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NORFOLK HARBOR NAVIGATION IMPROVEMENTS

MEETING AREA VALIDATION REPORT AND SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

November 17, 2021

US Army Corps of Engineers ®

Norfolk District
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Virginia Port Authority
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COVER SHEET

Norfolk Harbor Navigation Improvements Meeting Areas Validation Report and Supplemental Environmental Assessment

LEAD AGENCY: **Department of the Army**
U.S. Army Corps of Engineers, Norfolk District

ABSTRACT:
The purpose of the Norfolk Harbor Navigation Improvements Meeting Areas Validation Report and Supplemental Environmental Assessment (Report/SEA) is to serve as a U.S. Army Corps of Engineers (USACE) Decision Document for the Norfolk Harbor Navigation Improvements Project at Norfolk, Virginia. Section 1403 of the Water Resources Development Act of 2020 authorizes the modification of the existing project. Per the WRDA 2020, additional widening of the Thimble Shoal Channel was authorized provided the modifications do not exceed the maximum 902 Cost limitations of the previously approved project.

Due to significant changes in the container fleet forecasts, an economic update was needed to reevaluate benefits and costs of two areas of widening adjacent to Thimble Shoal Channel on either side of the Chesapeake Bay Bridge Tunnel called Meeting Area 1 (MA1) and Meeting Area 2 (MA2).

The change in container fleet forecast also necessitated a re-evaluation of the project scope to include an additional project element, originally screened out in the GRR/EA due to lack of economic justification. The economic analysis in this report will seek to outline the fleet forecast changes, benefits analysis, project scope, cost increase, and demonstrate that the additional project area (Meeting Area 1) is economically justified as part of the National Economic Development (NED). MA2 is still justified with a new more robust Benefits-to-Cost Ratio.

Navigation concerns documented in the approved Norfolk Harbor Navigation Improvements General Reevaluation Report and Environmental Assessment (GRR/EA) in 2018 are still valid. Two of those primary concerns: limited channel depth causing navigation inefficiencies and limited channel width preventing safe meeting of vessels, continue to be applicable in relation to the Meeting Areas of the Thimble Shoal Channel (TSC).

The Preferred Alternative referred to as the Recommended Plan (RP) is the NED Plan which includes:

- Widening the TSC-West/Meeting Area 1 to 1,400 feet and deepening to a required depth of -56 feet for 5.1 statute miles;
- Reaffirm the economic justification at current price levels of widening the TSC-East/Meeting Area 2 to 1,300 feet wide and deepening to a required depth of -56 feet, as previously authorized.
- The RP includes construction and maintenance of these features. Dredged material placement could occur at the DNODS, the NODS, and the CIDMMA for this project. Portions of the dredged material may be suitable for beneficial use. Beneficial use projects are encouraged and would be coordinated separately from this project based on schedule and sponsor

availability. They must also be individually authorized for such use. General operation and maintenance of the CIDMMA would continue with or without implementation of the Preferred Alternative. The project construction began in 2020 and following construction, channel depths would be maintained over the 50-year lifecycle of the project.

EXECUTIVE SUMMARY

The results of engineering, economic, environmental, and real estate investigations performed for this Validation Report and Supplemental Environmental Assessment (Report/SEA) will determine Meeting Area 1's economic justification for inclusion as part of the Recommended Plan for the Federal project and reaffirm MA2's economic benefits at current price levels.

Section 1403 of the Water Resources Development Act of 2020 included a provision to authorize modifications to the Norfolk Harbor Navigations Improvements Project and for this Validation Study (Thimble Shoal Widening). Per the WRDA 2020, additional widening of the Thimble Shoal Channel was authorized provided the modifications do not exceed the maximum 902 Cost limitations of the previously approved project

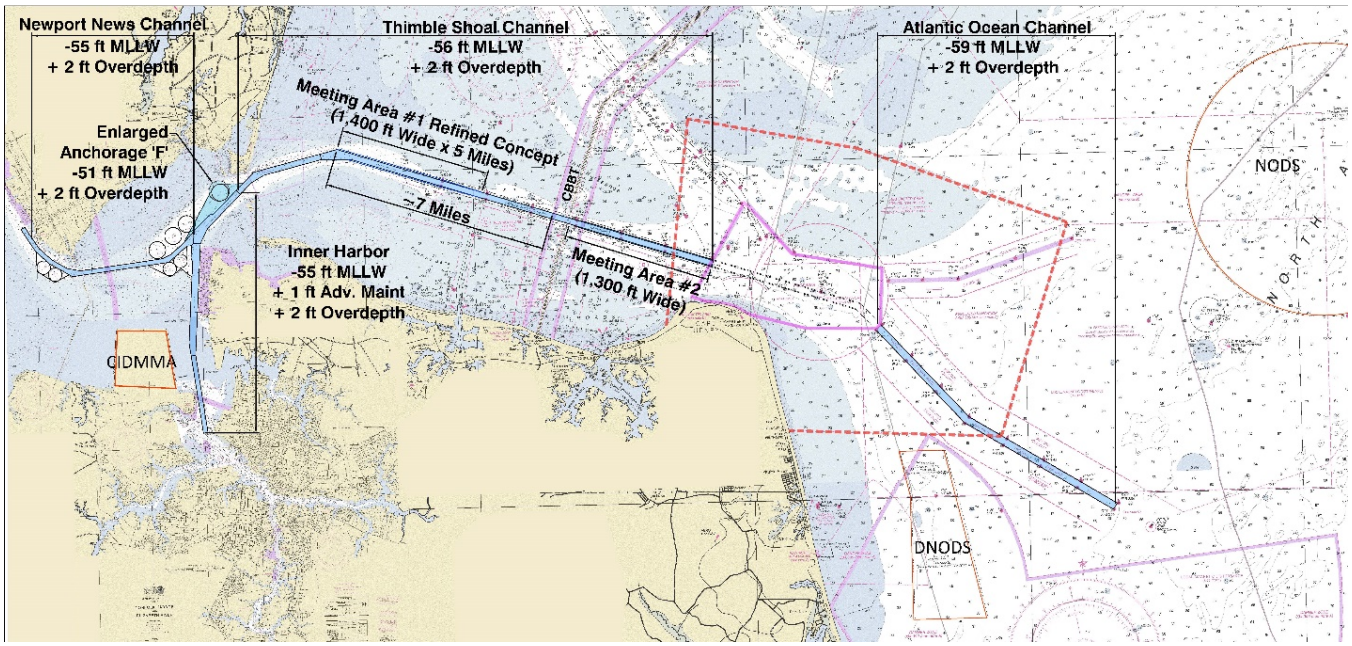

Figure 1: Meeting Area 1 and Meeting Area 2 Concept Map

DESCRIPTION OF REPORT

This Meeting Area Validation Report and Supplemental Environmental Assessment (Report/SEA) documents the Validation Study and the National Environmental Policy Act Evaluation for the inclusion of Meeting Area 1 and 2 in the National Economic Development Plan, and as part of the RP for the Norfolk Harbor Navigation Improvements General Reevaluation Report and Environmental Assessment (GRR/EA) approved by the Chief of Engineer's in October 2018. This process presents the results of investigations and analyses conducted to evaluate modifications to the existing Federal project to efficiently serve the current and future vessel fleet and process the forecasted cargo volumes. It presents: (1) a survey of existing and future conditions; (2) identifies the problems and opportunities; (3) continues to achieve the original objectives of the GRR/EA, (4) provides an evaluation of costs, benefits, adverse impacts, and feasibility; and, (5) identification of a National Economic Development (NED) Plan and Recommended Plan (RP) modifications.

PURPOSE AND NEED

The cargo transportation industry continues its shift to increased use of standardized containers used for multimodal (marine, rail, and truck) freight transportation systems. Additionally, the marine vessel fleet is trending to larger, deeper-draft vessels, particularly for containerships. Norfolk Harbor also serves as the location of Naval Station Norfolk, which supports the operational readiness of the U.S. Atlantic fleet. The existing dimensions of those channels place constraints on deeper-draft containerships, which result in reduced efficiency and increased costs.

The purpose of the Report/SEA is to provide an updated economic evaluation of two specific navigation elements, Meeting Areas 1 and 2 (also called the TSC-W widening and TSC-E widening, respectively) in the Norfolk Harbor.

The Report examines the National Economic Development (NED) benefits relative to the costs of both Meeting Area 1 (MA1) and Meeting Area 2 (MA2) to determine the average annual costs, benefits and benefit-to-cost ratio (BCR) at the FY2022 Federal Water Resources Discount Rate of 2.25% and the Office of Management and Budget (OMB) rate of 7%.

The need for this project arises from inefficiencies currently experienced by commercial vessels within the existing Norfolk Harbor. Industry adoption of larger vessels has necessitated periodic establishment of one-way traffic within channels that normally support two-way traffic. Compared to the forecast used during for the 2018 Norfolk Harbor and Channels Navigation Improvements General Reevaluation Report/Environmental Assessment (GRR/EA), ocean carriers have more rapidly transitioned to the ultra large container vessels than the forecast predicted, warranting a reassessment of Meeting Areas for two-way traffic.

Limited channel depth causing navigation inefficiencies and insufficient channel width not allowing safe meeting of vessels are two primary concerns. Larger ships currently experience transportation delays due to insufficient Federal channel depths. To reach port terminals, these larger ships experience delays and/or wait while Department of Defense (DoD) or commercial vessels transit the main channel. These approaches require the vessel operator to forego potential transportation cost savings available from the economies of scale associated with larger ships. Restrictive channel widths also limit ship passage to one-way traffic in many reaches.

RECOMMENDED PLAN

The Recommended Plan is the NED plan in the Report/SEA and includes:

- Widening the TSC-West/MA1 to 1,400 feet and deepening to a required depth of -56 feet for 5.1 statute miles;
- Reaffirm the economic justification at current price levels of widening the TSC-East/MA2 to 1,300 feet wide and deepening to a required depth of -56 feet, as previously authorized.
- The RP includes construction and maintenance of these features. Dredged material placement could occur at the DNODS, the NODS, and the CIDMMA for this project. Portions of the dredged material may be suitable for beneficial use. Beneficial use projects are encouraged and would be coordinated separately from this project based on schedule and sponsor availability. They must also be individually authorized for such use. General operation and maintenance of the CIDMMA would continue with or without implementation of the Preferred Alternative. The project construction began in 2020 and following construction, channel depths would be maintained over the 50-year lifecycle of the project.

COSTS AND BENEFITS

The same two design vessels were selected as used for the previous GRR/EA analysis. The fleet forecast was updated to determine benefit calculations using the HarborSym economic analysis model. The characteristics of the design vessels were used to evaluate the proposed dimensions. The dimensions of the two design vessels are described as follows:

- MSC Daniela:
  a. 1,201-foot length
  b. 168-foot beam
  c. 51.2-foot draft
- Large Capesize Bulker:
  a. 985-foot length
  b. 164-foot beam
  c. 59.7 - 60.4-foot draft

Table 3 provides an economic summary of benefits and costs for both Meeting Areas at 2.25% and 7% discount rates. MA2 is economically justified at both discount rates while MA1 is only economically justified at 2.25%. At the Federal Water Resources Discount Rate of 2.25%, the average annual costs of MA1 are $4,173,000 and the average annual net NED benefits of MA1 are $384,000 with a benefit to cost ratio of 1.1. For MA2 at 2.25% Discount Rate,,the average annual costs are $1,174,000. Average annual net NED benefits for MA2 are $2,508,000 with a benefit to cost ratio of 3.1 at 2.25%.

At the OMB Discount Rate of 7.0%, the average annual costs of MA1 are $7,810,000 and the average annual net NED benefits of MA1 are -$3,803,000 with a benefit to cost ratio of .5 at For MA2 at the 7.0% Discount Rate, the average annual costs are $1,762,000. Average annual net NED benefits for MA2 are $1,536,000 with a benefit to cost ratio of 1.9 at 2.25%.

Table 3: Meeting Area Economic Summary

Norfolk Harbor Widening Economic Update Preliminary Results		AAEQ	
		2.25%	7%
Meeting Area 2 Analysis (Thimble Shoal East Widening)	FWOP	$237,274,000	$234,210,000
	FWP	$233,592,000	$230,912,000
	NED Benefits	$3,682,000	$3,298,000
	NED Costs	$1,174,000	$1,762,000
	Net NED Benefits	$2,508,000	$1,536,000
	BCR	**3.1**	**1.9**
Meeting Area 1 Analysis (Thimble Shoal West Widening)	FWOP	$232,974,000	$230,352,000
	FWP	$228,417,000	$226,345,000
	NED Benefits	$4,557,000	$4,007,000
	NED Costs	$4,173,000	$7,810,000
	Net NED Benefits	$384,000	-$3,803,000
	BCR	**1.1**	**0.5**

Cost sharing for the RP will be done in accordance with Section 101 of the WRDA 1986, as amended, and cost shared as a General Navigation Feature. The Recommended Plan cost shares are based on all recommended channel depths are greater than -50 feet. Channel depths greater than -50 feet are cost shared 50 percent non-Federal and 50 percent Federal. The non-Federal sponsor will provide all LERRs. Disposal necessary for the Federal project is cost-shared as a general navigation feature. An additional 10 percent of the total costs of General Navigation Features will be repaid by the non-Federal sponsor over a period not to exceed 30-years. The sponsor's costs for LERRs, are credited against the additional cash contribution. The increase in operations and maintenance costs due to the recommended plan is $1,263,678 per year, which will be cost shared 50% by the non-Federal sponsor and 50% by the Federal government. A summary of cost shares is presented Table 1.

Table 1: Federal and Non-Federal Cost-Share for MA1 and MA2

COST SHARE MEETING AREA 1 *Rounded to nearest whole dollar value	Total Cost	Federal (50%)	Non-Federal (50%)
Dredging Cost (Including Mob/Demob)	$70,996,000	$35,498,000	$35,498,000
Environmental Mitigation	$0	$0	$0
Monitoring	$0	$0	$0
Construction Management	$3,871,600	$1,935,800	$1,935,800
Preconstruction Engineering & Design	$2,637,142*	$1,318,571	$1,318,571
Contingency (10%)	$7,750,474	$3,875,237	$3,875,237
Lands & Damages	$0	$0	$0
Total New Work Cost	$85,255,216*	$42,627,608*	$42,627,608*
Annual O&M Costs	$1,263,678	$631,839	$631,839

COST SHARE MEETING AREA 2 *Rounded to nearest whole dollar value	Total Cost (100%)	Federal (50%)	Non-Federal (50%)
Dredging Cost (Including Mob/Demob)	$10,865,190	$5,432,595	$5,432,595
Environmental Mitigation	$0	$0	$0
Monitoring	$0	$0	$0
Construction Management	$916,600	$458,300	$458,300
Preconstruction Engineering & Design	$1,513,392*	$756,696	$1,513,392
Contingency (10%)	$ 1,329,518	$664,759	$664,759
Lands & Damages	$0	$0	$0
Total New Work Cost	$14,624,700	$7,312,350	$7,312,350
Annual O&M Costs	$678,608	$339,608	$339,608

ENVIRONMENTAL IMPACTS AND MITIGATION

The possible consequences of the RP were considered in terms of probable environmental impact, social well-being, and economic factors. Endangered Species Act, Section 7 consultation was re-initiated and is ongoing. It is expected to be completed in December 2021. The Marine Mammal Protection Act coordination completed previously remains valid. The Essential Fish Habitat consultation as required per the Magnuson-Stevens Fishery and Conservation Management Act with the National Marine Fisheries Service (NMFS) has been reinitiated and is ongoing. It is expected to be completed in November 2021. Impacts to these species and any designated Critical habitat are not anticipated to be “significant,” as defined by the significance thresholds in Council on Environmental Quality’s Regulations for Implementing The Procedural Provisions of the National Environmental Policy Act (40 Code of Federal Regulations 1500-1508), as amended. There is no anticipated required compensatory mitigation anticipated with implementation of the Preferred Alternative. All mitigation, in terms of avoidance

and minimization measures, has been incorporated into the development of the proposed project. Best Management Practices have been incorporated in order to protect the environment and minimize impacts during construction, and operation and maintenance cycles. Best Management Practices and standard USACE protocols would be implemented for the protection of listed turtle and whale species, Atlantic Sturgeon, as well as other species protected by the Marine Mammal Protection Act to reduce any potential negative impacts of the project.

