. Some species, like croaker, drum, menhaden, weakfish, and spot, journey into the Bay while still in their larval stage to take advantage of the rich supply of food. Bluefish generally enter the Bay as juveniles or adults.

Fish in the Bay can also be categorized as planktivorous (menhaden, bay anchovy, and early juvenile stages of all fish species), reef-oriented, or piscivorous. Planktivorous fish are a key part of the food web in Chesapeake Bay. They consume plankton, and are preyed upon by larger fishes such as striped bass and bluefish (piscivores). Because oysters also feed on some types of phytoplankton, and phytoplankton serve as a food source for zooplankton, the mechanism of interaction between oysters and planktivorous fishes would be through the food chain. The primary mechanism of interaction between oysters and planktivorous fish would be the potential to compete for food.

Oyster bars provide habitat for several species of fish (reef-oriented), many of which are important in commercial and recreational fisheries. Red drum and toadfish are two common and important reef inhabiting fish species. The naked goby resides on oyster bars throughout its juvenile and adult lifestages (Breitburg 1991) and is considered an exclusively reef-dwelling species. Black sea bass (Centropristis striata), which is considered to be a temperate reef fish, is found seasonally on oyster bars and other hard substrate and structures in the middle and lower Bay during warm months. Although black sea bass generally migrate to ocean waters during the winter, they are reef dependent for a significant portion of each year. A third category of reef-oriented fish includes species that use a variety of habitats but frequent hard-bottom habitat, such as oyster bars; the Atlantic croaker is an example of such reef-aggregating species.

4.3.5 Avifauna

Many avian piscivore species use the abundant fish populations of Chesapeake Bay as their primary food sources. Two of the species documented best in the literature are the bald eagle (*Haliaeetus leucocephalus*) and the North American osprey (*Pandion haliaetus*) both of which frequent and nest Harris Creek.

The black duck (*Anas rubripes*) is a good representative of a benthic-feeding avian species. Black ducks feed on a combination of plants and animals. They forage underwater by dabbling and upending. Their diet consists mainly of the seeds of grasses, sedges, pondweeds, and other aquatic vegetation. They will also readily eat snails, Baltic clams, ribbed mussels, and fish (Krementz 1991). Ribbed mussels are a common organism on restored or natural oyster reefs. Black ducks depend upon the condition of the bottom of the bays and wetlands in which they feed. Diving ducks such as canvasbacks (*Aythya valisineria*) depend totally on aquatic habitats throughout their life cycle. They feed on plants and animals in wetlands and shallow benthic habitats. At one time, canvasbacks in Chesapeake Bay consumed wild celery almost exclusively, but the decline in wild celery caused the species to shift its diet to small clams. As bottom feeders, canvasbacks are likely to be able to forage on and around many oyster bars.

Neither black ducks nor canvasback ducks, nor any of the other waterfowl known to inhabit Chesapeake Bay, feed directly on oysters to any significant extent; however, canvasbacks may feed on or around oyster bars.

<u>4.3.5.1 Avian Oyster Predators</u>

An important representative species of avian oyster predators is the American oystercatcher (*Haematopus palliates*). They consume oysters and other shellfish and have powerful, brightly colored bills that they use to open the shells of bivalves. Oystercatchers were once hunted almost to extinction but are now conspicuous shorebirds found throughout the Chesapeake Bay region. Oystercatchers are wading birds that forage primarily intertidally, and are therefore, not likely to have a significant impact on the proposed reefs.

Several studies have shown that a decrease in shellfish stocks negatively affects the oystercatcher population (Goss-Custard et al. 2003; Atkinson et al. 2003; Tuckwell and Nol 1997a). When the abundance of shellfish is low, the birds can survive on alternative prey species, but these species often do not enable the birds to maintain good body condition (Smit et al. 1998). Tuckwell and

Nol (1997b) showed that kleptoparasitism by other species (e.g., gulls) increases when oystercatchers are feeding on non-oyster shellfish.

4.3.6 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 04-267), requires all Federal agencies to consult with the National Marine Fisheries Service (NMFS) on all actions, or proposed actions, permitted, funded, or undertaken by the agency that may adversely affect essential fish habitat (EFH).

The 1996 amendments to the Magnuson-Stevens Fishery Act strengthened the ability of NMFS to "protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans" Essential fish habitat is defined in 50 Code of Federal Regulations (CFR) part 600 as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity."

Oyster reefs are important aquatic habitats. Many EFH species in the Chesapeake Bay rely on reef habitat and/or organisms that inhabit reef structure at some stage of their life histories. Some fish species breed, feed and shelter on oyster reefs entirely. These resident species serve, along with invertebrates, as food sources for transient species visiting oyster reefs.

4.3.6.1 Essential Fish Habitat Species in Study Area

Previous consultation with John Nichols, NMFS, (email February 9, 2009) as part of the 2009 *Chesapeake Bay Oyster Restoration Using Alternate Substrate, Maryland* Environmental Assessment determined that some areas of the Chesapeake Bay under consideration for oyster restoration in Maryland lie within the general area that may provide EFH for some of the species managed by NMFS. Species for which EFH is a concern are as follows: summer flounder (*Paralichthys dentatus*), juvenile and adult life stages; bluefish (*Pomatomus saltatrix*), juvenile and adult life stages; windowpane flounder (*Scopthalmus aquosus*), juvenile and adult life stages; cobia (*Rachycentron canadum*), all life stages; red drum (*Sciaenops ocellatus*), all life stages; king mackerel (*Scomberomorus cavalla*), all life stages; and Spanish mackerel (*Scomberomorus maculatus*) (National Marine Fisheries Service, Northeast Region, Habitat Conservation Division EFH web site; www.nero.nmfs.gov/ro/doc/hcd.htm).

Due to specific habitat needs, it is unlikely that cobia, king mackerel, or Spanish mackerel would be in the project area (Murdy et al., 1994). Cobia more commonly inhabits areas of higher salinity than would be found in most of the project area. Spanish mackerel are most abundant from the mouth of the Chesapeake Bay region to south Florida. They prefer polyhaline regions (18-30ppt) of the lower Bay. Finally, none of the life stages of king mackerel are typically found within the project area. As a result, the Harris Creek EFH analysis focused on bluefish, windowpane flounder, summer flounder, and red drum (Table 6). Focusing on these four species for the Harris Creek EFH assessment was confirmed in a phone conversation with David O'Brien, NMFS, on January 6, 2014.

Table 6. Summary of EFH considered in Harris Creek

Species	Eggs	Larvae	Juveniles	Adults
windowpane flounder (Scopthalmus aquosus)			M	M
bluefish (Pomatomus saltatrix)			M	M
summer flounder (Paralicthys dentatus)			M	M
red drum (Sciaenops occelatus)	X	X	X	X

S º The EFH designation for this species includes the seawater salinity zone of this bay or estuary (salinity > 25.0‰).
M º The EFH designation for this species includes the mixing water / brackish salinity zone of this bay or estuary (0.5 < salinity < 25.0‰).
F º The EFH designation for this species includes the tidal freshwater salinity zone of this bay or estuary (0.0 < salinity < 0.5‰).