There would be no significant economic, recreation, aesthetic, or social well-being impacts, either adverse or unavoidable, as a result of the proposed action. This project would be expected to have a positive impact on the economy of Hampton Roads and the Commonwealth of Virginia. No adverse effect to historic properties is anticipated under the National Historic Preservation Act. State Historic Preservation Officer, Consulting Parties and Tribal Government coordination is ongoing, with completion expected in November 2021.

There would be no significant impacts anticipated to benthic resources, fisheries, fish and wildlife habitat, wildlife, wetlands, water quality, or air quality. All impacts would be anticipated to be temporary and negligible to minor in nature. Total Suspended Solids and turbidity in the water column resulting from dredging and material placement/disposal would quickly return to ambient conditions after construction or maintenance operations. A Record of Non-Applicability (RONA) has been prepared to document that the project's emissions would be de minimis, and therefore, a general conformity determination is not required.

The Norfolk Ocean Disposal Site (NODS) and Dam Neck Norfolk Ocean Disposal Site (DNODS) are authorized ocean disposal areas designated by the Environmental Protection Agency (USEPA) for AOC and the TSC dredged materials. U.S. Army Corps of Engineers has permitting authority under Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) for the use of these sites. In the past, dredged material from these locations has met Ocean Dumping Criteria, as set forth under 40 CFR 227.

Dredged material which meets sediment and elutriate testing requirements for placement at the CIDMMA may be placed in the Craney Island Re-handling Basin (CIRB) or directly in one of the containment cells at CIDMMA.

Dredged material placement actions at CIDMMA will comply with Clean Water Act and CIDMMA acceptance criteria. Commanders Policy WRD-01 is a Norfolk District internal guidance document which also governs the operation of CIDMMA. Prior to commencement of construction, dredged material will undergo evaluation procedures. During construction effluent discharged from the CIDMMA will be managed in accordance with Commander's Policy WRD-01 to maximize the retention of suspended solids minimizing migration of contaminants through the effluent pathway beyond the boundaries of the disposal site.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAEQ – Average Annual Equivalent
AOC – Atlantic Ocean Channel
APA – Administrative Process Act
APE – Area of Potential Effect
APP- Accident Prevention Plan
ASA – Assistant Secretary of the Army
BCR – Benefit-to-cost ratio
CAA – Clean Air Act
CBBT – Chesapeake Bay Bridge Tunnel
CERCLA – Comprehensive Environmental Response, Compensation and Liability Information System
CFR – Code of Federal Regulations
CIDMMA - Craney Island Dredged Material Management Area
CIEE - Craney Island Eastward Expansion
CIMT – Craney Island Marine Terminal
CIRB – Craney Island Rehandling Basin
CIRRC - Craney Island Road & Rail Connector
CRA - Cost Risk Analysis
CWA - Clean Water Act

CY – Cubic Yards
CZMA - Coastal Zone Management Act
DoD – Department of Defense
DNODs – Dam Neck Norfolk Ocean Disposal Site
DMMP – Dredged Material Management Plan
DPS – Distinct Population Segment
EA - Environmental Assessment
EFH - Essential Fish Habitat
EIS - Environmental Impact Statement
EJ – Environmental Justice
EO – Executive Order
EPCRA – Emergency Planning and Community Right-to-Know Act
ESA - Endangered Species Act
ESI - Environmental Sensitivity Index
ERSB - Elizabeth River Southern Branch
EQ-Environmental Quality
FEIS – Final Environmental Impact Statement
FEMA – Federal Emergency Management Agency
FONSI - Finding of No Significant Impact
FCSA – Federal Cost Share Agreement
FWOP – Future Without Project
GDM – General Design Memorandum
GIS – Geographic Information System
GNF– General Navigation Features
GRR/EA – Norfolk Harbor Navigation Improvements General Reevaluation Report and Environmental Assessment, 2018
HRBT – Hampton Roads Bridge – Tunnel
HRPDC – The Hampton Roads Planning District Commission
HRPTO - The Hampton Roads Transportation Planning Organization
IPCC - Intergovernmental Panel on Climate Change
IBI- Index of Biological Integrity
IDC Interest During Construction
IDR Integral Determination Report
LERRs - Lands, Easements, Rights-of-Way, and Relocations
LFA - Load Factor Analysis
LPC – Limiting Permissible Concentration
MA – Meeting Area
MEC/UXO – Munitions of Explosive Concern/Unexploded Ordinance
MBTA – Migratory Bird Treaty Act
MCY – Million Cubic Yards
MEC – Munitions and Explosives of Concern
MLLW – Mean Lower Low Water
MMBT – Monitor – Merrimac Memorial Bridge
MMPA – Marine Mammal Protection Act
MPA – Metropolitan Planning Area
MPO – Metropolitan Planning Organization
MPRSA - Marine Protection, Research and Sanctuaries Act
MSA - Metropolitan Statistical Area
MSFCMA - Magnuson-Stevens Fishery Conservation and Management Act
MSL – Mean Sea Level
MSI – Maritime Strategies International Ltd.
MS4s – Municipal Separate Storm Sewer Systems

N – Nitrogen
NAAQS - National Ambient Air Quality Standards
NAD – North Atlantic Division
NAVD - North American Vertical Datum
NED – National Economic Plan
NEPA - National Environmental Policy Act
NHPA - National Historic Preservation Act
NIT – Norfolk International Terminals
NMFS - National Marine Fisheries Service
NNBF – Natural and Nature Based Features
NNMT – Newport News Marine Terminal
NOAA – National Oceanographic and Atmospheric Administration
NODs - Norfolk Ocean Disposal Site
NPL – National Priorities List
NRHP - National Register of Historic Places
NWI - National Wetlands Inventory Project
OESS – Ordnance and Explosives Safety Specialist
OSE – Other Social Effects
OSH – Occupational Health and Safety
O&M – Operations and Maintenance
P – Phosphorus
P&G – Principles and Guidelines
PCB - Polychlorinated Biphenyls
PDT – Project Delivery Team
PED - Preconstruction, Engineering and Design
PMT - Portsmouth Marine Terminal
PPE – Personal Protective Equipment
PPT – Parts per thousand
PPX3 - Post Panamax Generation 3 vessels
RECONS – USACE online Regional Economic System
RED – Regional Economic Development
REPORT/SEA: Norfolk Harbor Navigation Improvements Meeting Area Validation Report and Supplemental Environmental Assessment
ROI – Region of Influence
RONA – Record of Non-Applicability
RSLR – Relative Sea Level Rise
SAV - Submerged Aquatic Vegetation
SHPO - State Historic Preservation Officers
SLC – Sea Level Change
SMMP – Site Monitoring and Management Plan
TEU – Twenty-foot Equivalent Units
TMDL – Total Maximum Daily Load
TRI – Toxics Release Inventory
TSC – Thimble Shoal Channel
USACE – United States Army Corps of Engineers
USEPA – United States Environmental Protection Agency
USFWS – United States Fish and Wildlife service
USGS - United States Geological Survey
USN – United States Navy
UXO – Unexploded Ordnance
VDEQ - Virginia Department of Environmental Quality
VDCR – Virginia Department of Conservation and Recreation

VDGIF - Virginia Department of Game and Inland Fisheries
VDH - Virginia Department of Health
VDHR - Virginia Department of Historic Resources
VIG – Virginia International Gateway
VIMS - Virginia Institute of Marine Science
VMRC – Virginia Marine Resources Commission
VPA – Virginia Port Authority
VSMP – Virginia Stormwater Management Program
VWP – Virginia Water Protection Permit
WRDA - Water Resources Development Act

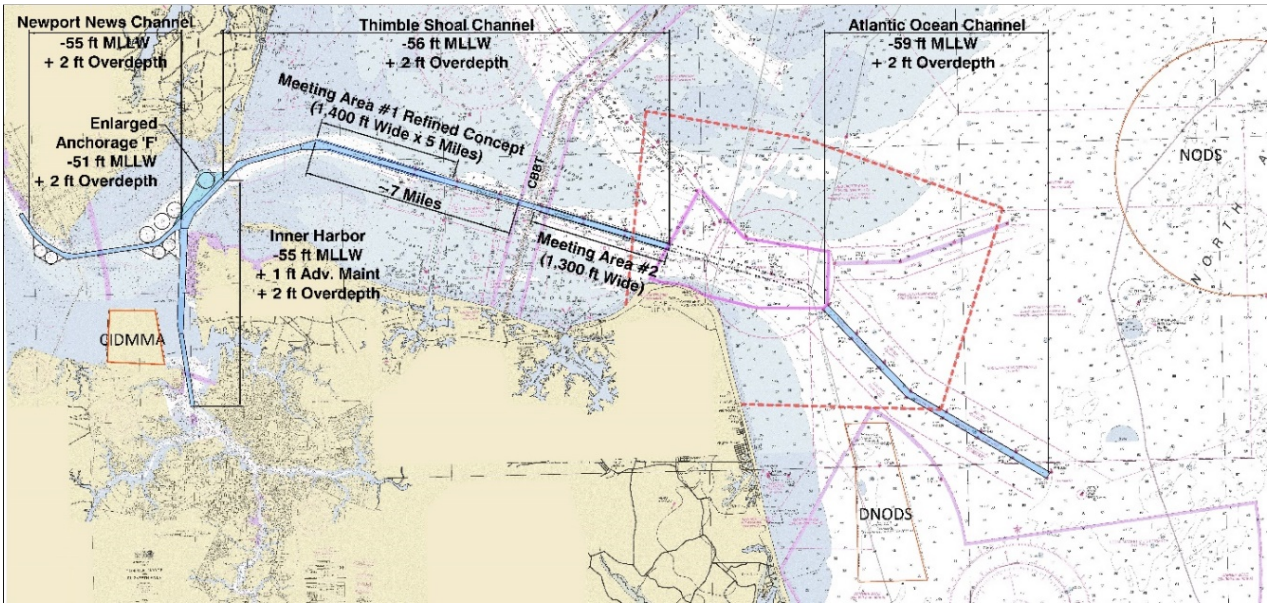
1 STUDY INFORMATION

1.1 Introduction

The Norfolk Harbor and Channels navigation project consists of a network of multiple channel and anchorage elements that provide deep draft access from the Atlantic Ocean into the Port of Virginia. The harbor in which the Port of Virginia is located covers a 25 square-mile area and serves a variety of private marine terminals, state-owned marine terminals, and federal maritime/military facilities located within the cities of Norfolk, Newport News, Portsmouth, Chesapeake, and Hampton in southeastern Virginia.

The purpose of the Norfolk Harbor Navigation Improvements Meeting Area Validation Report and Supplemental Environmental Assessment (Report/SEA) is to provide an updated economic evaluation of two specific navigation elements, Meeting Areas 1 and 2 (also called the Thimble Shoal Channel-West widening and Thimble Shoal Channel-East widening, respectively) in the Norfolk Harbor.

The Report will examine the National Economic Development (NED) benefits relative to the costs of both Meeting Area 1 (MA1) and Meeting Area 2 (MA2) to determine the average annual costs, benefits and benefit-to-cost ratio (BCR) at the FY2022 Federal Water Resources Discount Rate of 2.25% and the Office of Management and Budget (OMB) rate of 7%.



These Meeting Areas are located on each side of the existing 1000 feet wide Thimble Shoal Channel (TSC) which is divided by the Chesapeake Bay Bridge Tunnel (CBBT). MA1 and MA2 are proposed for widening to accommodate two-way vessel traffic for navigation efficiency.

MA1 and MA2 were both evaluated in the 2018 Norfolk Harbor Navigation Improvements Integrated General Reevaluation Report and Environmental Assessment (GRR/EA). MA2 was economically justified as part of the NED Plan in the report, which was the Recommended Plan (RP) for authorization following the completion of the GRR/EA. MA1 was not included in the NED Plan because its BCR was determined to be lower than 1.0 at the FY2018 Federal Water Resources Discount Rate and the OMB Discount Rate.

The need for this project arises from inefficiencies currently experienced by commercial vessels within Norfolk Harbor. Industry adoption of larger vessels has necessitated periodic establishment of one-way traffic within channels that normally support two-way traffic. Compared to the fleet forecast used in the GRR/EA, ocean carriers have more rapidly transitioned to ultra large container vessels than the forecast predicted, warranting a reassessment of the Meeting Areas for two-way traffic. New forecasted fleet inventory and economic data is now available which warrants the reevaluation of the MA1 to determine if the element is economically justified and reaffirmation of the NED benefits for MA2.

1.2 Study Authority

The U.S. Army Corps of Engineers (USACE), through its civil works mission, undertakes water resource development studies and projects and other assistance activities that are specifically authorized by Congress. In Section 7001 of the Water Resources Reform and Development Act (WRRDA) of 2014 (P.L. 113-121; 33 U.S.C. §2282d), Congress established an annual process for identifying proposals for site specific studies and projects within USACE's water resource mission and authorities. The process includes a call for non-Federal proposals and concludes with a report by the Assistant Secretary of the Army for Civil Works (ASACW) to the House Transportation and Infrastructure Committee and the Senate Environment and Public Works Committee.

The request for proposals is advertised in the *Federal Register* and non-Federal sponsors submit their suggestions for study authorizations and modifications to approved projects after consulting with their USACE District. The Virginia Port Authority (VPA) with the assistance of Norfolk District completed a 7001 Report submission to the ASACW for modifications to the Norfolk Harbor Navigation Improvement Project's approved RP to include widening of Thimble Shoal Channel to widen a portion of TSC to create Meeting Area 1.

Section 1403 of the Water Resources Development Act of 2020 included a provision to authorize modifications to the Norfolk Harbor Navigations Improvements Project and for this Validation Study (Thimble Shoal Widening). Per the WRDA 2020, additional widening of the Thimble Shoal Channel was authorized provided the modifications do not exceed the maximum 902 Cost limitations of the previously approved project. The specific text of the provision is:

SEC. 1403. NORFOLK HARBOR AND CHANNELS, VIRGINIA.

(a) IN GENERAL.—The Secretary is authorized to further improve the project for navigation, Norfolk Harbor and Channels, Virginia, authorized by section 201 of the Water Resources Development Act of 1986 (100 Stat. 4090), substantially in accordance with the plans, and subject to the conditions, described in the Report of the Chief of Engineers dated June 29, 2018.

(b) THIMBLE SHOAL CHANNEL WIDENING.—The Secretary may carry out additional modifications to the project described in subsection (a) that are identified in the report titled

"Report to Congress on Future Water Resources Development" submitted to Congress on February 5, 2018, pursuant to section 7001 of the Water Resources Reform and Development Act of 2014 (33 U.S.C. 2282d).

(c) MAXIMUM AUTHORIZED COST.—Notwithstanding section 902(a)(2)(B) of the Water Resources Development Act of 1986 (33 U.S.C. 2280(a)(2)(B)), the maximum authorized cost for the project described in subsection (a) shall not be modified for the improvements and modifications authorized by subsections (a) and (b)."

1.3 Planning Guidance

Engineering Regulation 1105-2-100 (dated 22 Apr 2000) Appendix E provides guidance on Civil Works Missions and Evaluation Procedures. Appendix E provides policy and planning guidance for project purposes of navigation and will be used as a guide for this document. Guidance on projects, costs, NED Plan Evaluation, Dredged Material Management Plans and the Planning Process are applicable topics to this Report/SEA.

Operations and Maintenance Costs for Commercial Navigation projects greater than 45 feet in depth are also discussed in Appendix E of ER 1105-2-100 (Table E-10) and will guide the future cost share of this project. The specific text reads, "Non-Federal sponsors will be responsible for all costs of the operation and maintenance, repair, rehabilitation, and replacement of mitigation measures except for: (1) inland navigation projects and harbor projects with depths up to 45 feet, which have no requirement for non-Federal sharing of these costs, and (2) harbors with depths over 45 feet which require a 50 percent non-Federal share for those costs assigned to increments in excess of a 45-foot project projects."

Engineer Regulation 1130-2-520: Navigation and Dredging Operations and Maintenance Policies (1996) This regulation establishes the policy for the operations and maintenance (O&M) of USACE navigation and dredging projects, as well as their related structures and equipment.

Engineer Pamphlet 1165-2-1, Chapter 12: Navigation (1999) This Engineer Pamphlet describes the Corps' role in navigation, federal policies covering navigation, and the construction aspects of navigation projects.

1.4 Sponsor

The lead Federal agency is U.S. Army Corps of Engineers (USACE). The non-Federal sponsor for this study is the Commonwealth of Virginia, acting through its agent, the Virginia Port Authority (VPA). The VPA, as the non-Federal sponsor, entered into a Feasibility Cost Share Agreement (FCSA) with USACE on June 15, 2015.

1.5 Study Purpose and Scope

The purpose of this Report/SEA is to provide an updated economic evaluation of two specific navigation elements, MA1 and MA2 (also called the TSC-W widening and TSC-E widening, respectively) within the Thimble Shoal Channel. Specifically, this study will reevaluate MA1 to determine if it is economically justified as part of the NED Plan for the GRR/EA. This study will

also reaffirm the economic justification of MA2 at the current price levels and discount rates with an updated fleet forecast. The scope of this validation report is limited to a reevaluation of the costs and NED benefits associated with the construction and maintenance of MA1 and MA2 and the subsequent dredged material placement.

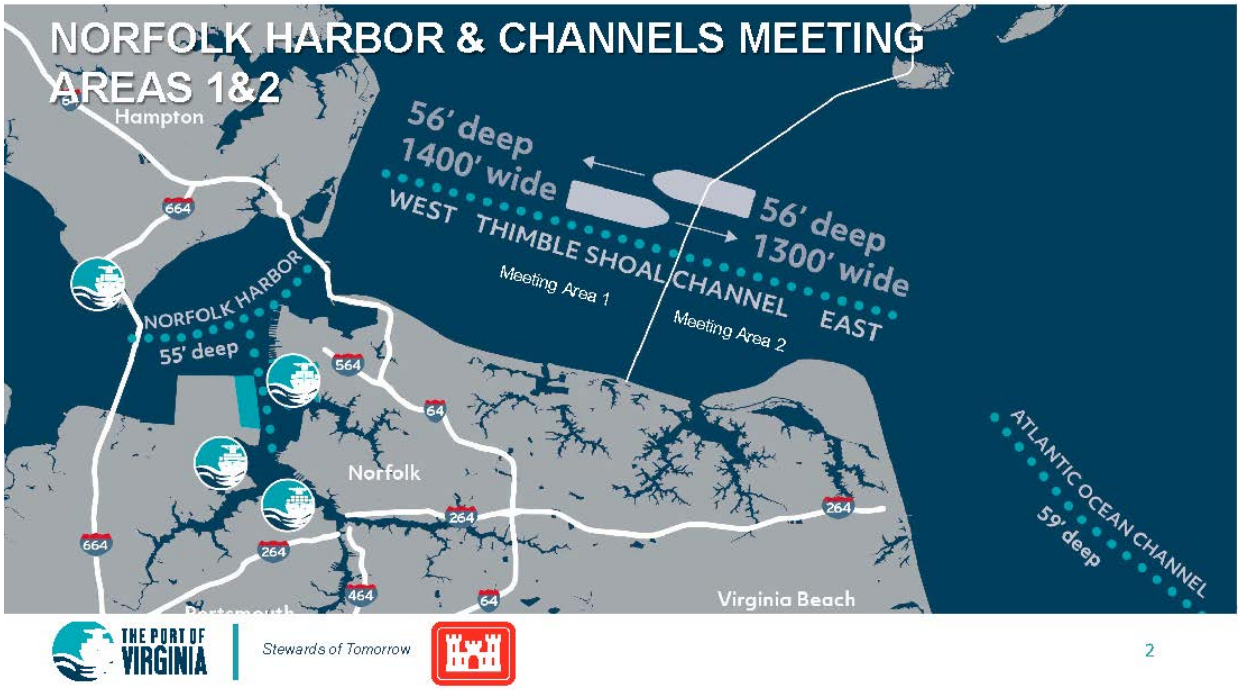


Figure 1-2. Overview Map of MA1 and MA2

1.6 Existing Project

The GRR/EA was signed by the Chief of Engineers in October 2018. The project consists of a network of Federally improved and maintained channels extending from the Atlantic Ocean, through the Chesapeake Bay, and into the Port of Hampton Roads. The following are the authorized project elements:

- Deepening the Atlantic Ocean Channel to a required depth of -59 feet;
- Deepening the Thimble Shoal Channel to a required depth of -56 feet;
- Deepening the Norfolk Harbor Channel to a required depth of -55 feet;
- Deepening the Norfolk Harbor Entrance Channel to a required depth of -55 feet;
- Deepening the Newport News Channel to a required depth of -55 feet;
- Widening the Thimble Shoal Channel east of the Chesapeake Bay Bridge Tunnel to approximately 1,300 feet (Meeting Area 2);
- Widening Anchorage F to approximately 3,620 feet and associated modifications of the Approach Area;
- Deepening Anchorage F to a required depth of approximately -51 feet;

- The existing 10 feet sand cover of the Chesapeake Bay Bridge Tunnel in the Thimble Shoal Channel would be reduced to approximately five feet. The materials covering the tunnel would be sand or potentially sand and rock; and
- Associated Operation and Maintenance of the Craney Island Dredged Material Management Area (CIDMMA).

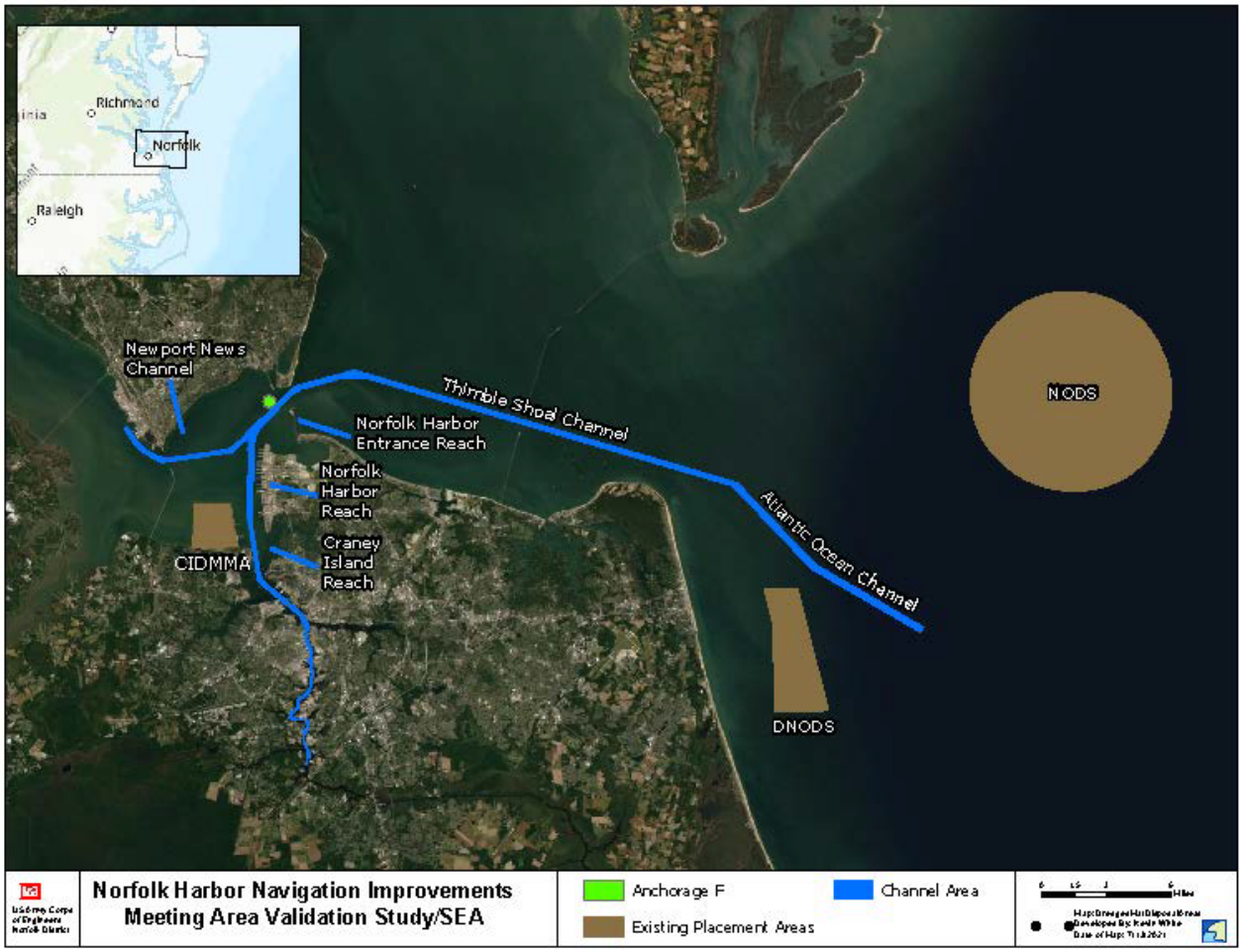


Figure 1-3. Map of the features of the Norfolk Harbor Navigation Improvements General Reevaluation Report and Environmental Assessment (2018).

The authorization also includes the construction and maintenance of these features. Dredged material placement/disposal could occur at the Dam Neck Ocean Disposal Site (DNODS), the Norfolk Ocean Disposal Site (NODS), the CIDMMA, and/or upland disposal sites, if needed. Portions of the dredged areas may be suitable for beneficial use projects and beneficial use projects are coordinated separately from this project. General operation and maintenance of the CIDMMA would continue. Following construction, channel depths would be maintained over the 50-year lifecycle of the project.

MA1 was evaluated in the GRR/EA but was not included in the Recommended Plan (Preferred Alternative) because it was not economically justified at that time. MA2 is part of the NED plan that was recommended in the GRR/EA and is planned for construction in the 2nd Quarter of FY22.

1.7 Construction History

The Norfolk Harbor and Channels project was initially authorized in 1986 but was not completely constructed. Below is a timeline of the construction history for the project:

- In 1986, -55/45-foot project authorized by WRDA 1986
- In 1989, project deepened to -50 feet within the outbound channels in Norfolk Harbor, full width in the Channel to Newport News
- In 2007, remaining inbound components deepened to -50 feet, Atlantic Ocean Channel to -52 feet full width
- In 2007, the -50-foot inbound component from the Atlantic Ocean to Lamberts Bend constructed
- In 2015, Congress appropriated funds for two GRRs and two FCSAs signed by the Virginia Port Authority (VPA).
- In 2018, the Norfolk Harbor Navigation Improvements General Reevaluation Report and Environmental Assessment (GRR/EA) was approved by the Chief of Engineers.
- The first element of the GRR/EA, Thimble Shoal Channel West (deepening the channel to -56), is currently under construction through a contract awarded in FY2020 by the non-Federal sponsor. The first USACE managed contract will be awarded in FY2022.

1.8 Overview of the Integration of the Validation Report/Supplemental Environmental Assessment

This Report integrates the Validation Study and the Environmental Assessment (EA). The purpose of the Validation Report is reevaluate MA1 and reaffirm MA2 for inclusion in the National Economic Development (NED) Plan for the GRR/EA based on an updated Fleet Forecast and economic analysis at current price levels.

The purposes of the supplemental Environmental Assessment are to:

- Identify and analyze the environmental impacts of the alternatives;
- Incorporate environmental concerns into the decision-making process;
- Evaluate a reasonable range of project alternatives have been considered and evaluated; and
- Determine whether projected environmental impacts warrant the preparation of an Environmental Impact Statement (EIS).

1.9 Previous Reports

Numerous studies and reports have been conducted on the Norfolk Harbor and in the vicinity of the Port of Hampton Roads. A detailed list of these reports, as well as a historical summary of the numerous Federally authorized channels and anchorages in the Port of Hampton Roads, can be found in the Navigation Management Plan for the Port of Hampton Roads, Virginia, dated February 2000. Additional studies, reports, and authorizations, including those since February 2000 are listed below:

- Final Environmental Impact Statement (FEIS) for the Proposed Dredging of Norfolk Harbor Channel, Norfolk and Portsmouth, Virginia, July 2009.
- Craney Island Eastward Expansion, Norfolk Harbor and Channels, Hampton Roads, Virginia, Final Feasibility Report and Environmental Impact Statement, January 2006.
- Norfolk Harbor and Channels, Virginia, -50-foot Channel Project, -50-foot Inbound Element, Final Limited Reevaluation Report, October 2002.
- Navigation Management Plan for the Port of Hampton Roads, Virginia, February 2000.
- Limited Reevaluation Report, Norfolk Harbor and Channels, Virginia, -50-Foot Anchorage Project, May 1996, Revised July 1996.
- FEIS for the Designation of an Ocean Dredged Material Disposal Site Located Offshore Norfolk, Virginia, Environmental Protection Agency, November 1992.
- Norfolk Harbor and Channels, Virginia, Long-Term Dredged Material Management (Inner Harbor), Final Supplemental Report, May 1992.
- Norfolk Harbor and Channels, Virginia, Long Term Disposal (Inner Harbor), Draft Information Report, June 1990.
- Norfolk Harbor and Channels, Virginia, -50-Foot Outbound Element, Supplemental Engineering Report to General Design Memorandum 1, Revised September 1989.
- Norfolk Harbor and Channels, Virginia, -50-Foot Outbound Element, Supplemental Engineering Report to General Design Memorandum 1, June 1986.
- Norfolk Harbor and Channels, General Design Memorandum (GDM) 1, June 1986.
- Norfolk Harbor and Channels, Virginia, Deepening and Disposal, Final Supplement 1 to the FEIS, and Appendix: Dam Neck Ocean Disposal Site Evaluation Study, May 1985.
- Norfolk Harbor and Channels, Virginia, Feasibility Report and Final Environmental Impact Statement, July 1980, and FEIS Addendum, December 1980 (all in House Document 99-85 dated 18 July 1985, 3 volumes).
- Norfolk Harbor Navigation Improvements General Reevaluation Report and Final Environmental Assessment, October 2018.
- Final Supplemental Environmental Assessment, Norfolk Harbor Navigation Improvements Project, Thimble Shoal Channel, Chesapeake Bay Bridge Tunnel – Protective Rock Blanket Project, July 2021.

1.10 Public, Resource Agency, and Tribal Coordination

A coordination meeting with the Virginia Department of Historic Resources (DHR) was held on September 17, 2021 to provide an overview of the undertaking and to discuss the proposed Section 106 consultation strategy. National Historic Preservation Act, Section 106 consultation was initiated on October 23, 2021 and is currently underway. Tribal coordination was initiated on October 19, 2021 and is currently underway. Coordination letters were also sent to the Naval History and Heritage Command and local cities near the project site.