4.3.7 Rare, Threatened, and Endangered Species

The Endangered Species Act (ESA) of 1973 (16 USC 1531-1543) regulates activities affecting plants and animals classified as endangered or threatened, as well as the designated critical habitat of such species. Prior coordination completed for the 2009 Alternate Substrate EA identified the potential presence of the following rare, threatened, and endangered species: the threatened loggerhead turtle (*Caretta caretta*), the endangered Kemp's ridley turtle (*Lepidochelys kempiz*), and the endangered leatherback turtle (*Dermochelys coriacea*). These species can occasionally move into the central and upper Chesapeake Bay during warm weather months. The Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*) may also be in the project area. The shortnose stugeon (*Acipenser brevirostrum)* has been listed for the entire Chesapeake Bay and its tributaries. Additionally, there are 9 animals and 15 plant species found in Talbot County on Maryland's rare, threatened, or endangered species list. Alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) were listed as species of concern under the Endangered Species Act (ESA) throughout all or a significant portion of their range or as specific distinct population segments (DPS) (NOAA 2013).

4.4 Community Setting

4.4.1 Land-Use

Talbot County is a predominately rural county located in the west-central portion of Maryland's Eastern Shore. Talbot County is approximately 171,000 acres in size; comprising farmland, forest, and wetlands (Talbot County 2005). The county has 600 miles of shoreline and 107.2 miles of stream features with the major tributaries being the Wye River, Miles River, Harris Creek, Broad Creek, the Tred Avon River and the Choptank River. Harris Creek contains a small drainage basin characterized by low topographic relief. Agriculture is the predominant land-use with some forested and developed areas. All of Talbot County's major watersheds are impaired for nutrients (i.e., nitrogen, phosphorus and/or other impairments).

4.4.2 Recreation

Public landings in the County offer boat ramps, mooring facilities, fishing and crabbing piers, picnic areas and parking facilities. Although public landings provide waterfront access opportunity, most facilities are small in land area and limited in size.

4.4.2.1 Fishing

The Maryland portion of the Chesapeake Bay supports a significant recreational fishery. According to data available from the Maryland Saltwater Sportfishermen's Association, the value of recreational fishing is over $1 billion to the State's economy. The key species targeted in the lower reaches of the Choptank River complex are black seabass *(Centropristis ocyurus)*; bluefish (*Pomatomus saltatrix*); Atlantic croaker (*Micropogonias undulates*); spot (*Leiostomus xanthurus)*; weakfish (*Cynoscion regalis*); striped bass (*Morone saxatilis)*; summer flounder (*Paralichthys dentatus)*; perch (*Pomoxis annularis*); tautog (*Tautoga onitis)*; and on occasion, Yellowfin tuna (*Thunnus albacares*). Fishermen in Harris Creek may fish for a number of different species including striped bass, catfish and perch. They also use several different methods, including charter boats, private boats, or fishing from the shore. Numerous saltwater species enter the river to spawn in springtime, starting with catfish and perch in March and April, followed by croaker in April and May, and then both grey and speckled sea trout in the ensuing months. Many of the Chesapeake Bay's striped bass populations head up the mainstem of Chesapeake Bay to enter the tidal tributaries on their spring spawn run as well. Recreational crabbers are also found in Harris Creek.

There is no recreational oystering in the Bay, although many owners of shoreline property participate in oyster-rearing programs coordinated by the State of Maryland Grow Oysters program. Fish species supported by oyster communities are key elements in providing recreational opportunities. The value of oyster restoration to the local economy would be measured in terms of business sales, jobs and associated income. There is extensive recreational crabbing throughout Harris Creek.

4.4.2.2 Boating and Navigation

The geographic setting of Harris Creek is located in an area prominent in shipping activities since the earliest colonial times. Wharfs along Harris Creek are home to boatyards, marinas and boat repair facilities. Harris Creek is not used for commercial shipping, but is extensively used by recreational boaters and commercial watermen. Use by watermen between October 1 and March 31 (oyster season) has declined following Harris Creek's designation as an oyster sanctuary.

In addition to fishing, boaters participate in various other boating activities including cruising, entertaining/socializing, swimming, nature observation/sightseeing, waterskiing, tubing, racing, and other water-related activities. These boaters spend money in the community and in the process generate economic impacts for the local area.

MD DNR- Boating Service completed a Waterway Assessment Survey and Hydrographic Analysis as part of the USACE permitting process (Appendix D). There are 139 registered boats claiming 'primary use' of Harris Creek as reported by MD DNR's Licensing and Registration

(MD DNR 2013). MD DNR conducted a Waterway Phone Survey of a subset of boat owners to obtain information on boating use in Harris Creek. The average boat owner has transited Harris Creek for 23 years. Drafts were able to be determined from 109 of the 139 registered boats. The average draft is 2 ft, with a range of 0.5−5 ft. Of the boat owners surveyed, 4 transit Harris Creek daily, 27 weekly, and 16 monthly. Most use the waterway during the daytime.

There are two federally maintained navigation channels within proximity to the project area: Dogwood Harbor and Knapp's Narrows. Knapp's Narrows has greater commercial activity. As of 2012, Knapp's Narrows has a reported depth of 5 ft (MD DNR 2013), but is authorized to a depth of 9 ft. Dogwood Harbor has a reported depth of 7 ft (MD DNR 2013). The channel is very narrow from Knapp's Narrows into Harris Creek. Large power boats (30+ ft), including charter fishing vessels, use Dogwood Harbor and the channel (MD DNR 2013). Harris Creek has some coves that attract larger vessels, both power and sail boats, from around the Chesapeake Bay for recreation and/or shelter from storms. For example, Dun Cove is frequented by larger sailing vessels, as is Waterhole Cove (MD DNR 2013) (Figure 2).

As part of the development of the Harris Creek Tributary Plan, the U.S. Coast Guard (USCG) provided general guidance regarding the constraints for oyster restoration projects. The USCG recommended any restoration work be placed outside a 250-foot setback radius at all existing aids to navigation. This excludes placement of reef structures and work from occurring in those areas identified. Additionally, the USCG recommended oyster restoration actions be located a minimum 150 feet from any federally-maintained navigation channels. During development of the Harris Creek Tributary Plan exclusion of areas where aids to navigation are present reduced the total area of restorable bottom. Also, any site located within 250 feet of a marina was eliminated for safe ingress and egress of vessel traffic. For the MD DNR Harris Creek permit, the USCG advised that the concept of keeping structures and work outside the marked/established channels, i.e., between shoreline and existing aids to navigation in order to not interfere with existing waterway use, was the USCG standing position, and further they advised that where no established and maintained channel exists, establishment of oyster sanctuaries and reefs should be sited outside/shoreward of line segments extended between adjacent aids to navigation.

4.4.2.3 Waterfowl Hunting

The eastern shore of Maryland is an important stopover for many migratory waterfowl species along the Atlantic Flyway in addition to the home to numerous resident waterfowl. The Chesapeake Bay is located along the Atlantic flyway with the annual seasonal migration of millions of waterfowl to the Bay. About 1 million swans, geese and ducks winter on the Bay (USFWS 2013). Four categories of waterfowl inhabit the Chesapeake Bay: dabbling ducks, diving ducks, geese, and swans. All four kinds depend on agricultural areas, bay bottom, and wetlands for food and nesting habitat.

Talbot County is steeped in a rich waterfowl hunting tradition and is an important wintering area for many targeted species of waterfowl. American black ducks, mallards, canvasbacks, and Canada geese are prized waterfowl species that frequent Harris Creek. Numerous professional guide services and outfitters are setup in the county providing services to local area residents and travelers to the region contributing economic revenue to the local economy and the State. The annual Waterfowl Festival is held in Easton which pays tribute to the deep roots of waterfowl hunting in the area's culture. The festival draws 18,000 to 20,000 visitors each year. Also, The Talbot County Ducks Unlimited Chapter is very active in the area conserving and restoring over 8,000 acres to date (DU 2013). According to the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, the average migratory bird hunter in Maryland spends $1,104 per year on hunting-related expenses. Of that $1,104, $299 is spent on hunting trip-related costs.