On October 19, 2021 a Fish and Wildlife Coordination Act (FWCA) consultation meeting was conducted with the U.S. Fish and Wildlife Service (USFWS). Consultation has concluded and the USFWS provided confirmation that an additional Fish and Wildlife Coordination Act Report (FWCAR) will not be required for the Report/SEA as impacts were adequately addressed in the 2018 FWCAR for the GRR/EA.

The USACE reinitiated Endangered Species Act (ESA), Section 7 consultation with the USFWS as there were modifications to the Official Species list since the previous consultation was completed in 2018 for the Norfolk Harbor Navigation Improvements Project. No additional ESA, Section 7 consultation with the NMFS is required because the previous formal consultation completed in 2018 for the Norfolk Harbor Navigation Improvements GRR/EA resulted in a Biological Opinion that included the MA1 impacts and accounted for all required Atlantic sturgeon and sea turtle takes.

On October 14, 2021, an Essential Fish Habitat (EFH) Consultation Meeting was conducted to discuss the proposed action and determine the consultation pathway. In accordance with the Magnuson-Stevens Fishery and Conservation Management Act, EFH consultation was reinitiated on October 15, 2021 and consultation is ongoing as updates to the previous consultation were required.

A draft of the Report/SEA will be made available for a 30-day public review period. The Notice of Availability of the Report/SEA will be published in the Virginian Pilot Newspaper and on the project website; the notice will also be advertised via social media. All comments will be addressed in the Final Report/SEA.

Environmental coordination is located in Appendix C and cultural coordination including tribal coordination is located in Appendix D.

2 EXISTING NAVIGATION FEATURES

2.1 Navigation Features

The harbor is formed by the confluence of the James, Nansemond, and Elizabeth Rivers. Norfolk Harbor's container terminals service a vast hinterland that extends from the Mid-Atlantic States out to the Mid-West and Southeastern portions of the U.S. One-third of the containers are moved over land by rail. The harbor's coal terminals service all the major coal producing regions of the U.S.

The predominant general navigation features are shown below (Figure 2-1) and described in the GRR/EA in detail, but descriptions of each major feature are provided below:

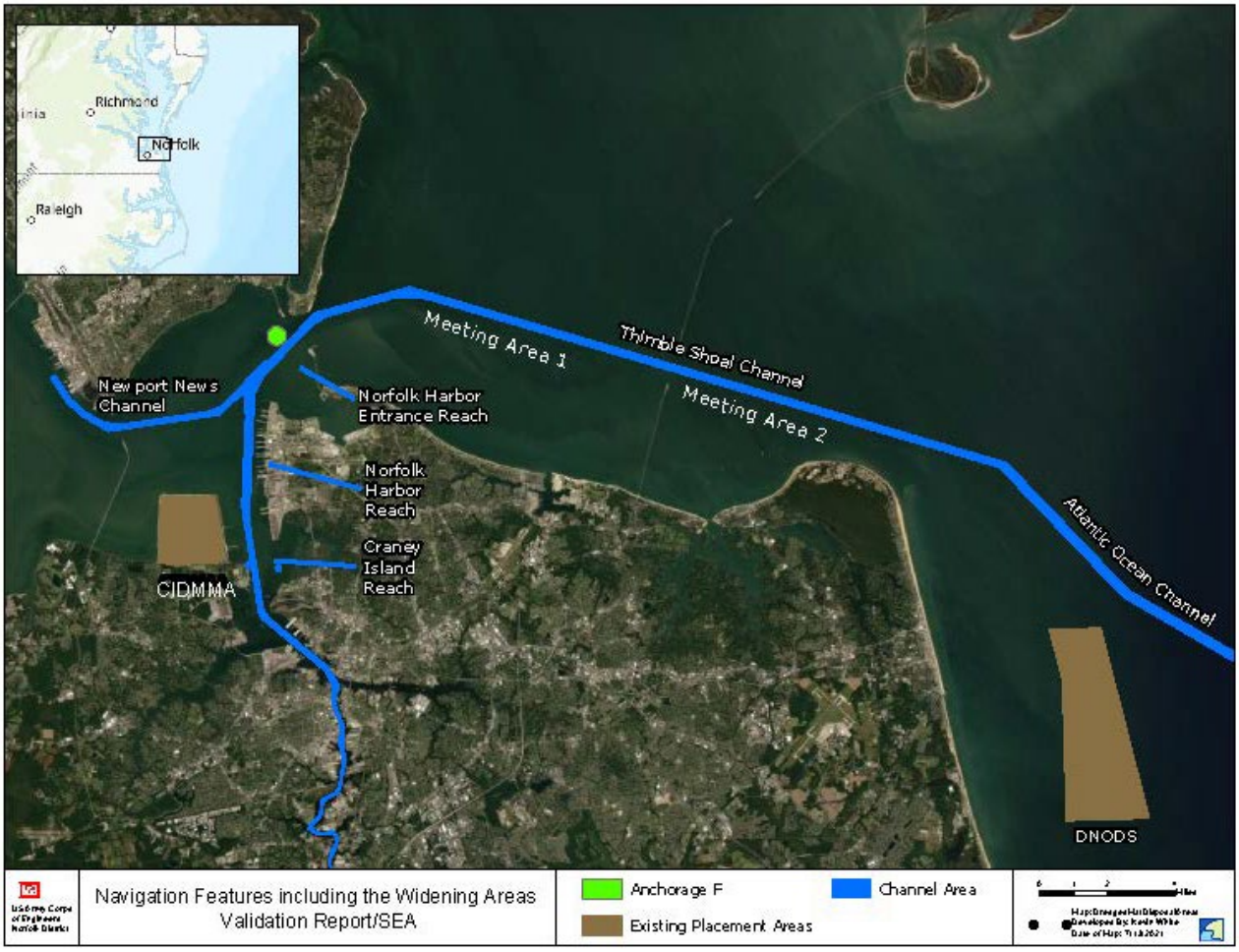


Figure 2-1. Navigation Features including the Widening Areas in the Validation Report / SEA.

Atlantic Ocean Channel

The Atlantic Ocean Channel (AOC) is located off the eastern coast of Virginia (Figure 2-1) and was authorized by the WRDA of 1986. WRDA 1986 authorized USACE to construct the AOC to

be 11.1 miles long, 1,300 feet wide, and -57 feet deep[1]. As part of the 50-foot inbound construction effort in 2006, the channel was deepened to provide for a required depth and width of -52 feet and 1,300 feet, respectively.

The Atlantic Ocean Channel is part of the Port of Virginia and Baltimore system of channels, and is the segment providing access for all ships calling on port facilities, naval bases, and shipyards in the Hampton Roads, York River and Baltimore areas. All commercial tonnage entering and leaving the Ports of Virginia and Baltimore pass through this channel. The channel is currently maintained to the full authorized width and a required depth of -52 feet to enable loaded colliers, container ships and military vessels to transit the channel with ship drafts as great as -47 feet (-45 ft with no tide restrictions).

Material is typically dredged via hopper dredge from this channel. Dredged material is placed at DNODS. Dredged material is largely fine sand that has also been beneficially used for the Virginia Beach Hurricane Protection project and the Craney Island Eastern Expansion (CIEE) Project. Due to periodic use as a sand source, maintenance dredging has not been required.

Per the GRR/EA, deepening of the AOC to a required depth of approximately -59 feet was approved but not yet constructed.

Thimble Shoal Channel

The TSC is located in the southern part of the Chesapeake Bay, just off the shoreline of Norfolk and Virginia Beach, east of the CIDMMA (Figure 2-1). This project was originally authorized by the River and Harbor Act of 1917. The original authorized channel dimensions were 13.4 miles long, 1,000 feet wide, between the -55-foot contours, to a depth of -55 feet. The channel has been maintained to a required depth of -50 feet. Thimble Shoal Channel extends from the deep water to the east of Hampton Roads to the deep water at the mouth of the Chesapeake Bay.

Material is typically dredged via hopper dredge from this channel. Dredged material is placed at the DNODS. The material in TSC to the west of the CBBT is predominantly clays and silts, for which beneficial use projects have not been identified. In contrast, material in the eastern portion of channel is largely fine to medium-grained sand and the segment is a common source of material for beach nourishment projects.

Per the GRR/EA, deepening of the TSC to a required depth of approximately -56 feet was approved. This also included approval of MA2 which consists of a widening of the Thimble Shoal Channel east of the Chesapeake Bay Bridge Tunnel to approximately 1,300 feet. Construction of the Thimble Shoal Channel to a depth of -56 feet is currently underway but not yet completed.

Channel to Newport News and Anchorages

The Channel to Newport News and the associated Newport News anchorages segment of the Norfolk Harbor Project (Figure 1-2) is authorized to -55 feet deep by 800 feet wide from Norfolk Harbor Channel in Hampton Roads to Newport News and the Newport News Anchorages. However, the channel has been maintained to a required depth of -50 feet. Material is typically dredged via hydraulic and/or mechanical dredging methods. Material dredged from this area is typically placed at the CIDMMA.

[1] Please note that depths described in this document are provided in Mean Lower Low Water (MLLW).

Per the GRR/EA, deepening of the Channel to Newport News was approved to a depth of -55 feet.

Norfolk Harbor Channel - Sewells Point to Lamberts Bend and Norfolk Harbor Anchorages

The Sewells Point to Lamberts Bend Reach (also called the Norfolk Harbor Reach and the Entrance Reach) of the Norfolk Harbor Project is located in Norfolk between Sewells Point and Lamberts Bend (Figure 1-2). This segment of the project is approximately eight miles long and varies in width between 800 feet to 1,200 feet. This reach also consists of: Anchorage F, Sewells Point East Anchorage (includes the Naval Maneuvering Area and Approach Areas), Sewells Point West Anchorage and (Approach Area), Anchorage G, and all approach areas.

The authorized project dimensions for this reach (the Norfolk Harbor Reach and the Entrance Reach) include a channel -55 feet deep and 1,200 feet wide from that depth in Hampton Roads to a point approximately 6.0 miles upstream from the Hampton Roads Bridge Tunnel (HRBT); thence -55 feet deep and 800 feet wide to Lambert Point (The Craney Island Reach). The Sewells Point to Lamberts Bend Channel is currently maintained to a required depth of -50 feet from the 55-foot contour in Hampton Roads (near the HRBT) to Lamberts Point.

Material is dredged from this area via hydraulic cutterhead pipeline dredge and/or a clamshell dredge. Material dredged from this area is placed at the CIDMMA. The material in the Sewells Point to Lamberts Bend Channel is primarily silt and clay for which beneficial use projects have not been identified.

Per the GRR/EA, deepening of the Norfolk Harbor and Channel as well as the Norfolk Harbor and Channels Entrance Area was approved to a required depth of approximately -55 feet and the following improvements were also approved:

- Widening Anchorage F to approximately 3,620 feet and associated modifications of the Approach Area; and
- Deepening Anchorage F to a required depth of approximately -51 feet.

Dam Neck Ocean Disposal Site (DNODS)

The DNODS is located three nautical miles east of Virginia Beach (Figure 2-1) The DNODS area was first utilized as an ocean placement site in 1967. This ocean placement site was designated by the administrator of the U.S. Environmental Protection Agency (USEPA) in March of 1988. The DNODS runs parallel to Virginia Beach, covering about eight square nautical miles. Water depths at DNODS vary between -31 to -49 feet deep. The remaining DNODS capacity is estimated to be about 63 million cubic yards. The site is the primary dredged material disposal site for the TSC, Cape Henry Channel, and AOC. Only material that meets Marine Protection Research and Sanctuaries Act (MPRSA) Section 103 ocean placement guidelines with USEPA concurrence will be placed at this site.

Norfolk Ocean Disposal Site (NODS)

The NODS (Figure 1-2) was officially designated as an ocean placement site in 1993, pursuant to Section 102 (c) of the Marine Protection, Research, and Sanctuaries Act of 1972 (as amended, 33 U.S.C. 1401 *et seq*). This ocean placement site was designated by the administrator of the USEPA in December of 1986. The site is authorized to receive new work and maintenance dredged material from the lower Chesapeake Bay. This site is also authorized

to receive appropriate dredged material from TSC, Cape Henry, AOC, and York Spit channels. An EIS, titled: “Final Environmental Impact Statement for the Designation of an Ocean Dredged Material Disposal Site Located Offshore Norfolk Virginia” was finalized in November of 1992.

The center of the NODS is located 17 nautical miles from Virginia Beach. Water depths near the center of the site vary between -65 to -80 feet. Up to approximately 250 million cubic yards of dredged material from dredging projects (public and private) may be disposed at the site over the next 49 years. The quantity of material to be placed at the site depends on the quality of the dredged material. As with DNODS, only material that meets MPRSA Section 103 ocean placement guidelines with USEPA concurrence will be placed at this site.

Craney Island Dredged Material Management Area

The CIDMMA (Figure 2-1) is located within the City of Portsmouth in the eastern portion of the Atlantic Coastal Plain and adjacent to the confluence of the James River, Elizabeth River, and Nansemond River, and is in close proximity to the Chesapeake Bay and the Atlantic Ocean. The CIDMMA is a 2,500-acre confined disposal facility in the Hampton Roads area of Virginia. The CIDMMA was authorized by the River and Harbor Act of 1946 and constructed from 1956-1958. The federally owned facility is operated by USACE and is used by private interests, local municipalities, federal and Commonwealth of Virginia government agencies for the disposal of dredged material from Norfolk Harbor and its adjacent waterways.

Dredged material is received in two different ways at the CIDMMA. It is either pumped directly into one of three upland containment cells or it is deposited in the rehandling basin and then pumped into the facility. The Craney Island Rehandling Basin is a large deeper area off the southeast shoreline of the island that can be filled with material and then dredged once filled. Since it began operation, the CIDMMA has received, on average, 3.5 million cubic yards of dredged material per year. However, there have been several years when it has received more than 10 million cubic yards.

Currently capacity at CIDMMA is extremely limited. Dikes for containment of dredged material will be constructed in the near future to create additional capacity but use of this site is limited until the CIEE is complete and new capacity has been created. Future dredging efforts for the GRR/EA features could provide necessary dike-raising material.

2.2 Channel Nomenclature and Typical Cross Section

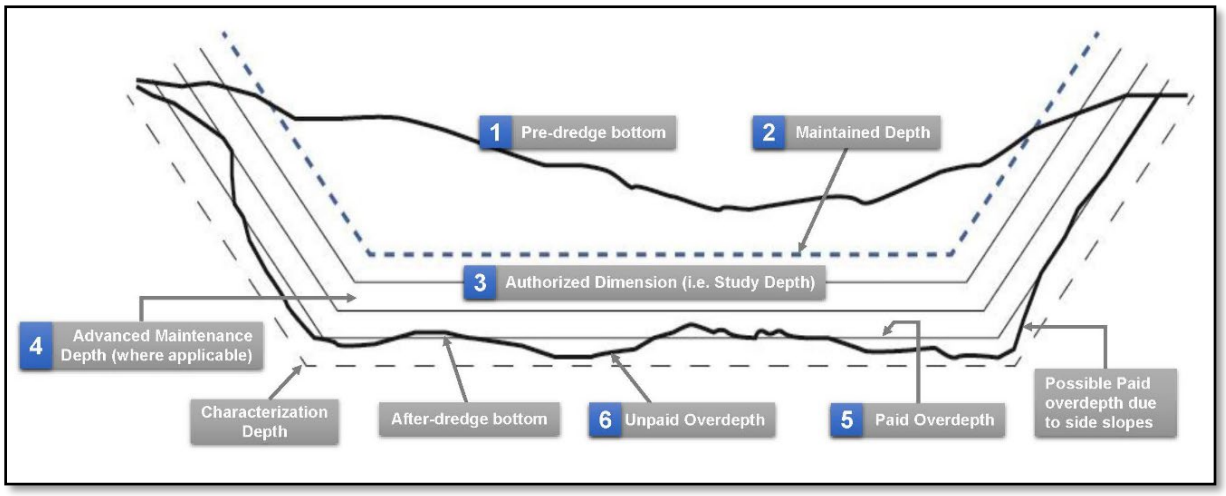


Figure 2-2. Channel Nomenclature and Typical Channel Cross Section with Dredging Zones

1. Pre-Dredge/Existing Grade/Mudline – The mudline based on the latest condition survey of the channel.
2. Maintained Depth – Without-Project Condition - The maintenance quantity is the volume of material that must be dredged from the existing condition (based on the latest condition survey of the channel) to achieve the currently maintained channel dimensions. This volume to restore the channel to the District's historically maintained depth is included in the Dredged Material Management Plan, but is not a new work dredging cost.
3. Authorized Dimensions/Project Depth/Grade – This is the Nominal Depth used for Plan Formulation Increments and includes consideration for Under keel Clearance (UKC). UKC is further discussed below.
4. Advanced Maintenance – Cost estimates for the inner channels include 1 foot of advanced maintenance.
5. Allowable (Paid) Overdepth – To be consistent with historic dredging in these project reaches, 1 foot of paid overdepth is included.
6. Over-dig (Non-Pay/Unpaid) Overdepth – Non-pay volume is dredging beyond the new work quantity above due to inaccuracies in dredging, dredge type, dredge area, wind, and wave conditions, etc. These non-pay volumes are based on assumptions developed in the Cost Engineering Dredge Estimating Program (CEDEP) worksheet that accounts for the efficiency of the dredges for each reach based upon the areas, volume, amount of pay, amount not dug on average, and the amount dug in excess of the allowable pay amount, any many other factors associated with dredging operations. CEDEP is the basis for the unit cost for dredging. The inclusion of non-pay is in accordance with a USACE memorandum (USACE, 2006) providing guidance on adequacy of describing the total volumes to be dredged (ex. allowable overdepth and non-pay volumes).

Note: For purposes of cost estimates, estimated dredging depths assume 1-foot depths for both Allowable Paid Overdepth and Non-Pay Overdepth categories. Depths and consequential estimated volumes communicated for environmental compliance may be deeper than the

economic depths assumed in the cost analysis. Use of these conservative volumes and depths are an attempt to determine worse-case scenarios to ensure full environmental compliance.

3 PLAN FORMULATION

3.1 Problems, Opportunities, Objectives, and Constraints

Problems
This Report/SEA was completed using the same problems, opportunities, constraints, and objectives that were developed for the GRR/EA. This Report/EA focuses primarily on the insufficient Federal channel width within TSC that is preventing two-way traffic for DoD and commercial vessels.

Multiple issues were identified in the GRR/EA that are still contributors to this primary problem:

- There is not a location within the channel for large ships to meet, often resulting in one-way traffic in the Federal channel. This delays cargo schedules, causes port congestion, and berth inefficiency.
- Inadequate Federal channel depth and width cause inefficiencies in maritime commerce, specific issues include:
  - Commercial vessel navigation may be restricted in the channel at times when naval vessels are navigating the channel.
  - The proximity of the Federal channel to Naval Station Norfolk's waterfront restricts vessel speed in the channel.

Opportunities
Opportunities are the desirable future outcomes which address the water resource problems and improve conditions in the project area. Opportunities identified for this analysis include:

- Beneficial Use of Dredged Material. The dredged material from the channel improvements is a potential resource for environmental restoration, beach nourishment, flood control structures, and Craney Island Eastward Expansion fill.
- More Efficient Transport of Commodities. If fewer vessels are restricted by tides, congestion and 'bunching' of ships will be relieved, allowing for more efficient flow of vessels in and out of the channels. Wider channels and additional Meeting Areas might reduce restrictions on vessels meeting or overtaking, which would reduce delays and transportation costs in the channel.
- Reduction of Impacts to Commercial Traffic due to DoD Activities. An additional Meeting Area could possibly allow for both commercial and DoD activities to occur simultaneously.
- Improved safety of navigation. With channels designed to accommodate the fleet and an additional Meeting Area, navigational safety would likely be improved.

Objectives

Federal Objective
The Planning Guidance Notebook (ER 1105-2-100, dated 22 April 2000) states that "water and related land resources project plans shall be formulated to alleviate problems and take advantage of opportunities in ways that contribute to planning objectives and, consequently, to the Federal objective" (page 2-1). Plan formulation has been conducted for this Validation

Report with a focus on achieving the Federal objective of water and related land resources project planning, which is to contribute to NED consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements (Principles and Guidelines, 1983).

Planning Objectives

The goal of this study is to reasonably maximize Norfolk Harbor's contribution to NED, consistent with protecting the Nation's environment. Physical constraints and inefficiencies are addressed in the existing navigation system's ability to safely and efficiently serve the forecasted vessel fleet and process the forecasted cargo volumes. Specific objectives for this report are:

- Reduce cargo transportation costs for the existing and future fleet over the period of analysis at Norfolk Harbor
- Reduce navigation operational constraints caused by one-way traffic in certain reaches for the existing and future fleet over the period of analysis at Norfolk Harbor.

4 PROJECT COST

This Report evaluates the costs for MA1 and MA2 using FY2022 price levels, updated dredge volumes, and existing contract/bid documents. MA1 was evaluated and documented in the GRR/EA but was not justified for inclusion into the NED Plan based on the fleet forecast used for the study and resultant benefits vs. project costs ratio. PED and construction management costs for the MA1 were developed during the GRR and re-certified for FY2020. Project experience with other segments suggests they are sufficiently conservative.

4.1 Project Cost Changes Since the GRR/EA

There were several drivers of cost change to the project costs since the last project cost certification for the Norfolk Harbor Navigation Improvements GRR/EA which was completed on April 30, 2018. Since the 2018 cost certification, dredge volumes were revised, and a cost estimate was updated to reflect the revised volumes. Dredge volumes were updated based on 2018 after-dredge surveys and inner harbor volumes were revised to reflect current USACE advanced maintenance practices. The project area was more clearly defined.

Overhead, equipment, labor, and fuel costs were updated to reflect current data and recent bidding climate:

- Equipment costs updated for FY2020 using the latest 2018 projections from the USACE Construction Equipment Ownership and Operating Expense Schedule, Region II
- 2020 Virginia labor rates manually inputted
- Second half 2019 money rate used per U.S. Treasury Department figures published in the Federal Register
- Fuel costs based on February 2020 local rates.
- Hydraulic dredging costs for the Inner Harbor Channels, Newport News Channel, and Anchorage ‘F’ have been revised to reflect use of a 24-inch dredge based on comments provided by the District indicating this is the maximum recommended size that can be accommodated at CIDMMA for meeting effluent water quality requirements (previously, a 30-inch dredge was assumed). **Note:** this change results in higher costs for these segments than what was originally used for the GRR.
- All the estimated costs have been updated using updated CEDEP files. Primarily the Economic Index and the Fuel Price was updated. Also, the TPCS CWCCIS TAB was updated from 2019 to 2021.

4.2 Estimated Project Cost and Assumptions

Dredging costs were developed by the VPA based on contract bids for TSC-W and TSC-E and MA2 Bids (Appendix B). Cost assumptions include:

- MA1 is estimated to take approximately 18 months to complete, requiring at least two mobilizations due to the 2.5-month seasonal dredge restriction imposed on hopper dredges.
- MA2 is estimated to take approximately 3.5 months to complete.
- Pre-construction, engineering, and design (PED) costs are estimated for input into the total project costs.

- The estimate for PED includes a breakdown of field work including sediment sampling and testing, engineering, and surveys to assemble bid documents, as well construction management and support through construction.
- Maintenance costs were derived from the GRR FY2018 values and escalated to FY2022 using the USACE escalation tables.
- A contingency of 10% was applied to all costs.
- O&M costs are split 50% Federal and 50% non-Federal. This is the guidance of Appendix E of ER 1105-2-100 (Table E-10). This is a general navigation feature deeper than -50 feet.
- "Relocation of Aids to Navigation" is determined to be $50K for each Meeting Area but the cost is the responsibility of the U.S. Coast Guard and not included in the Cost Table 4-1.

Costs are presented for MA1 (1,400 feet wide x 5 miles long) and MA2 (1,300 feet wide) (Table 5-1). Please note the without-project condition width in the proposed meeting areas is 1,000 feet. The channel widening in Meeting Areas 1 and 2, therefore, is limited to an additional 200 feet on either side of the main channel.

4.3 Section 902 Authorized Maximum Cost of Projects

Because this project was authorized in WRDA 1986, the Section 902 limit on total project cost applies. The Total Project Cost Summary (TPCS), updated for this Report/SEA is located in the Cost Appendix B. The TPCS states the entire Norfolk Harbor Navigation Improvements Project is $419M, which is an increase over the original GRR/EA TPCS (2018) of $297M. The MA1 costs of $85,255,216 and MA2 costs of $14,624,700 are included in the updated TPCS. These updated costs are still well below the ~$1,400M Section 902 limit for the combined Norfolk Harbor Navigation Improvements Project and Elizabeth River Southern Branch Navigation Improvements projects.

Table 4-1. Meeting Area 1 & 2 Construction Costs in FY2022 dollars

Meeting Area 1 & 2 Construction Costs (New Work + O&M) FY2022 Dollars		
	West Side (TSC-W) (5.1 Statute miles)	East Side (TSC-E) (Construction Scheduled Jan 2022)
Description	MA1 @ 1,400'	MA2 @ 1,300'
Dredging Cost (with mob/demob)	$ 70,996,000	$ 10,865,190
Local Service Facility Construction Costs	0	0
Environmental Mitigation	0	0
Monitoring	0	0
Construction Management, Delta Increase for Meeting Area	$ 3,871,600	$ 916,600
PED, Delta Increase for Meeting Area	$ 2,637,142*	$ 1,513,392*
Lands & Damages	0	0
Contingency (10.0%)	$ 7,750,474	$ 1,329,518
Construction Duration (months), Delta Increase over TSC	18	3.5
Additional PED Duration (months)	12	2
Total Cost (New Work)	$ 85,255,216	$ 14,624,700
Additional Annual Maintenance Costs	$ 1,263,678	$ 678,609
Additional Maint Vol from Deepening (CY/Year)	52,155 CY/Year	30,535 CY/Year
Total Maintenance Vol (CY/Year)	52,155 CY/Year	30,535 CY/Year
50-Year Est Maint Volume Increase (CY)	2,607,750 CY	1,526,750 CY
50-Year Est Maint Volume Increase (months of dredging)	36	15
Note: Both Meeting Areas have determined a cost of Relocating Aids to Navigation in the amount of $50K per Meeting Area. This cost is the responsibility of the U.S. Coast Guard and is not included in the Total Cost table. Maintenance costs were derived from the GRR FY18 values and escalated to FY2022 using the USACE escalation tables.		

5 ECONOMIC ANALYSIS

The purpose of this section is to provide discussion of the economic analysis on the TSC Meeting Areas. This analysis has been undertaken due to changed conditions at Norfolk Harbor. The container ship fleet has transitioned to larger vessels at a faster rate than was projected in the GRR/EA completed in 2018. As a result, the NFS requested an update of the economics to account for this in the analysis of the two meeting areas in TSC.

5.1 Economic Update Analytical Methods & Assumptions

Incorporation of the change in the container shipping fleet sizes into the analysis of the meeting areas required multiple steps. First, it was necessary to verify the extent of the change in the container shipping fleet. Then, an annualized port traffic list was developed based on the new existing condition. Next, the commodity growth rates, load factor analysis parameters, and fleet transition rates derived from the GRR/EA were applied to the newly developed baseline port traffic to develop the future port traffic list. The future port traffic lists were then adjusted to reflect a -55' project depth.

It should be noted that the analysis up to this point dealt strictly with container ship traffic moving through terminals at Norfolk Harbor. However, an assessment of the widening required incorporating the coal bulker trade moving through Newport News and Pier 6, the naval traffic, as well as all the shipping moving through Elizabeth River Southern Branch. Container vessels moving through Newport News, Norfolk International Terminal (NIT), Virginia International Gateway (VIG), and Portsmouth Marine Terminal (PMT) were the only portion of the Hampton Roads fleet that incorporated updated fleet transition and loading behavior. All other vessel loading, sailing, and ship call frequencies are the same as they were at time of the GRR/EA.

Updated Norfolk Harbor Economic Widening Analysis vs. Norfolk Harbor GRR/EA

The updated economic analysis for this report is similar to the economics conducted for the GRR/EA. A All of the analytical components, inputs, assumptions, and relationships are defined in the economics appendix for the 2018 GRR/ EA. The only items that changed are the baseline and projected container cargo traffic vessel calls to Norfolk Harbor. These changes pertain to the baseline fleet and cargo composition, shipment sizes, and the overall number of container ship calls projected to move through the harbor over the period of analysis.

All other elements of the economic modeling and analysis are the same as the GRR/EA. Please reference the economics appendix of the GRR/EA for more details on that topic.

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Once the future port traffic list was developed and representative of all the Hampton Roads traffic, the HarborSym model was configured to perform an analysis of the meeting areas in two phases. In the first phase, an economic assessment of MA2 was conducted to measure the impact of the changed fleet conditions on the economic justification of widening TSC-E at the current FY2022 Water Resources Discount Rate (2.25%) and at the 7.00% OMB Discount Rate for budgeting purposes. In the second phase, an economic assessment of MA1 was performed on TSC-W, also at the current

FY2022 Water Resources Discount Rate (2.25%) and at the 7.00% OMB Discount Rate. The analysis was organized into four major steps:

- Step-1: Development of the baseline vessel call list
- Step-2: Projection of future vessel call lists
- Step-3: Economic reevaluation of Thimble Shoal Channel East (MA2)
- Step-4: Economic evaluation of Thimble Shoal Channel West (MA1)

In the sections that follow, data and analysis will be presented to explain these steps in terms of what they are, why they were conducted, and the overall result.

5.2 Step 1: Existing Conditions & Baseline Port Traffic – Future Without Project

The baseline port traffic was derived based on VPA data from calendar year 2019, 2020, and the 1st 6 months of 2021. For the purposes of analysis, port traffic details will be expressed in terms of cargo tonnages and vessel calls. VPA data was converted to a total tonnage (import & export) value per call for use in the analysis as follows:

- Total Imported Tonnes ~ (Box Weight per TEU*(#Loaded TEU Imports + #Empty TEU Imports)) + Imported Cargo Weight
- Total Exported Tonnes ~ (Box Weight per TEU*(#Loaded TEU Exports + #Empty TEU Exports)) + Exported Cargo Weight

The annualized number of baseline calls and cargo tonnages by vessel class and trade route was estimated as follows:

1. A preliminary annualized cargo volume was estimated by averaging the monthly totals for 2019, 2020, and 2021 for loaded and total import & export twenty-foot equivalent units (TEUs), and loaded and total import and export tonnages. This average monthly total was summed for all 12 months to estimate an annualized total for each route group.
2. The annualized cargo volumes for each of the aforementioned route groups was distributed by vessel class based on cargo proportions developed from the existing condition data.
3. The mean shipment size for each trade route and vessel class was derived based on the existing condition data.
4. The annualized number of vessel calls was developed by dividing the annualized cargo volume per trade route and vessel class by the mean shipment size. The number of calls was computed for total TEU imports, loaded TEU imports, total imported tonnes, loaded imported tonnes, total TEU exports, loaded TEU exports, total TEU tonnes, and loaded TEU tonnes. Each of these eight categories was compared with the number of vessel calls per year for 2019, 2020, and 2021 from the VPA data. Vessel calls computed based on loaded export TEUS and loaded export tonnes that resulted in excessively high or excessively low vessel call numbers were excluded. The remaining vessel call categories were relatively consistent with the existing condition data per year. The maximum number of calls for the remaining six categories was used for the final

annualized baseline for each trade route and vessel class combination. Table 4-1 provides detail on the annual number of vessel calls by trade route and vessel class for each calendar year as well as the annualized 2021 baseline.