4.4.2.4 Swimming

Given the ongoing efforts to regulate and control pollutants and nutrients entering Harris Creek, the quality of swimming and opportunities for recreational swimming in the river may vary by tributary. The water quality of the Tred Avon is degraded by low oxygen, sediment, nutrients, fecal coliform and biological impairments. A Chesapeake Bay Foundation Report published in 2000 highlights the impact on public health in the Chesapeake Bay region due to the increased presence of several pollutants that pose threats to human health (CBF 2009). These include vibrio, cyanobacteria (blue green algae), cryptosporidium, mercury, and nitrates.

4.4.2.5 Wildlife Viewing

In addition to waterfowl viewing opportunities associated with Harris Creek's location in the Atlantic Flyway, the Chesapeake Bay Gateway Network connects visitors and locals to a network of trails including waterway trails in the vicinity of the project. There are community and neighborhood parks that provide public venues to view wildlife. There are no Federal, State or County designated parks for wildlife viewing along Harris Creek.

4.4.3 Air Quality

Talbot County is in attainment for all National Ambient Air Quality Standards (NAAQS) (carbon monoxide, lead, nitrogen dioxide, ozone, particle pollution, and sulfur dioxide).

4.4.4 Cultural and Historic Resources

The project, as a Federal undertaking, falls within the review requirements of the National Historic Preservation Act of 1966, as amended, and its implementing regulations 36 CFR, Part 800. These regulations require the USACE-Baltimore to identify, evaluate and mitigate impacts to National Register eligible or listed cultural resources prior to project initiation, in consultation with the appropriate State Historic Preservation Officer (SHPO), and at times, the Advisory Council on Historic Preservation (ACHP). Talbot County has numerous listings on the National Register for Maryland in addition to maintaining an active Historic Preservation Commission since 1976 (Talbot County 2005). Also, Section 101(b)(4) of NEPA requires Federal agencies to coordinate and plan their actions so as to preserve important historic, cultural, and natural aspects of the country's national heritage. Coordination with MHT concluded that although it is possible, it is unlikely that there are historic properties within the project area that could be impacted by proposed actions.

4.4.5 Hazardous, Toxic, and Radioactive Waste

The EPA EnviroFacts website was consulted to acquire a listing of Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) and

Resource Conservation Recovery Information System (RCRIS) sites within the project area. There are three identified sites along Harris Creek associated with hazardous and toxic waste. One site is listed for air emissions, a second site is listed with general Resource Conservation and Recovery Act (RCRA) information. A third site has been issued a general permit to discharge various wastes into the lower Choptank River.

4.4.6 Socioeconomic Conditions

The Talbot County population estimate for 2012 was 38,098 with the demographic makeup for the county as outlined in Table 7. According to the most recently adopted Comprehensive Plan for Talbot County (2005), the current and projected population and household data for 2000 to 2030 prepared by the Maryland Department of Planning shows that by 2030, the County's population would grow to 38,950 residents. Age distribution shows the largest cohort in 2000 to be individuals aged 20 to 44 years of age. The median age was 43.3 years compared to the statewide average of 36 years. In 2000, there were 1.36 jobs for every person in the labor force with 76.1% of employed residents working in the county. The total number of county jobs held by residents was 62%, with non-residents holding 38% of the jobs. The major economic sectors include services, retail trade, and manufacturing. The agriculture, fisheries, forestry, government, transportation, communication and public utilities sectors have decreased their share of total employment over the last three decades.

Table 7. Talbot County Demographics Census 2012

Demographic Group	Talbot County
White alone, percent, 2012 (a)	83.5%
Black or African American alone, percent, 2012 (a)	13.3%
American Indian and Alaska Native alone, percent, 2012 (a)	0.3%
Asian alone, percent, 2012 (a)	1.4%
Native Hawaiian and Other Pacific Islander alone, percent, 2012 (a)	0.1%
Two or More Races, percent, 2012	1.5%
Hispanic or Latino, percent, 2012 (b)	5.7%
White alone, not Hispanic or Latino, percent, 2012	78.8%

(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.

4.4.7 Visual and Aesthetic Resources

Low topographic relief and irregular shorelines characterize the eastern shore of the Chesapeake Bay and provide a general backdrop to Harris Creek. The river, creeks, birds, foliage and small historic towns characterizing Harris Creek offer residents and visitors many opportunities to view visual and aesthetic resources of the surrounding area. The historic watermen's communities and rural heritage offer an aesthetic charm and have contributed greatly to tourist-based industries in these areas. Traditional workboats operating in the area bring aesthetic appeal to the region as well as cultural value.

4.4.8 Public Health and Safety

One of the most important issues is the impact of water quality on public health, safety and welfare. Water quality is a fundamental problem facing most of the Chesapeake Bay and its oyster populations (CBF 2013). The 2012 report card by the Midshore Riverkeeper Conservancy (MRC) using volunteer monitoring data collected as various sites tributary-wide graded the river at an overall B rating for water clarity, dissolved oxygen, temperature, pH, salinity, nitrogen, phosphorus, and *chlorophyll a* (MRC 2012). However, the monitoring protocols used by MRC are not the same as those parameters used to screen Harris Creek as a candidate for large-scale oyster restoration and are a general measure used to assess water quality by the nonprofit.

Oyster harvesting is restricted in various areas by MDE for public health reasons, including areas with excessive coliform bacteria counts, and setbacks from marinas and municipal discharges. Through August 2013, Harris Creek had no areas within the sanctuary designated as State of Maryland Shellfish Closure Areas. There is one branch of Harris Creek upstream of the sanctuary that is restricted to harvests (MDE 2013).

4.4.9 Noise

The study area is open tidal waters of Harris Creek in depths ranging from a minus 6 to 9 feet depth contour in an area that includes residential buildings and marine waterfront centers. Estuarine shorelines abutting specific restoration site are characterized as predominately private homesteads with piers and other waterfront structures. Ambient noise levels are low, and typical of those found in rural tributaries with low-density development. While the background noise level for residents within the vicinity of the project area might typically be 40 dBA, a resident may also hear acute noise sources, particularly in the daytime, associated with suburban neighborhoods such as a power mower, which will generate 65-95 dBA at 50 ft or a leafblower (110 dBA at 50 ft). Residents living near the water would be sensitive to increased noise. Overwintering and resident waterfowl are also sensitive to certain activities such as in-water pile driving and dredging and many in-water construction activities are limited based on time of year restrictions set by the MD DNR.

The proposed oyster restoration actions would result in temporary construction noise associated with the initial reef build-out; however, BMPs will be employed to minimize the temporary noise impact during construction including: limiting work to daytime hours. Twin 375 horsepower diesel engines power the typical vessel used to construct oyster habitat. Cruising speeds are generally 12.7 knots.

4.4.10 Commercial Waterway Uses

4.4.10.1 Commercial Navigation

As described in Section 4.4.2.2, there are two federally maintained navigation channels within proximity to the project area. Commercial navigation includes charter boats and commercial watermen.

4.4.10.2 Commercial Fishing

Commercial species sought by Bay watermen include oysters, blue crabs, soft-shell clams, eels, and several species of finfish (among them striped bass, bluefish, menhaden, and perch). The 2012 annual totals for commercial landings in Maryland were 33,300.8 metric tons (73,414,971 lbs) generating $77,858,646 in revenue (NMFS 2012). Commercial oystering was an important industry in Harris Creek prior to its 2009 designation as a sanctuary. Commercial oystering continues in adjacent Broad Creek and the Choptank River. The history of commercial oyster harvests in the Chesapeake Bay is discussed in prior NEPA documents (USACE 2009; USACE 2012). Today areas outside of the State designated sanctuary limits (southern end of Harris Creek) are still commercially fished for oysters from September to April during the season. The dockside value of oysters landed in 2009 to 2010 was $4.4 million in Maryland (MD DNR 2013). Oysters and striped bass have traded places a few times over the last few decades for third- and fourth-most valuable Chesapeake Bay fisheries, behind blue crabs and Atlantic menhaden (NOAA). The total commercial blue crab landings for the Choptank River complex were 4.3 million pounds for calendar year 2008 (MD DNR 2005, NOAA/NMFS 2013). Annual commercial striped bass landings for the Choptank River were 33,532 lbs in 2004 (MD DNR 2005, NOAA/NFMS 2013).

Other shellfish of commercial significance in the Chesapeake Bay include the soft-shell clam (*Mya arenaria*), the hard-shell clam (*Mercenaria mercenaria*) and the blue crab (*Callinectes sapidus*). Commercial clamming is prohibited in oyster sanctuaries designated prior to 2009. For sanctuaries designated after 2009 (including Harris Creek), clammers must observe a 150 ft buffer around NOBs. There have been no commercial clam harvests reported in Harris Creek in recent years.

Annual commercial harvests of blue crabs from Chesapeake Bay averaged 73-million-pounds between 1968–2004. In 2007, the CBP documented that harvests had been approximately 60 million pounds in the prior years (CBP 2007), with Maryland harvests slightly higher than those in Virginia. Maryland harvests increased in 2010 and 2011. A target of 215 million spawning-age female crabs has been established and was surpassed in 2010. In all other years, the crab populations have been below the target, but above the threshold of 70 million (CBP 2013b).

4.4.10.3 Oyster Aquaculture

There are five active leases within the Harris Creek sanctuary based on information provided by MD DNR Shellfisheries Program (email provided by Katie Busch on January 2, 2014). Four are upstream of any proposed actions. The fifth is in Briary Cove.

4.4.11 Sea Level Rise and Climate Change

4.4.11.1 Project Sensitivity to Sea Level Rise

The ability of oysters to keep pace with sea level rise depends upon their capacity to grow upward from the bottom at a rate greater than the rate of sedimentation and find attachment sites above the pycnocline. Annual growth on reefs, 25 to 30 mm/yr (greater than 1 inch), restored in Maryland waters shows that oysters are capable of keeping pace with sea level rise in less saline waters (Paynter 2008). Results of a recent investigation by Rodriguez et al. (2014) suggest that intertidal reefs in North Carolina are capable of keeping pace with sea level rise through 2100.

4.4.11.2 Climate Change

Climate change has the potential to alter many of the conditions for oyster restoration projects proposed for Harris Creek by affecting temperature, salinity, rainfall, and carbon dioxide levels in the water column. One of the principal strategies in developing tributary-level restoration plans was to target initial restoration actions in tributaries that provide the greatest potential to allow for adaptation to climate change on behalf of the oyster. An overall salinity-based strategy to address disease and promote the development of disease resistance was integral to initial screening criteria. Harris Creek is a mesohaline salinity system and as such provides for the potential to develop disease resiliency in response to disease challenges. In addition to the salinity-based strategy, focusing ecological restoration tributary-wide is the strategy most likely to allow large populations of oysters to persist in the face of disease and other stressors.

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 Physical Environment

5.1.1 Substrate

USACE-Baltimore would physically construct reef habitat on 74 acres at 34 unique sites throughout the NOB limits by deploying substrate materials onto the seafloor thereby creating relief. The mean site area is 4 acres, but sizes range from 0.5 – 25.5 acres. Reef construction would occur only in depths ranging from minus 6 – 9 ft MLLW. The newly constructed bars would then be planted with hatchery-produced oyster spat-on-shell throughout the NOB in accordance with the tributary-level restoration plan. The underlying bottom hard substrate composition would be overlain with no more than 12 inches of alternate substrate, but would not otherwise change as a result of undertaking the proposed project and expansion into shallow water areas of the tributary. Rock (granite) or mixed shell is anticipated to be the most readily available substrate.

5.1.2 Sedimentation

Current sediment patterns will be altered by the construction of oyster reef habitat deployed on the existing river bottom. Turbidity levels would increase in the short-term due to temporary suspension during construction, which is expected to settle within a short-period of time. Any suspended matter will eventually settle out of the water column. Healthy oyster populations are anticipated to improve sediment condition in the long-term through filtration and the production of biodeposits.

5.1.3 Water Depth and Circulation

Restoration will result in a direct and permanent impact on water depth at restoration sites. Water depth above restored habitat will be reduced by 1 foot. Local water circulation is expected to be slightly altered following the addition of reef structure to the bottom, but no adverse impacts are anticipated.

5.2 Physiochemical Environment

5.2.1 Water Quality

Oysters once contributed significantly to maintaining water quality and aquatic habitat in the Chesapeake Bay ecosystem. Oysters both affect local water quality and are affected by water quality. Restoring oyster reef communities in Harris Creek is expected to provide a direct improvement to water quality in waters adjacent to restored reefs due to the filtration capacity of oysters. Oyster reef construction involves the placing of shells and/or alternative hard substrate (concrete, granite, limestone etc.) on the river bottom. This placement can result in temporary, local increases in turbidity. This increase is due to re-suspending recently settled sediments from the bottom where the materials are placed. This disruption is expected to be temporary and limited in extent. Background levels of local TSS are not expected to increase to levels that negatively impact fish, shellfish, SAV or other estuarine life due to the placement of reef base materials. Any alternate substrates used for restoration must be clean prior to going into the water; therefore, little material is expected to be washed off the materials as they are being lowered onto the bottom. Once on the bottom, the construction materials are expected to minimally lower TSS levels, even without oysters, due to the impermeable nature of the material, as opposed to open bay bottom, which is typically loose sediments of varying size from fine silts to coarse sands. Negative impacts to water quality are expected to be short-term and not significant by implementing the proposed action.

5.2.2 Dissolved Oxygen

Increasing existing oyster populations in Harris Creek as a result of undertaking the restoration project would remove DO from the water column through oyster respiration. However, oxygen-depleted conditions for other aquatic organisms in the water column are not expected as there is adequate DO in the tributary for all organisms. Rather oxygen improvements are anticipated due to removal of organic matter by oyster filtration that would otherwise decompose in the benthos and consume dissolved oxygen.

5.2.3 Salinity and Temperature

The proposed project will have no impact on salinity or temperature.

5.3 Biological Resources

5.3.1 Submerged Aquatic Vegetation

No adverse impacts to SAV are anticipated as a result of the proposed project. No SAV beds would be impacted as a result of undertaking this project since no SAV occurs in the vicinity of the restoration footprint. SAV is typically restricted to water depths shallower than 6 ft due to water clarity. Reef deployment would occur between 6–9 ft MLLW. Therefore, SAV is not likely to occur within the proposed project areas. Additionally, initial site selection withdrew areas containing SAV from the proposed project. Restoration sites located adjacent to where SAV typically occurs may require additional pre-construction ground-truthing for SAV prior to reef substrate deployment and seeding activities. Increased oyster filtration has the potential to improve water quality and lead to a moderate expansion of SAV habitat.

5.3.2 Wetlands

No wetlands would be impacted as a result of undertaking this project since no wetlands are in the vicinity of the project footprint.

5.3.3 Benthic Macroinvertebrates

Oyster habitat is a unique feature of Bay benthic habitats. The bars and reefs themselves provide hard structures used by a diversity of macroinvertebrates (e.g., blue crabs and soft-bottom benthos) and fish. Oyster reef establishment is expected to have positive benefits to adjacent benthic communities and their predators. Rodney and Paynter (2006) showed that the total macrofaunal abundance (free living macrofauna + fouling organisms) was an order of magnitude higher on restored bars compared to unrestored reefs. Further, many organisms that were significantly more abundant on restored reefs are also known to be important food items for several commercially and recreationally important finfish species.