5. The annualized total number of calls was multiplied by the mean shipment size to compute the annualized baseline for total import tonnes and total export tonnes. Table 5-1, Table 5-2 and Table 5-3 provide detail container cargo tonnes per year as well as the annualized baseline for imports and exports respectively.

Table 5-1. Container Calls by Vessel Class & Trade Route

Route	Class	2019	2020	2021	2021 Baseline Calls
AF-SA-CAR-ECUS	SPX	78	74	38	77
	PX	26	21	10	23
	PPX1	106	95	45	98
	PPX2	47	23	4	30
	PPX3	5	0	0	2
	PPX3-Max	2	2	0	2
EU-MED-ECUS	SPX	36	41	41	47
	PX	236	247	96	231
	PPX1	132	159	87	151
	PPX2	131	119	55	122
	PPX3	26	19	9	22
	PPX3-Max	3	3	8	6
FE-PAN-ECUS	SPX	1	0	0	-
	PX	0	0	0	-
	PPX1	1	2	0	2
	PPX2	157	105	55	128
	PPX3	71	66	22	64
	PPX3-Max	72	111	76	105
FE-SUEZ-ECUS	SPX	1	4	5	4
	PX	1	3	6	4
	PPX1	70	15	12	39
	PPX2	48	90	65	81
	PPX3	47	41	30	47
	PPX3-Max	67	81	50	79
# Vessel Calls		# Vessel Calls	1364	1321	714

Table 5-2: Imported Container Cargo Tonnes by Vessel Class & Trade Route Group

Route	Class	2019	2020	2021*	2021 Baseline Import Tonnes
AF-SA-CAR-ECUS	SPX	130,936	126,502	63,987	130,261
	PX	34,224	10,302	5,710	20,271
	PPX1	931,761	835,556	406,145	865,851
	PPX2	638,926	285,960	39,603	391,009
	PPX3	80,719	-	-	32,288
	PPX3-Max	35,110	36,557	-	35,834
EU-MED-ECUS	SPX	88,299	105,138	235,884	171,001
	PX	903,608	975,037	330,663	881,434
	PPX1	1,423,538	1,121,414	657,290	1,279,202
	PPX2	1,961,284	1,756,412	889,803	1,842,999
	PPX3	432,668	279,954	154,407	353,234
	PPX3-Max	44,530	27,169	124,391	84,039
FE-PAN-ECUS	SPX	5,464	-	-	-
	PX	-	-	-	-
	PPX1	8,857	22,631	-	20,992
	PPX2	1,592,165	1,160,986	647,370	1,373,081
	PPX3	776,410	648,323	185,430	648,116
	PPX3-Max	1,104,256	1,601,338	1,122,356	1,551,871
FE-SUEZ-ECUS	SPX	1,706	27,948	24,572	21,690
	PX	2,157	17,612	61,153	32,369
	PPX1	212,129	93,046	110,116	166,973
	PPX2	604,998	911,493	846,809	942,992
	PPX3	708,192	585,622	533,444	727,806
	PPX3-Max	1,169,159	1,365,839	825,080	1,340,637
Total Container Cargo Import Tonnes		**12,891,096**	**11,994,839**	**7,264,214**	**12,913,950**

Table 5-3: Exported Container Cargo Tonnes by Vessel Class & Trade Route

Route	Class	2019	2020	2021*	2021 Baseline Export Tonnes
AF-SA-CAR-ECUS	SPX	145,455	162,046	120,674	185,577
	PX	45,032	38,489	28,763	49,382
	PPX1	501,234	435,334	219,570	463,554
	PPX2	433,221	200,439	16,079	219,519
	PPX3	47,194	-	-	18,878
	PPX3-Max	28,704	25,431	-	-
EU-MED-ECUS	SPX	69,127	61,476	47,280	71,640
	PX	1,471,856	1,551,969	748,771	1,564,613
	PPX1	786,281	815,219	699,073	962,331
	PPX2	1,164,931	1,133,135	588,360	1,183,897
	PPX3	230,437	215,843	86,762	218,997
	PPX3-Max	10,008	6,770	52,881	24,405
FE-PAN-ECUS	SPX	580	-	-	-
	PX	-	-	-	-
	PPX1	12,106	23,598	-	23,905
	PPX2	2,712,068	1,770,583	989,634	2,224,229
	PPX3	1,252,341	1,389,291	403,839	1,216,956
	PPX3-Max	1,319,056	1,921,883	1,509,929	1,942,569
FE-SUEZ-ECUS	SPX	-	4,087	5,896	2,935
	PX	784	2,970	16,220	5,970
	PPX1	492,767	103,375	84,158	272,277
	PPX2	670,577	977,809	666,838	947,537
	PPX3	703,272	525,877	401,702	645,147
	PPX3-Max	1,058,330	1,533,920	774,583	1,322,589
Total Container Cargo Export Tonnes		**13,155,360**	**12,899,545**	**7,461,013**	**13,566,905**

Table 5-4 and Table 5-5 provide a comparison of annualized vessel calls and cargo volumes between the GRR/EA and the annualized calls based on the most recent VPA data respectively. SPX, and PX ship calls show significant decreases over this period. PPX1 vessel calls show a mild decrease in comparison. PPX2 and PPX3 vessels have increased significantly. The greatest change is the massive increase in PPX3 capacity replacing PX capacity. The number of calls has decreased by 25% while the cargo volume has increased by 57%.

Table 5-4: Comparison of Annualized Containership Baseline Calls

Vessel Class	2015 Baseline	2021 Baseline	% Change in Baseline
SPX	243	128	-47.3%
PX	975	258	-73.5%
PPX1	303	290	-4.3%
PPX2	202	361	78.7%
PPX3	100	135	
PPX3-Max	0	192	227.0%
Total Calls	**1823**	**1364**	**25%**

Table 5-5. Comparison of Annualized Containership Baseline Tonnes

Vessel Class	2015 Baseline	2021 Baseline	% Change in Baseline
SPX	842,578	583,104	-30.8%
PX	7,168,441	2,554,039	-64.4%
PPX1	3,728,309	4,055,084	8.8%
PPX2	3,252,684	9,125,262	180.5%
PPX3	1,893,629	3,861,421	
PPX3-Max	-	6,301,944	436.7%
Total Tonnes	**16,885,641**	**26,480,855**	**-57%**

5.3 Step 2: Projection of Future Port Traffic – based on GRR/EA

Future port traffic at the Port of Hampton Roads was derived by taking the baseline cargo tonnages and vessel calls and applying the cargo growth rates and fleet transition rates developed in the GRR/EA. Table 4-6 provides details on the commodity growth rates that were applied to the baseline cargo tonnages to project the future cargo traffic. Cargo was projected for 2024 (base year), 2030, 2035, 2040, and 2045. Table 4-7 provides details on the updated container cargo projections in tonnes. The updated commodity projections by trade route were distributed by vessel class and then further adjusted with the same fleet transition rates that

were applied in the 2018 GRR. The vessel load factor analysis was updated with more current shipment sizes based on the VPA existing condition dataset. This allowed the projected port traffic to be adjusted to load deeper to account for the 55' deepening. Finally, the remaining traffic at the port of Hampton Roads was added to the total vessel calls based on the GRR/EA.

Table 5-6: Container Cargo Growth Rates

	2021-2024	2024-2030	2030-2035	2035-2040	2040-2045
FE-PAN-ECUS	3.78%	4.08%	3.25%	2.97%	2.72%
FE-SUEZ-ECUS	3.87%	4.20%	3.71%	3.53%	3.36%
EU-MED-ECUS	2.72%	2.98%	2.70%	2.50%	2.30%
AF-SA-CAR-ECUS	3.90%	4.60%	4.50%	4.29%	4.05%
IMPORT CONTAINER GROWTH RATES (TONNES)					
Year Range	**2021-2024**	**2024-2030**	**2030-2035**	**2035-2040**	**2040-2045**
FE-PAN-ECUS	3.41%	4.00%	3.40%	3.11%	2.83%
FE-SUEZ-ECUS	3.54%	4.24%	3.97%	3.79%	3.61%
EU-MED-ECUS	2.47%	3.11%	3.02%	2.82%	2.60%
AF-SA-CAR-ECUS	3.87%	4.88%	4.96%	4.75%	4.49%
EXPORT CONTAINER GROWTH RATES (TONNES)					
Year Range	**2021-2024**	**2024-2030**	**2030-2035**	**2035-2040**	**2040-2045**
FE-PAN-ECUS	4.11%	4.15%	3.10%	2.84%	2.62%
FE-SUEZ-ECUS	4.25%	4.16%	3.40%	3.20%	3.04%
EU-MED-ECUS	3.06%	2.80%	2.23%	2.04%	1.85%
AF-SA-CAR-ECUS	3.96%	4.05%	3.57%	3.31%	3.05%

Table 5-7: Updated Commodity Projections in Tonnes by Trade Route

Route Group	2021	2024	2030	2035	2040	2045
FE-SUEZ-ECUS	6,428,921	7,155,217	8,959,446	10,620,942	12,493,987	14,591,170
FE-PAN-ECUS	9,001,718	9,907,975	12,331,161	14,332,520	16,461,262	18,701,512
EU-MED-ECUS	8,637,793	9,153,015	10,789,018	12,244,055	13,777,355	15,365,052
AF-SA-CAR-ECUS	2,412,423	2,723,523	3,474,399	4,255,334	5,167,722	6,215,446
Total	**26,480,855**	**28,939,730**	**35,554,025**	**41,452,850**	**47,900,326**	**54,873,179**

Table 5-8 provides detail on the total number of vessel calls by container ship class and overall vessel type. It should be noted that while the overall number of large PPX3 vessels calls is projected to increase dramatically over the period of analysis, the overall number of containership calls is approximately 27% less than what was projected for the GRR/EA.

Table 5-8: Port of Hampton Roads Fleet Projections

Vessel Call Projections by Containership Class at Norfolk Harbor						
Vessel Class Name	**2021**	**2024**	**2030**	**2035**	**2040**	**2045**
SPX	128	111	79	54	65	75
PX	257	204	117	63	70	80
PPX1	271	303	384	461	533	616
PPX2	335	360	378	305	350	396
PPX3	135	166	256	366	423	484
PPX3-Max	192	231	335	467	542	622
Containership Class Subtotal	**1318**	**1375**	**1549**	**1716**	**1983**	**2273**

Vessel Calls Projections by Vessel Type at Port of Hampton Roads						
Vessel Type Name	**2021**	**2024**	**2030**	**2035**	**2040**	**2045**
Containership	1318	1375	1549	1716	1983	2273
10-30K DWT Bulker	106	104	120	133	138	150
40-70K DWT Bulker	233	194	208	220	232	247
Capesize Bulker	514	399	411	421	427	436
Tanker	71	71	78	82	87	90
Tanker Barge	1142	1142	1195	1239	1285	1337
Dry Cargo Barge	1270	1270	1403	1481	1553	1617
General Cargo Ship	121	121	143	156	167	179
Navy	949	949	949	949	949	949
Other	1383	1383	1383	1383	1383	1383
Gas Carrier	12	12	12	12	12	12
Cruise Ship	22	22	22	22	22	22
Total Vessel Calls	**7141**	**7042**	**7473**	**7814**	**8238**	**8695**

5.4 Step 3: Economic Reevaluation Assumptions for TSC-E (MA2)

The economic evaluation of TSC-E (MA2) was conducted under the following assumptions:

MA2 Economic Parameters

- Vessel Operating Cost are based on EGM 20-04 and are assumed to be reflective of FY2021 price levels
- Base Year: 2024

- Discount Rate
  - FY 2022 Federal Water resources Discount Rate (2.25%)
  - OMB Rate (7.00%)

MA2 Future Without Project (FWOP) Assumptions

- Planning Segment-1 has been deepened to 55'
- Planning Segment-2 has been deepened to 55'
- Thimble Shoal Channel East is 1,000 ft wide
- Thimble Shoal Channel West is 1,000 ft wide
- Anchorage F has not been widened and has a depth of 50'
- HarborSym Assumptions
  - # Iterations = 50
  - Major transit rule for Thimble Shoal Channel – Combined Beam Width rule only allows meeting if the combined beam width of both vessels take up to approx. 0.175 of the channel width or less.

MA2 Future With Project (FWP) Assumptions

- Planning Segment-1 has been deepened to 55'
- Planning Segment-2 has been deepened to 55'
- Thimble Shoal Channel East is 1,300 ft wide
- Thimble Shoal Channel West is 1,000 ft wide
- Anchorage F has not been widened and has a depth of 50'
- HarborSym Assumptions
  - # Iterations = 50
  - Major transit rule for Thimble Shoal Channel – Combined Beam Width rule only allows meeting if the combined beam width of both vessels take up to approx. 0.264 of the channel width or less.

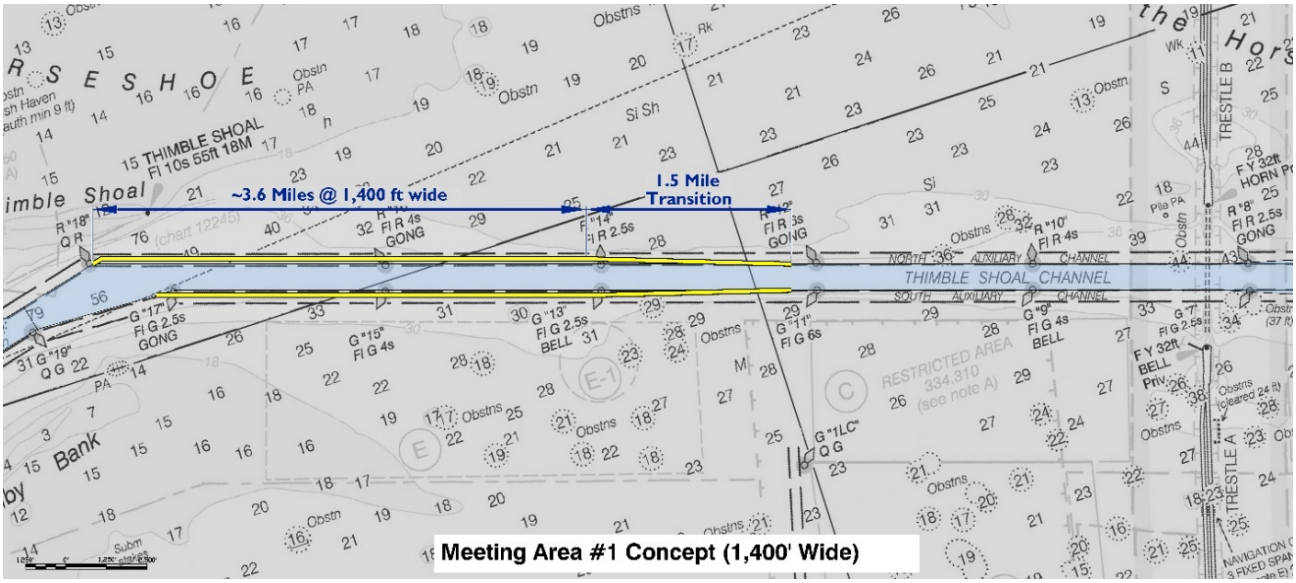

Figure 5-1. Meeting Area 1 Concept.