As a result of constructing reef habitat in the sanctuary, benthic substrate would be permanently buried by the proposed reef structures. The proposed actions would lead to a permanent transformation of bare benthic bottom to reef habitat. However, this would be a conversion to a more historic condition when extensive oyster reef habitat existed in the Chesapeake Bay. Some benthic organisms would be smothered by construction. However, these species are plentiful in the study area. Motile species, would be temporarily displaced by construction activities.

5.3.3.1 Eastern Oysters

Recruitment, settlement, and growth of oysters in Harris Creek over time will increase the size of reef structures. Expanding restoration actions into shallower depths provides for the greatest likelihood of achieving sustainability, provides the greatest ecosystem benefits, and maximizes diversity, resiliency, and reproduction potential.

5.3.3.2 Clams

The major potential mechanisms for these species to interact with oysters are through competition for food and space. It is anticipated that as a result of undertaking the restoration work, direct competition for space could occur on a local scale if an increase in oyster populations causes an expansion of hard-bottom habitat over existing soft-bottom habitat. Increased competition between clams and oysters for food could result in a reduction in the abundance of infaunal bivalves (USACE 2012). However, the impact of competition for suitable bottom is expected to be minimal as clam species are not thought to be habitat limited. Areas not suitable for oysters in mud and silt bottoms would be available for colonization by clam species since the oyster restoration polygons have targeted hard substrates.

5.3.3.3 Phytoplankton

Since oysters feed primarily on phytoplankton they may compete for food with other filter-feeding invertebrates, planktivorous fish, and zooplankton (Kennedy et al. 1996; NRC 2004). The extent of such competition resulting from restoration outcome depends on the food preferences of the competing species; moreover, significant competition is likely to occur only when the concentration of phytoplankton in the water is low in relation to the number of consumers. Currently, competition for phytoplankton is believed to be minimal because oyster numbers are low compared with their historical abundance and because nutrient input and the resultant production of phytoplankton are high (Newell 1988). Increasing oyster biomass in Harris Creek would likely result in greater cropping of phytoplankton populations through increased filtration thereby improving local water quality and reducing periods of anoxia. Expansion of restoration into shallower waters will expose more of the water column to the potential benefits of increase filtration by oysters.

5.3.3.4 Zooplankton

Using a simple quasi-equilibrium, mass-action model (Ulanowicz and Tuttle 1992), researchers have predicted that an increase in the abundance of oysters in the Bay would decrease phytoplankton productivity; the abundances of pelagic microbes, ctenophores, and medusae; and particulate organic carbon. The model also predicted increases in benthic primary production and fish stocks. Many reef-dwelling benthic invertebrates produce planktonic larvae; therefore, oyster reefs might provide both sources of larvae and recruitment sites at the end of planktonic development (Harding 2001). The primary mechanism of interaction between oysters and the zooplankton community would be indirect, through competition for planktonic food. The impact of competition for food resulting from a successful restoration outcome is expected to be minimal.

5.3.3.5 Blue crab

Expanding oyster reef restoration into shallower habitats would directly benefit blue crab populations by providing valuable habitat, increasing their food supply, and provide habitat for blue crab prey species. An increase in the abundance of SAV resulting from increased filtration by oysters could enhance the blue crab population by providing more refuge for juvenile crabs.

5.3.5 Avifauna

The expansion of oyster restoration into shallow waters is expected to have a direct benefit on avian piscivore species (e.g. raptors), benthic-feeding species (e.g. Black Duck), and those such as oystercatchers that feed directly on oysters by providing additional foraging habitat.

5.3.6 Essential Fish Habitat

USACE has provided NFMS an EFH Assessment of the proposed project area. A response from NFMS was received on March 10, 2014. Provided the reefs are constructed between December and March, and at least 300 feet from SAV, no negative impacts to EFH or habitat area of particular concern (HAPC) are anticipated. The project has the potential to beneficially impact forage and/or shelter habitat since rehabilitated oyster bar habitat will provide a more productive area for forage and shelter for smaller species. It is expected that finfish abundance would be greater in addition to transient fish due to abundant benthic fish and decapods crustaceans.

5.3.7 Rare, Threatened, and Endangered Species

The proposed restoration sites are identical to sites for which MD DNR received a permit from USACE to construct. Therefore, USACE has made a no effect determination based on the ESA coordination undertaken as part of the USACE-Regulatory process to provide our non-federal partner, MD DNR, a permit for the proposed work. ESA coordination through the USACE-

Regulatory process determined that the proposed work would have no detrimental impacts to this resource.

5.4 Community Setting

5.4.1 Land Use
The proposed action will have no impact on land use.

5.4.2 Recreation

5.4.2.1 Fishing
There is a well recognized relationship of oyster three dimensional habitats to commercial and recreational fisheries and therefore the proposed action is expected to have a long-term benefit to recreational fishing. Any temporary disturbance on the waterway would be localized during reef placement and seeding actions.

5.4.2.2 Boating and Navigation
Impacts to boating and navigation were a prime focus of the USACE-Regulatory permitting process whereby MD DNR received a permit to construct the proposed restoration sites. Throughout the process, proposed restoration sites were reviewed for navigational conflicts. Any sites that posed a potential issue were removed or revised to avoid impacting navigation. USACE-Baltimore (Regulatory) has determined that the proposed work to expand into shallower areas of the sanctuary would not adversely affect general navigation as shown on the tributary plan since those areas of concern have been resolved. A Waterway Assessment was completed by MD DNR-Boating Services to advise this process. The average draft of registered boats is 2 ft with a maximum draft of 5 ft. Knapp's Narrows has a reported depth of 5 feet. The proposed work would not restrict navigational clearances in the location of substrate reefs past the maximum boat draft depth identified. The proposed work would not alter the water depths in any maintained navigational channel. At all other restoration locations, water clearance depths would be greater than 5 ft. Further, USCG recommended guidelines have been incorporated into site selection. Therefore, no reef-based obstructions to navigation are expected to occur within Harris Creek. Additionally for purposes of updating federal navigation charts, USACE will coordinate the as-built surveys with NOAA's Marine Chart Division of constructed reefs sites.

5.4.2.3 Waterfowl Hunting
A decline in environmental quality of Harris Creek if continued could have negative impacts to waterfowl hunting opportunities. There is the potential for waterfowl hunting to be enhanced with restoration of additional oyster reef habitat that would provide further foraging habitat for hunted avian species. Further, any beneficial impacts to SAV from oyster restoration would provide for increased numbers of ducks, including canvasback and red head ducks which feed on SAV.

5.4.2.4 Swimming
Expanding oyster restoration into shallower water depths is expected to improve local water quality which may lead to better opportunities for recreational swimming due to fewer toxic

blooms and hypoxic events. In addition, restoration work in shallower depths may improve water quality in neighboring areas where people swim along the adjacent shorelines.

5.4.2.5 Wildlife viewing

As a result of undertaking the proposed project, a minor temporary disruption to wildlife viewing may occur during reef placement at specific sites, but it is anticipated upon project completion that oyster restoration efforts would provide better opportunities for wildlife viewing in the small tributaries throughout Harris Creek. Building elevated reefs would provide three-dimensional structures that act as shelters and breeding grounds for fish, crabs, and scores of other aquatic wildlife. It is possible that an increase in aquatic ecosystem health would result in greater opportunities for wildlife viewing.