5.5 Step 4: Economic Evaluation Assumptions for TSC-W (MA1)

The economic evaluation of Thimble Shoal Channel East (MA1) was conducted under the following assumptions:

MA1 Economic Parameters

- Vessel Operating Cost are based EGM 20-04 and are assumed to be reflective of FY2021 price levels
- Base Year: 2024
- Discount Rate
  - FY 2022 Federal Water resources Discount Rate (2.25%)
  - OMB Rate (7.00%)

MA1 FWOP Assumptions

- Planning Segment-1 has been deepened to 55’
- Planning Segment-2 has been deepened to 55’
- Thimble Shoal Channel East is 1,300 ft wide
- Thimble Shoal Channel West is 1,000 ft wide
- Anchorage F has been widened to 3620’ and deepened to 51’
- HarborSym Assumptions
  - # Iterations = 50
  - Major transit rule for TSC– Combined Beam Width rule only allows meeting if the combined beam width of both vessels take up to approx. 0.264(TSC-E) and 0.175 (TSC-W) of the channel width or less.

MA1 Future With Project Assumptions

- Planning Segment-1 has been deepened to 55'
- Planning Segment-2 has been deepened to 55'
- Thimble Shoal Channel East is 1,300 ft wide
- Thimble Shoal Channel West is 1,400 ft wide
- Anchorage F has been widened to 3620' and deepened to 51'
- HarborSym Assumptions
  - # Iterations = 50
  - Major transit rule for Thimble Shoal Channel – Combined Beam Width rule only allows meeting if the combined beam width of both vessels take up to approx. 0.264(TSCE) and 0.245(TSCW) of the channel width or less.

5.6 Widening Analysis Methods & Results

Evaluation of both TSC widening options used the HarborSym model with the parameters described in step 4. All benefits are based on reducing the amount of time vessels need to transit the port of Hampton Roads by alleviating the "bottle neck" in TSC. NED benefits reflect the difference in port cost based on reducing the amount of time in hours needed to make transits in and out of the Port of Hampton Roads. For all other parameters see the economic appendix for the GRR/EA. and illustrate the results of the MA2 and MA1 widening analyses respectively.

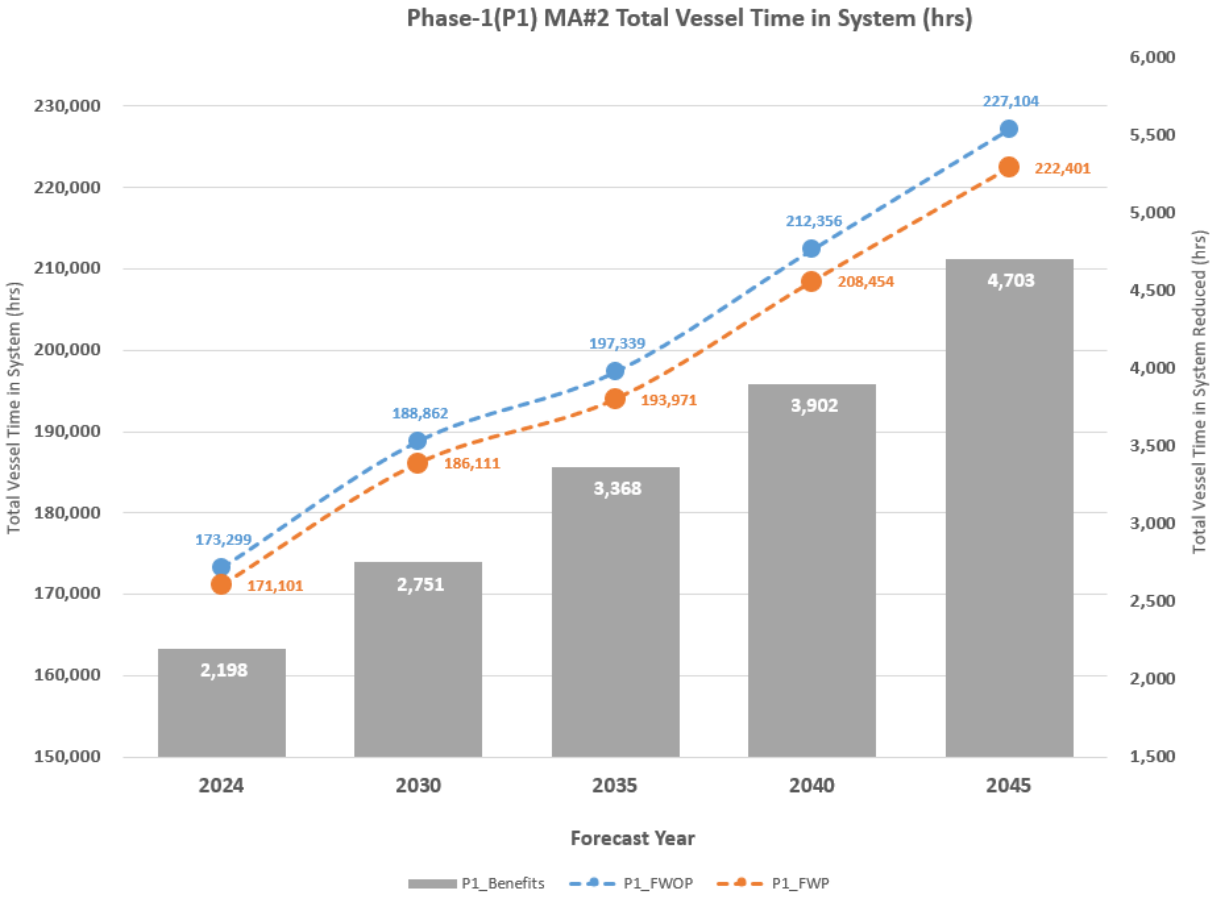

Figure 5-2. MA2 Total Hours in System per Model Year

Figure 5-2 illustrates the results of the phase 1 (MA2) widening analysis, and Figure 5-3 shows the same for phase 2 (MA1). The charts reflect the difference in total time in system vessels needed to transit the harbor between the with and without project condition. The blue (FWOP) and orange marker (FWP) and line displays the number of hours each port traffic list for each model year needed to transit the harbor. The grey bars show the difference between FWOP and FWP in terms of the number of hours reduced due to widening. Note that the MA1 widening provides significantly greater reductions in the total vessel time in system in comparison to MA2

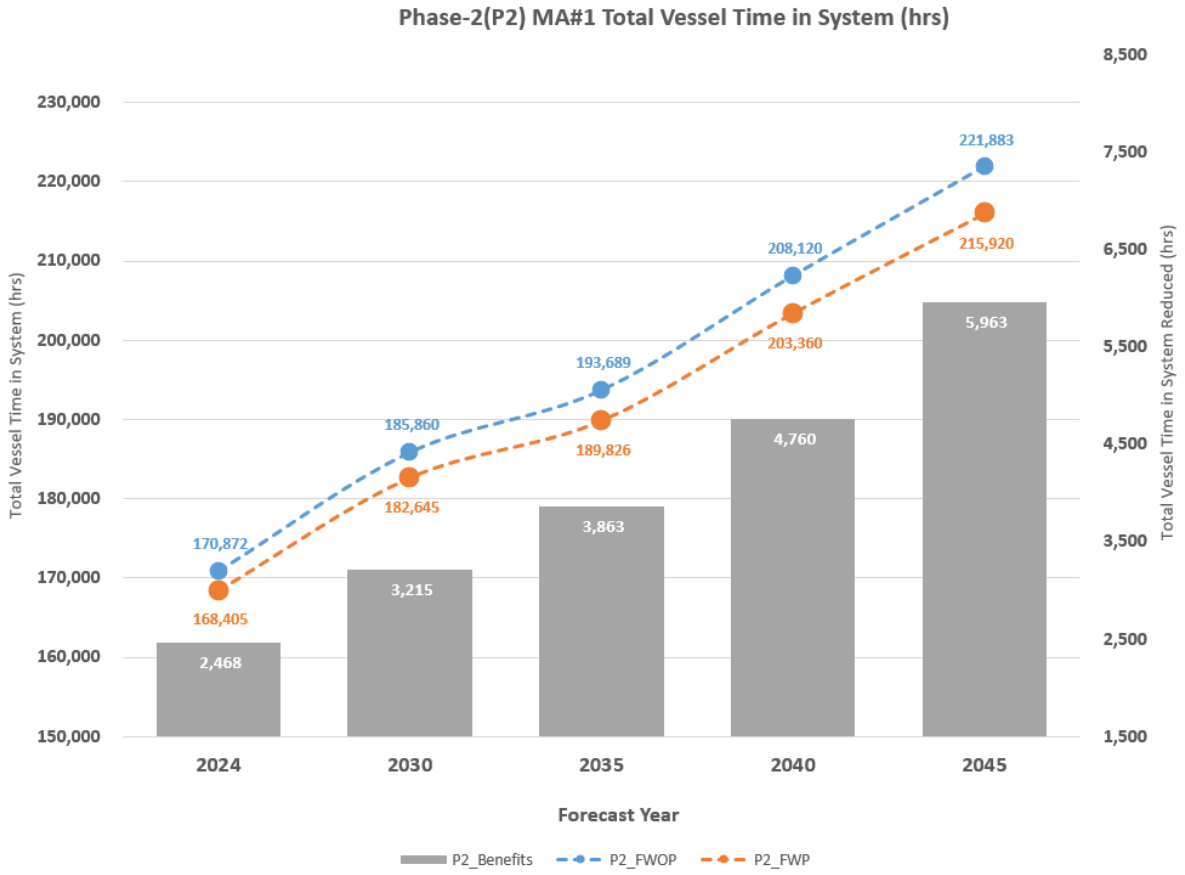

Figure 5-3: MA1 Total Hours in System per Model Year

Table 5-10 provides detail on the results of the widening analysis by model year for the FWOP and FWP conditions for both meeting areas. The values reflect the port costs associated with each model year port traffic lists calling for the MA2 and MA1 analyses.

The economic cost for the widening is based on the cost reflected in Table 5-10. Table 5-10 and Table 5-11 provides an economic cost breakdown at 2.25% and 7.00% discount rates respectively.

Table 5-9. NED Present Value and AAEQ Cost at 2.25%

NED Cost for MA2 & MA1 at 2.25%		
Cost Item	**MA2**	**MA1**
Total Initial Construction Cost	$14,674,699	$85,125,215
Interest During Construction	$90,376	$1,672,845
Economic Investment Cost	$14,765,075	$86,798,060
Annual O&M	$678,609	$1,263,678
AAEQ NED Cost	**$1,174,000**	**$4,173,000**

Table 5-10: NED Present Value and AAEQ Cost at 7.00%

NED Cost for MA2 & MA1 at 7.00%		
Cost Item	**MA2**	**MA1**
Total Initial Construction Cost	$14,674,699	$85,125,215
Interest During Construction	$276,858	$5,221,583
Economic Investment Cost	$14,951,557	$90,346,798
Annual O&M	$678,609	$1,263,678
AAEQ NED Cost	**$1,762,000**	**$7,810,000**

Table 5-13 provides an economic summary of all benefits and costs for both meeting areas at 2.25% and 7% discount rates. MA2 is economically justified at both discount rates while MA1 is only economically justified at 2.25%. MA1 generates 24% more benefits than MA1, because vessels are more likely to meet on the western side of the Chesapeake Bay Bridge Tunnel. However, widening costs are significantly higher in this channel reach.

Table 5-11: Results of Widening Analysis

Model Year	MA2 Widening Analysis Results			MA1 Widening Analysis Results		
	FWOP	**FWP**	**Benefits**	**FWOP**	**FWP**	**Benefits**
2024	$185,383,584	$183,517,330	$1,866,254	$183,170,822	$181,032,110	$2,138,712
2030	$204,461,407	$202,026,950	$2,434,457	$201,584,616	$198,705,346	$2,879,271
2035	$218,285,754	$215,203,162	$3,082,593	$214,704,654	$211,090,787	$3,613,867
2040	$235,883,080	$232,220,103	$3,662,977	$231,652,856	$227,128,168	$4,524,688
2045	$254,400,605	$249,902,776	$4,497,829	$249,150,665	$243,444,933	$5,705,732

Table 5-12: Norfolk Harbor Widening Economic Summary

Norfolk Harbor Widening Economic Update Preliminary Results		AAEQ	
		2.25%	7%
Meeting Area 2 Analysis (Thimble Shoal East Widening)	FWOP	$237,274,000	$234,210,000
	FWP	$233,592,000	$230,912,000
	NED Benefits	$3,682,000	$3,298,000
	NED Costs	$1,174,000	$1,762,000
	Net NED Benefits	$2,508,000	$1,536,000
	BCR	**3.1**	**1.9**
Meeting Area 1 Analysis (Thimble Shoal West Widening)	FWOP	$232,974,000	$230,352,000
	FWP	$228,417,000	$226,345,000
	NED Benefits	$4,557,000	$4,007,000
	NED Costs	$4,173,000	$7,810,000
	Net NED Benefits	$384,000	-$3,803,000
	BCR	**1.1**	**0.5**

5.7 Without-Project Conditions Maintenance Dredging Assumptions

Under without-project conditions, recent historical maintenance dredging practices are projected to continue. Maintenance dredging will continue annually with individual channel reaches being dredged in alternate years as needed. The total projected maintenance dredged material volume over the 50-year study period is 66.7 MCY. Note that by approximately 2044, CIDMMA is projected to stop receiving dredged material and maintenance material from the inner channels will be placed at the NODS.

5.8 With-Project Maintenance and Construction Dredging Assumptions

The project is estimated to take approximately 18 months to complete, which will require at least two mobilizations due to the 2.5-month seasonal dredge restriction imposed on hopper dredges.

Sediment samples for this segment (and experience from the deepening of the main channel) indicate the material is predominantly silts (~55%), clays (~30%), and fine sands (~15%). Beneficial use opportunities for this type of material have not been identified. Regionally, there is a preference for sandier dredged material to support dike construction at CIDMMA and beach nourishment efforts.

Offshore placement is planned for DNODS, resulting in a one-way haul distance of approximately 25 miles. The project area is subject to Northern Right Whale protocols that limit transit speeds to less than 10 knots. For the dredging, a single generic large hopper dredge was assumed (7,600 CY volume; 4,500 CY effective capacity based on site conditions). Equipment, fuel, and other rates reflect currently available data.

Mobilization/Demobilization and turtle trawling rates reflect recent project bid results at the Port for dredging projects in FY 2020 and FY 2021. Turtle trawling is only necessary if the project experiences a specified number of takes, but 60 days is a typical bid amount for a project of this duration.

Dredged Areas and Volumes Summary

For MA1, the following dredge volumes were estimated based on the after-dredge surveys of the deepened TSC performed from March 2020 to June 2021. To widen the channel 200 ft on each side of the main channel to a required depth of -56 ft plus 1 foot of pay overdepth and 1 foot of non-pay overdepth, the following volumes are estimated:

Volume to required depth: 4,227,546 CY
Additional 1 ft pay overdepth: 362,011 CY
Additional 1 ft non-pay overdepth: 368,228 CY
Total Volume: 4,957,785 CY (4,589,557 CY Pay Vol)

For MA2, the following dredge volumes were also estimated based on the dredge surveys of the deepened TSC performed from March 2020 to June 2021. To widen the channel 150 ft on each side to a required depth of -56 ft plus 1 foot of pay overdepth and 1 foot of non-pay overdepth, the following volumes are estimated:

Volume to required depth: 1,186,000 CY
Additional 1 ft pay overdepth: 203,000 CY
Additional 1 ft non-pay overdepth: 250,000 CY
Total Volume: 1,789,000 CY (1,789,000 CY Pay Vol)

6 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the existing environmental and socioeconomic conditions found within the Region of Influence (ROI), the area of potential impact of the project alternatives. This chapter has been prepared in accordance with the NEPA and the CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations (CFR) 1500-1508), regulations. This section summarizes the existing (baseline) conditions, to provide a sound basis for plan formulation as described in Section 4 and the impact analysis. For both existing and future either with or without implementation of an action alternative, dredged material placement/disposal could occur at the CIDMMA, the DNODS, and the NODS. Although not anticipated, dredged material not meeting open ocean disposal or CIDMMA placement requirements would be required to be disposed of at an approved, upland disposal facility.