5.4.3 Air Quality

No negative impacts are expected to air quality since Talbot County is in attainment for all NAAQS.

5.4.4 Cultural and Historic Resources

Coordination with the Maryland Historical Trust (MHT) (the SHPO) has occurred since the inception of the Chesapeake Bay Oyster Recovery Project (1996). Through previous coordination (letter dated 2 December 1995), MHT screened NOBs in a number of Maryland rivers (including Harris Creek and the Choptank River) and provided a list of recommended areas that should be avoided due to known or suspected historical resources. Further coordination completed for the 2009 EA identified no additional concerns. No NOBs in Harris Creek have been flagged as areas of potential concern. Future investigations could become necessary if sensitive areas are selected for oyster recovery actions with the potential to affect significant cultural resources.

Additionally, the MHT provided comments to USACE-Regulatory as part of the MD DNR permitting process for shallow water oyster restoration in Harris Creek which covered the same area as this EA. In a comment provided on January 25, 2013, MHT stated that the vast majority of the areas in the currently proposed undertaking were reviewed by MHT as part of the original authorization. Historic wharves, shipwrecks and other archeological sites may be contained within the polygons and no systematic archeological surveys have been conducted in Harris Creek. Therefore MHT believes it is possible, albeit unlikely, that historic properties could be impacted. Further, the harvesting activity that occurred on the NOBs for well over a century included regular disturbance of the bottom by oyster fishing gear, which scrapes the bottom to a depth of up to six inches below the sediment surface. This makes the presence of cultural resources within these polygons unlikely, as these areas were regularly disturbed in a fashion similar to a farmer plowing a field. If any potential cultural resources (i.e. objects such as structural timbers, rigging, machinery, and glass, ceramic, and/or metal artifacts that could indicate the presence of a historic shipwreck, or other historic archeological site) are identified all bottom disturbing activities must immediately cease and MHT must be notified within 48 hours of the discovery.

Oyster reef construction has the potential to affect underwater historic and/or archeological resources; however, the proposed actions and alternatives do not impact any such resources since there are no documented and/or undocumented historical and/or archeological properties including shipwrecks in the vicinity of any restoration polygon. Placing 1-foot of relief through the tributary at identified reef placement sites would not compromise the structure integrity of the bottom of any potential historical or archeological site. The proposed reef structures would not be visible from the waterway and "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion" would not be affected by this undertaking.

5.4.4 Hazardous, Toxic, and Radioactive Waste

The proposed action will have no impact on CERCLIS or RCRA sites within Harris Creek.

5.4.6 Socioeconomic Conditions

No impacts are expected to socioeconomic conditions in Talbot County from the proposed project.

5.4.7 Visual and Aesthetic Resources

No detrimental or beneficial impacts to aesthetic resources are expected to occur as a result of undertaking the proposed oyster restoration project. Reef construction and seeding activities would involve waterway vessel equipment including operation of an onboard crane which would be visible from the waterway and abutting shorelines. A typical oyster restoration vessel is 60-feet long with a beam width of 19-feet which draws 3.5- to 5-feet of water. The vessel is used to transport and place hatchery-produced seed oysters onto designated sanctuary sites. The vessel also carries oyster shell and other alternate materials for reef construction. A 4,000 pound crane is onboard to deploy material. Twin 375 horsepower diesel engines power the vessel. Cruising speeds are generally 12.7 knots. The extent and perception of the aesthetic alteration would vary depending upon the nature of the surrounding area and the values of the public using the waterway. Following completion of restoration actions, there would be no changes to the existing visual or aesthetic resources.

5.4.8 Public Health and Safety

The proposed project would have no negative impacts on public health and safety. Expansion of oyster restoration into shallow waters is anticipated to provide a positive impact to water quality, at least in the vicinity of restored reefs.

5.4.9 Noise

Noise would increase in the immediate vicinity of restoration work during placement of substrate and spat-on-shell. No work would occur at night. It is not anticipated that the proposed project would result in ambient noise levels outside those noise levels already experienced on the waterway. Following completion of restoration actions, there would be no impacts to noise levels.

5.4.10 Commercial Waterway Uses

5.4.10.1 Commercial Navigation

As described in Section 5.4.2.2, navigation impacts were thoroughly considered through the USACE-Regulatory permitting process whereby MD DNR received a permit to construct the proposed restoration sites. Areas of potential conflict with navigational interests were removed from consideration for restoration during the permitting process. No negative impacts are expected for commercial navigation from expansion of oyster restoration into shallower water depths.

5.4.10.2 Commercial Fishing

No negative impacts are anticipated to commercial fishing of finfish, eels, or clams by expanding oyster restoration into water depths between 6–9 ft MLLW. Throughout public coordination for Harris Creek restoration work, commercial crabbers identified a concern that alternate substrate reefs posed a problem for crabbing with trotlines and could lead to a negative impact on that industry. Crabbers were asked to provide input on site selection. Large stone was identified as posing the greatest problem for trotliners. To minimize this impact, mixed shell has been utilized to the maximum extent possible for reef restoration. To incorporate limited amounts of mixed shell into reef design and still achieve desired reef height, many sites are planned to receive a base of stone with shell placed on top to prevent trotlines from snagging. Commercial clamming operations are not permitted within the areas proposed for oyster restoration.

5.4.10.3 Oyster Aquaculture

None of the active leases overlap with sites proposed for restoration. Future lease applications will be screened by MD DNR for conflicts with restored oyster reef habitat.

5.4.11 Sea Level Rise and Climate Change

The specific risk from climate change and the influence those impacts may have on restoration outcomes is uncertain at this time. Scientist at the CBP are working to understand the possible effects of climate change on the Chesapeake Bay and its watersheds, including how these changes may affect oyster restoration efforts. Relative sea-level-rise, increasing temperatures, changes in species distribution, and altered water chemistry are likely to produce both positive and negative benefits to oysters and expected ecosystem services. USACE (2012) discusses potential climate change-driven impacts to Chesapeake Bay resources. The reefs restored in accordance with the Master Plan (USACE 2012) are anticipated to be capable of growing vertically and keeping pace with sea level rise in Harris Creek; however, monitoring as scheduled will confirm that accretion and reef growth is occurring at a pace that is positive in the face of climate-driven effects. In the event that reefs are not keeping pace with sea level rise or are being negatively impacted by other climate change related alterations, adaptive management measures will be taken. These measures would likely consist of adding spat-on-shell plantings to the reef to increase height, add carbonate to the system, and add broodstock. However, in more extreme cases, alternate substrate could also be added to provide elevation. Table 8 summarizes the potential climate change impacts to oysters.

Table 8. Potential Climate Change Impacts to Oyster Resources

Parameter	Potential Climate Change Alteration	Impact to Oysters	
Temperature	Higher winter temperatures	longer growing season would increase productivity, growth rates, size, reduce time to maturity	positive
	Higher water temperatures	decrease oxygen in water, reduce habitat	negative
	Higher year round temperatures	increase disease pressure	negative
		reduce surface freezing could expand intertidal habitat	positive
Salinity	Increase	higher reproduction/growth	positive
		higher disease pressure	negative
		expanded habitat	positive
	Decrease (localized)	reduced habitat	negative
		lower reproduction/growth	negative
		lower disease pressure	positive
Rainfall	Increased freshwater runoff from more extreme storms	stronger stratification would reduce oxygen levels in deep waters	negative
		decrease salinity	negative and positive
		reduced habitat	negative
Carbon dioxide levels in the water column	Increase – leading to acidification	increase the dissolution of shell reefs; reduce oyster's ability to form shell	negative
Sea level rise	Increase	Current information suggests that oyster growth in Maryland will be sufficient to keep pace with sea level rise	negligible

Alterations in Harris Creek would be expected to be similar to those that occur Bay-wide. However, the cumulative impacts resulting from sea-level rise, temperature variability, extreme weather and precipitation, and acidification are unknown.

Table 9 summarizes the impacts presented in Section 5.

Table 9. Summary of potential project impacts

Resource	Alternative 1	Alternative 2	Alternative 3
Land Use	No impact	No impact	No impact
Substrate	No impact	The substrate of all restored areas (59–67 acres) will be permanently converted from hard sediment to reef by placement of alternate substrate.	The substrate of 74 acres will be permanently converted from hard sediment to reef by placement of alternate substrate.
Sediment	No impact	Positive impacts anticipated over long-term through oyster filtration and the production of biodeposits. Restoration actions likely will cause a negative, but short-term increase in turbidity resulting from substrate placement.	Positive impacts anticipated over long-term through oyster filtration and the production of biodeposits. Restoration actions likely will cause a negative, but short-term increase in turbidity.
Water depth and circulation	No impact	Water depth at 59–67 acres will be reduced by up to 1 ft with substrate placement, but will not negatively impact other resources. With the introduction of reef structure, local circulation is to be altered, likely with positive benefits to oysters.	Water depth of 74 acres will be reduced by up to 1 ft with substrate placement, but will not negatively impact other resources. With the introduction of reef structure, local circulation is to be altered, likely with positive benefits to oysters.
Environmental Conditions	No impact	Overall, with the restoration of oysters in the proposed project site, environmental conditions will benefit from improved water quality and fish habitat.	Overall, with the restoration of oysters in the proposed project site, environmental conditions will benefit with improved water quality and fish habitat
Air Quality	No impact	No impact	No Impact
Social and Economic Setting	No impact	Recreational and commercial fishing of finfish and shellfish will be temporarily disrupted by restoration actions. Efforts have been taken to minimize any potential negative impacts to commercial crabbers. Recreational fishing and commercial fishing of finfish is anticipated to be positively impacted.	Recreational and commercial fishing of finfish and shellfish will be temporarily disrupted by restoration actions. Efforts have been taken to minimize any potential negative impacts to commercial crabbers. Recreational fishing and commercial fishing of finfish is anticipated to be positively impacted.
Boating and Navigation	No impact	No negative impacts anticipated as potential conflicts have been extensively reviewed and incorporated into proposed plans.	No negative impacts anticipated as potential conflicts have been extensively reviewed and incorporated into proposed plans.

Resource	Alternative 1	Alternative 2	Alternative 3
Water Quality	No impact	A temporary increase in turbidity within the water column is expected during placement of alternate material. Long-term impacts to water quality are expected to be positive including nutrient concentrations, sediment, and DO. No impact on salinity or temperature.	A temporary increase in turbidity within the water column is expected during placement of alternate material. Long-term impacts to water quality are expected to be positive including nutrient concentrations, sediment, and DO. No impact on salinity or temperature.
Biological Resources	No impact	Indirect and direct, positive benefits expected, particularly to benthic macroinvertebrates and blue crabs.	Indirect and direct, positive benefits expected, particularly to benthic macroinvertebrates and blue crabs.
Plankton	No impact	The impact of competition for food is expected to be minimal. Oysters will remove phytoplankton from the water column. Reef sites expected to provide recruitment sites for some larval life stages.	The impact of competition for food is expected to be minimal. Oysters will remove phytoplankton from the water column. Reef sites expected to provide recruitment sites for some larval life stages.
Fisheries	No impact	Positive, direct impacts	Positive, direct impacts
Vegetation	No impact	No negative impacts anticipated to SAV. Potential for indirect, positive impacts.	No negative impacts anticipated to SAV. Potential for indirect, positive impacts.
Rare, Threatened, and Endangered Species	No impact	No anticipated impact	No anticipated impact
Wetlands	No impact	No impact	No impact
Essential Fish Habitat	No impact	No significant negative impacts anticipated. Positive impacts to some species anticipated.	No significant negative impacts anticipated. Positive impacts to some species anticipated.
Hazardous, Toxic, and Radioactive Waste	No impact	No impact	No impact
Noise	No impact	Minimal, short-term impacts. Following construction, ambient noise levels not expected to be outside those noise levels already experienced on the waterway.	Minimal, short-term impacts. Following construction, ambient noise levels not expected to be outside those noise levels already experienced on the waterway.
Environmental Justice	No impact	No impact	No impact

6.0 CUMULATIVE EFFECTS ANALYSIS

Cumulatively, expanding oyster restoration into shallow water depths is expected to have a positive, direct impact on the Harris Creek ecosystem. The proposed work is a part of the broader Harris Creek Oyster Restoration Tributary Plan. Since 2012, USACE-Baltimore has constructed 79 acres of 1-foot high oyster reef using alternate substrates, primarily mixed shell and granite. Reefs restored, thus far, by USACE-Baltimore are consistent with existing NEPA documentation for the Oyster Recovery Project due to being at water depths greater than 9 feet. Restoration partners have also seeded 133 acres resulting in restoration of 212 acres of the 377 target (56%). There are 136 acres of shallow water reef habitat being planned including work by MD DNR and work proposed here by USACE-Baltimore. Along with the oyster restoration work, monitoring efforts of oyster habitat and water quality are being planned and implemented by USACE, NOAA, and MDNR. NOAA is funding coordinated research to investigate the reef ecosystem services such as the nitrogen removal potential of restored oyster reefs and finfish fish utilization of the expanded habitat network. USACE is performing further work with the University of Maryland to better understand larval transport and enhancement of oyster resources in adjacent non-restored areas. NOAA has previously completed seafloor mapping and analysis to support Harris Creek oyster reef restoration.

In May 2014, NOAA designated the Choptank River complex in Maryland and Delaware, which includes Harris Creek, as one of two Habitat Focus Areas under their Habitat Blueprint. The Habitat Blueprint is NOAA's strategy to integrate habitat conservation throughout their agency, focus efforts in priority areas, and leverage internal and external collaborations to achieve measureable benefits within key habitats (NOAA 2014). It enables them to prioritize long-term habitat science and conservation efforts in selected areas. NOAA will be developing an implementation plan for the area. The intent is the successfully protect and restore the ecological health of the watershed.

Cumulatively, the coordinated large-scale oyster restoration work along with the designation of the Choptank Complex as a Habitat Focus Area is projected to have significant positive benefits on the oyster resources in the region, and the Harris Creek and lower Choptank ecosystem. Broad ecosystem services as discussed in Section 3.2 are expected to be re-established or greatly enhanced due to the concerted efforts. The restoration of expansive habitat should provide a connected network of reef habitat to a large-scale that does not exist elsewhere in Maryland waters of the Chesapeake Bay. This network will provide foraging and refuge habitat for a diverse assemblage of fish and estuarine fauna.

Other projects that need to be considered along with oyster restoration are SAV restoration, shoreline stabilization efforts, watershed management, and various efforts to improve water quality. A number of local efforts are being undertaken to support the Chesapeake Bay Restoration and Protection Executive Order 13508, and the nutrient reduction goals established in the Chesapeake Bay TMDL that will help address water quality issues. The Executive Order goals targeting water quality, habitat, and fish and wildlife and the efforts of the various GITs are directly related to achieving oyster restoration goals. Opportunities to match oyster restoration efforts, spatially and temporally, with land management projects are anticipated as a result of implementing specific watershed improvement plans for the county under these mandates. The oyster restoration work being undertaken by the USACE and its partners will further support these TMDL efforts by improving local water quality within Harris Creek.

The location of oyster bars adjacent to other estuarine habitats such as shorelines and SAV has the potential to provide cumulative benefits to these habitats and the Harris Creek system. SAV beds have the potential to benefit oyster habitat by trapping suspended sediments in the water column thus reducing the potential siltation of reef habitat and turbidity in the water affecting free-swimming larvae. SAV and oysters both positively impact local water quality which in turn benefits the entire estuarine ecosystem. SAV is known to benefit from the presence of oyster reefs, which dampen wave energy (Turner et al. 1999; Heiss and Bortone 1999). There is the potential for SAV to increase once large-scale oyster restoration is complete due to water quality improvements.

In addition, groups like MRC and other nonprofits are working with landowners to reduce pollution from agricultural related land-uses that dominate the watershed through programs such as the State of Maryland's cover-crop program. Undertaking the proposed restoration in the sanctuary may provide improved water quality conditions; however, threats from sewage and bacteria may present concerns outside sanctuary limits. There is an important relationship between water quality and oyster restoration. Although watershed development plays a large role, water quality has declined precipitously as oyster populations continue to decline. The State of Maryland is actively targeting fecal bacteria seeped from sewage and septic tank leaks, pet waste and boats. It is anticipated that collective actions undertaken by the federal, state, and local governments in addition to actions by environmental nonprofits and through citizen engagement would improve public health and safety in project areas tributary-wide.

7.0 ENVIRONMENTAL COMPLIANCE

In addition to the environmental impacts discussed in this EA, a review of the proposed action has been made with regard to other potential areas of concern. Environmental compliance was fulfilled through a number of avenues. Coordination through past NEPA documents for oyster restoration was built upon for this supplemental EA. Table 10 summarizes the compliance status of the proposed project.

7.1 Clean Water Act

Due to the expected impacts, a 404(b)(1) evaluation of the proposed project on waters of the United States was performed pursuant to the guidelines promulgated by the Administrator, U.S. EPA., under authority of Section 404 of the Clean Water Act. A report of that evaluation can be found in Appendix E. All proposed work will be completed under the purview of the Section 401 Water Quality Certification for Wetlands License 12-WL-1231 acquired by MD DNR through the USACE-Regulatory permitting process. This certificate is provided in Appendix C.

7.2 Coastal Zone Management Act

Through the USACE-Regulatory process, MD DNR received Wetlands License 12-WL-1231. That license states that the Maryland Department of the Environment determined that the proposed activities comply with, and will be conducted in a manner consistent with, the State's Coastal Zone Management Program, as required by Section 307 of the Federal Coastal Zone Management Act of 1972, as amended.

7.3 Endangered Species Act

Endangered Species Act coordination was fulfilled by the actions completed as part of the USACE-Regulatory permitting process undertaken by MD DNR. Additionally, no rare, threatened, or endangered species under the purview of FWS were identified in the project area in a preliminary Endangered Species Act species list generated using FWS's Information, Planning, and Conservation decision support system. This was communicated to FWS in a letter dated December 19, 2013. For those resources under the purview of NOAA, USACE has made a no effect determination based on 1) previous NOAA input (email from Julie Crocker as part of 2009 EA), and 2) the ESA coordination undertaken as part of the USACE-Regulatory process to provide our non-federal partner, MD DNR, a permit for the proposed work.

7.4 Fish and Wildlife Coordination Act

Coordination for Section 7 of the ESA and Fish and Wildlife Coordination Act were initiated by a letter sent to USFWS December 19, 2013. A formal letter stating full compliance with FWCA and FWS support for the project was received on February 11, 2014.

7.5 Magnuson-Stevens Act (Essential Fish Habitat)

EFH coordination was continued from prior coordination via email sent to NMFS on January 6, 2014. Based on this coordination an EFH assessment was completed (Appendix F) and was submitted to NMFS for review and approval. A letter documenting NFMS's concurrence was received on March 10, 2014.

8.0 PUBLIC INVOLVEMENT AND AGENCY COORDINATION

8.1 Public Involvement

Public involvement was initiated with an open house held in St. Michaels, MD on March 21, 2012. The intent of the open house was to present initial oyster restoration plans for Harris Creek to the public and solicit public input to incorporate into plan revisions. There were 39 registered attendees. Comments received focused largely on coordinating efforts with the Marylanders Grow Oysters program and local pier/waterway use. Public input was also solicited through a public hearing held by USACE-Regulatory within the MD DNR permitting process. Comments from both the open house and public hearing are provided in Appendix G. The draft EA underwent public review from March 20- April 21, 2014 following internal USACE reviews. The availability of the draft supplemental EA for public review was published in the Star Democrat, a daily newspaper printed and published in the City of Easton, County of Talbot County, MD. The draft supplemental EA was made available on the project's website: http://www.nab.usace.army.mil/Missions/Environmental/OysterRestoration.aspx. Public notice announcements were posted three times to social media outlets, including Facebook, Twitter, and Google+ on March 20 at 12 p.m., April 2 at 10 a.m., and April 15 at 3 p.m. Between all postings, it is estimated that the content reached approximately 300 individuals. No public comments were received.

8.2 Agency Coordination

Agency coordination letters and correspondence are provided in Appendix G and summarized in Section 7. In addition, coordination with USCG was undertaken throughout development of the Harris Creek Tributary Plan and through the USACE-Regulatory permitting process for MD DNR.

Table 10. Compliance of the Proposed Action with Environmental Protection Statutes and Other Environmental Requirements

Federal Statutes	Level of Compliance[1]
Archeological and Historic Preservation Act	Full
Clean Air Act	Full
Clean Water Act	Full
Coastal Barrier Resources Act	N/A
Coastal Zone Management Act	Full
Comprehensive Environmental Response, Compensation and Liability Act	N/A
Endangered Species Act	Full
Estuary Protection Act	N/A
Farmland Protection Policy Act	N/A
Federal Water Project Recreation Act	N/A
Fish and Wildlife Coordination Act	Full
Land and Water Conservation Fund Act	N/A
Magnuson-Stevens Act	Full
Marine Mammal Protection Act	Full
Marine Protection, Research, and Sanctuaries Act	Full
National Historic Preservation Act	Full
National Environmental Policy Act	Full
Resource Conservation and Recovery Act	Full
Rivers and Harbors Act	Full
Water Resources Planning Act	Full
Watershed Protection and Flood Prevention Act	Full
Wild and Scenic Rivers Act	N/A
Executive Orders, Memoranda, etc.	
Migratory Bird (E.O. 13186)	Full
Protection and Enhancement of Environmental Quality (E.O. 11514)	Full
Protection and Enhancement of Cultural Environment (E.O. 11593)	Full
Floodplain Management (E.O. 11988)	Full
Protection of Wetlands (E.O. 11990)	Full
Prime and Unique Farmlands (CEQ Memorandum, 11 Aug 80)	N/A
Environmental Justice in Minority and Low-Income Populations (E.O. 12898)	Full
Protection of Children from Health Risks & Safety Risks (E. O. 13045)	Full
Chesapeake Bay Protection and Restoration (E.O. 13508)	Full
Invasive Species (E.O. 13112)	Full
Indian Sacred Sites (E.O. 13007)	Full
Stewardship of the Oceans, Our Coasts, and the Great Lakes (E.O. 13547)	Full
Facilitation of Cooperative Conservation (E.O. 13352)	Full

[1] Level of Compliance:
Full Compliance (Full): Having met all requirements of the statute, E.O., or other environmental requirements for the current stage of planning.
Non-Compliance (NC): Violation of a requirement of the statute, E.O., or other environmental requirement.
Not Applicable (N/A): No requirements for the statute, E.O., or other environmental requirement for the current stage of planning.

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