The Affected Environment for this Report/SEA is fully described in the USACE (2018) Norfolk Harbor Navigation Improvements GRR/EA for the following sections:

- Geology, Physiography, and Topography
- Vegetation, Wetlands, and Submerged Aquatic Vegetation
- Plankton Community
- Wildlife
- Noise and Vibration
- Utilities
- Aesthetics
- Recreation
- Transportation

Because the USACE (2018) GRR/EA fully describes the Affected Environment for these sections they are not repeated in this chapter. There would be no effects to Land Use/Induced Development, therefore, this topic is dismissed from further discussion.

For the Environmental Consequences Section, the No Action/Future Without Project Alternative assumes that the Norfolk Harbor Navigation Improvements will be completed, as described in the GRR/EA. These impacts were already evaluated previously, and a Finding of No Significant Impact (FONSI) was issued for them. Therefore, the No Action/Future Without Project Alternative includes those effects and serves as the baseline from which to compare the Project Action Alternative, for this Report/SEA.

One consideration important in the environmental impact analysis is that the actual dredged depths can be deeper than the required channel depths. Required depths do not necessarily indicate the maximum, potential dredging depths which may also include Advanced Maintenance Dredging (1 foot), Paid Allowable Overdepth Dredging (2 feet), and Non-Pay Allowable Overdepth dredging (2 feet) for Norfolk Harbor. Please see Table 6-2 under the Bathymetry Environmental Consequences, for an approximate estimate of estimated maximum, potential dredging depths that account for the overdepth and advanced maintenance dredging with implementation of the Action Project Alternative. For the purposes of the environmental

impact analysis (as described in the Environmental Consequences sections), the full range of environmental impacts including the maximum, potential dredging depths were evaluated. The full range of potential environmental impacts, the maximum depths, volumes, and dredging durations in the environmental analysis are greater than those assumed in the economic analysis are being considered.

Table 6-1 provides a summary of the impacts for the resources that could be potentially affected by implementation of the project alternatives.

Table 6-1: Environmental consequences of the project alternatives summary table.

Resource	No Action Alternative/Future Without Project Alternative	Action Project Alternative
Geology, Physiography, and Topography	There would be no impacts to geology or physiography. Continued use of the potential dredged material placement/disposal sites would have an adverse, permanent, and negligible to minor impact to topography. Topography may change at a slightly higher rate at the CIDMMA because of increased dredging volumes placed/disposed at the CIDMMA. There would be no effect on seismicity because the ROI is not within a seismically active geologic setting.	There would be no impacts to geology or physiography. Impacts to topography would be at the same threshold level of impact as the NAA/FWO (adverse, permanent, and negligible to minor).
Bathymetry, Hydrology, and Tidal Processes	Per the Norfolk Harbor Navigation Improvements GRR/EA (USACE 2018), the dredging, disposal, and maintenance will alter the bathymetry in the navigation channels, deepening it and removing all the sediments currently occupying this area. This may also potentially increase the tidal prism in the channel. This bathymetric alteration may influence effects of the tides. These impacts would be adverse, permanent, and minor.	The additional channel dredging and widening associated with MA1 will alter the bathymetry in the navigation channels slightly more than described in the GRR/EA. The dredging could deepen areas to the north and south of the existing channel, by as much as 20 feet. This may also potentially increase the tidal prism in the channel. This bathymetric alteration may influence effects of the tides locally around MA1. These impacts would be adverse, permanent, and minor.

Resource	No Action Alternative/Future Without Project Alternative	Action Project Alternative
Hazardous, Toxic, and Radioactive Waste (HTRW)	Per the GRR/EA (USACE 2018), extensive sediment testing conducted over the last decade within the ROI has consistently met guidelines for upland and offshore ocean disposal sites. Therefore, dredging, disposal, and maintenance would continue to have an adverse, temporary, negligible level of impact and will remain within dredged material placement/disposal limits at the CIDMMA and open ocean disposal sites.	The marine sediments along 11 statute miles of Thimble Shoal Channel met the criteria for the Limiting Permissible Concentrations for water quality criteria, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement of the dredged material at either the DNODS or the NODS is acceptable. Therefore, impacts would be at the same threshold level of impact as the NAA/FWO: temporary and negligible and are not expected to have any substantive permanent adverse impacts.
Water Quality	Temporary increases in Total Suspended Solids, turbidity, and nutrients resulting from dredging and dredged material placement/disposal would continue. The dredging operations, material placement/disposal and the discharge of effluent from the CIDMMA would result in adverse, temporary impacts to water quality that are negligible to minor.	Temporary impacts to water quality would be at the same threshold level of impact as the NAA/FWO Project Alternative (adverse and negligible to minor), however, the relative level of impact with the Action Project Alternative would be only slightly higher due to the increased duration of dredging and dredged material placement/disposal.
Vegetation, Wetlands, and Submerged Aquatic Vegetation	Dredging and dredged material placement/disposal would not impact any Submerged Aquatic Vegetation (SAV) or wetlands. Placement/disposal of dredged material may alter the topography and consequently vegetation cover at the CIDMMA. Placement of the dredged material may result in temporary to permanent, negligible, impacts to vegetation at the CIDMMA.	Similar to the NAA/FWO dredging and dredged material placement/disposal would not impact any SAV or wetlands. Similar to the NAA/FWO, placement/disposal of the dredged material may result in temporary to permanent, negligible, adverse impacts to vegetation at the CIDMMA.
Benthic Fauna	Dredging and dredged material placement/disposal operations would cause adverse, temporary, and minor impacts to the benthic community from removal of the benthic community, potential turbidity impacts and burial of sessile organisms. No impacts to oyster reefs are anticipated.	Impacts would be at the same threshold level of impact as the NAA/FWO (adverse, temporary, and minor), however, the relative level of impact with the Action Project Alternative would be a small increase, relative to the Norfolk Harbor Navigation Improvements overall.

Resource	No Action Alternative/Future Without Project Alternative	Action Project Alternative
Plankton Community	Adverse, temporary, and negligible impacts to the local plankton community as described in the GRR/EA, from proposed and maintenance dredging, and navigation and dredged material placement/disposal operations, include entrainment, burial/siltation, and reduced phytoplankton productivity would continue.	Impacts would be at the same threshold level of impact as the NAA/FWO (adverse, temporary, and negligible) however, the relative level of impact with the Action Project Alternative would be slightly higher due to the increased duration of dredging and dredged material placement/disposal.
Fish and Fish Habitat	As thoroughly described in the GRR/EA, new and current dredging and dredged material placement/disposal operations that may affect egg, larval, juvenile, and adult life stages of fishes include direct removal or burial, turbidity/siltation effects, shifts in dissolved oxygen and salinity, entrainment, visual and noise disturbances, and alteration of habitat would continue. The impacts to fish resources and habitat would be adverse, temporary, and negligible to minor. While impacts to Essential Fish Habitat (EFH) would be adverse, they would not be substantive. EFH consultation was completed with NMFS, for the GRR/EA, in 2018.	Similar to the NAA/FWO, impacts to fish and fish habitat would result in negligible to minor adverse impacts, including those to EFH. Impacts would range from mostly temporary impacts to some permanent impacts. No substantive adverse impacts to fish or fish habitat including EFH are anticipated. No population level impacts to any managed fish species or associated prey species would be anticipated. Consultation with NMFS has been re-initiated and is ongoing.
Wildlife	Current dredging and dredged material/placement would have disturbance effects to wildlife and further dredged material placement/disposal at the CIDMMA would provide additional habitat for some wildlife species. Temporary to permanent impacts to wildlife that would range from adverse to beneficial impacts that are negligible to minor would be anticipated.	Impacts would be at the same threshold level of impact (adverse to beneficial, temporary to permanent, and negligible to minor) as the NAA/FWO, however, the relative level of impact with the Action Project Alternative would be slightly higher due to the increased duration of dredging and dredged material placement/disposal.

Resource	No Action Alternative/Future Without Project Alternative	Action Project Alternative
Special Status Species	The No Action/Future Without Project Alternative would be as described as the Recommended Plan in the Norfolk Harbor Navigation Improvements General Reevaluation Report/Supplemental Assessment, and for which a Biological Opinion was obtained (USACE 2018). Although some adverse impacts to habitat and potential incidental take of Atlantic sturgeon and sea turtles (green, Kemp's ridley, leatherback, and loggerhead) are anticipated, these adverse impacts are not anticipated to jeopardize the continued existence of any Federally listed species.	A detailed assessment of the potential impacts of implementation of the Action Project Alternative on Federally listed species is provided in the Biological Assessment submitted to the USFWS in 2021 provided in Appendix C and as described in the NMFS Biological Opinion provided in Appendix C. Best management practices planned for implementation are described in these documents as well. The results of the effect assessments are summarized in Table 6-5 and Table 6-6. Although some adverse impacts to habitat and potential incidental take of Atlantic sturgeon and green sea turtles, Kemp's ridley sea turtles and loggerhead sea turtles are anticipated, these adverse impacts are not anticipated to jeopardize the continued existence of any Federally listed species. There would be no impacts to critical habitat as none occurs in the ROI/Action Area.
Air Quality	The Norfolk Harbor Navigation Improvements as well as the current maintenance operations would generate emissions from the combustion of fuel used to operate vessels and equipment (e.g., dredge operation, pumps, transportation, and final dredged material placement/disposal). There would be adverse, temporary, minor impacts to air quality.	Impacts would be at the same threshold level of impact (adverse, temporary, and minor) as the NAA/FWO, however, the relative level of impact with the Action Project Alternative would be a small increase, relative to the Norfolk Harbor Navigation Improvements Project overall. A Record of Non-Applicability (RONA) and a general conformity applicability analysis have been prepared and are included in the Environmental Appendix, Appendix C, to document that the estimated air emissions would be de minimis; Therefore, a general conformity determination is not required.

Resource	No Action Alternative/Future Without Project Alternative	Action Project Alternative
Climate Change	As described in the GRR/EA, approved new and maintenance operations would continue to generate, greenhouse gas emissions from the combustion of fuel used to operate vessels and equipment (e.g., dredge operation, pumps, transportation, and final dredged material placement/disposal). There would be adverse, temporary, negligible to minor contributing impacts to greenhouse gas emissions.	Impacts would be at the same threshold level of impact (adverse, temporary, and negligible to minor) as the NAA/FWO, however, the relative level of impact with the Action Project Alternative would be a small increase, relative to the Norfolk Harbor Navigation Improvements overall. In future conditions with implementation of the Action Alternative we would anticipate fewer greenhouse gas emissions resulting from deep draft vessels as compared to future conditions without implementation of the Action Project Alternative.
Flood plains	Dredging itself would have no adverse effect on flood plains. Potential adverse impacts to floodplains from material placement/disposal operations would be adverse, temporary, and negligible. A CIDMMA dike breach/failure would be unlikely.	Dredging itself would have no adverse effect on flood plains. Impacts would be at the same threshold level of impact (adverse, temporary, and negligible) as the NAA/FWO.
Noise and Vibration	Implementation of the NAA/FWO is predicted to result in adverse, temporary, and minor noise and vibration impacts resulting from operation of dredging vessels and dredging and material placement/disposal equipment, for both the new Norfolk Harbor dredging and for maintenance.	Impacts would be at the same threshold level of impact as the NAA/FWO, however, the relative level of impact with the Action Project Alternative would be slightly higher due to the increased duration of dredging and dredged material placement/disposal.
Occupational Safety and Health	The Norfolk Harbor Navigation Improvement project and maintenance dredging and dredged material placement operations would continue. Contract requirements are added to USACE dredging contracts where Munitions of Explosive Concern/Unexploded Ordnance (MEC/UXO) might be encountered during dredging activities. The contract for the Thimble Shoal and Cape Henry Maintenance Dredging project required the contractor to develop a MEC Safety and Work plan. Following proper precautions, existing, adverse, temporary, safety risks that are at a negligible to minor level of impact would continue.	The effects would be the same, except the duration of exposure to occupational safety and health risks would increase very slightly with implementation of the Action Project Alternative. The occupational safety and health risks would be very similar and remain at an adverse, temporary, and negligible to minor level of impact.

Resource	No Action Alternative/Future Without Project Alternative	Action Project Alternative
Utilities	The Norfolk Harbor Navigation Improvements is anticipated to cause temporary, adverse impacts to the DeGaussing Range at Sewell's Point, but additional detailed channel studies will be conducted during the Preconstruction, Engineering, and Design (PED) Stage to verify this course of action. Any potential impacts would be avoided or fully mitigated by relocation of the range by the U.S. Department of the Navy (Navy), if deemed necessary. There would be no anticipated impacts to other utilities in the ROI. Maintenance would have no effect on utility infrastructure.	The Action Project Alternative is not anticipated to have any additional effect on utilities.
Cultural Resources	Per the GRR/EA, the Programmatic Agreement (PA) with the State Historic Preservation Office was completed that sets forth procedures for mitigating adverse effects to historic properties if any are identified (USACE 2018). Potential effects to historic properties were accounted for in the executed PA.	Four archeological sites are located near the Thimble Shoal Channel; however, none will be affected. The only historic property within the visual/noise APE for cultural resources is the Civil War Battle of Hampton Roads site 114-5471. Although dredging for MA1 could have a visual and noise impact to site 114-5471 with the dredge and equipment, it would be temporary and short-term, and result in no long-term adverse effects. The SHPO has concurred with the finding of no adverse effect for this undertaking per their letter included in Appendix D. Providing avoidance commitments are met and the APE is not substantially altered, the Section 106 compliance process is complete for this undertaking.
Aesthetics	There would be no predicted changes to the existing aesthetic environment. The aesthetic environment would continue to be that of a working waterfront with a mix of adjacent land uses.	The aesthetic environment would be similar to the Action/FWO but temporary impacts to the viewshed would increase because of increased dredging at MA1 only, and dredged material placement/disposal durations and dredging locations. Implementation of the Action Project Alternative would result in adverse, temporary and negligible impacts to the aesthetic environment.

Resource	No Action Alternative/Future Without Project Alternative	Action Project Alternative
Recreation	While dredging and dredged material placement/disposal activities are ongoing, areas adjacent to the dredging and dredged material placement/disposal actions would be unavailable for recreation and represent an adverse, temporary and negligible impact to recreation.	Impacts would be at the same threshold level of impact as the NAA/FWO (adverse, temporary, and negligible).
Socioeconomics and Environmental Justice	As described in the GRR/EA, the improved navigation channel and maintenance of it would allow more efficient movement of the same quantity of cargo but would not be anticipated to result in changes in the overall quantity of cargo being moved. It would not create disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, or Native American tribes. The NAA/FWOP Alternative would result in a temporary and permanent, beneficial minor increase in the local economy.	Implementation of the Action Project Alternative would be similar to the NAA/FWOP Alternative; however, it would be slightly more beneficial for socioeconomics, through more efficient movement of cargo and less waiting time. Regional Economic Development benefits would be anticipated to be temporary and permanent, beneficial and minor.
Transportation and Navigation	The Norfolk Harbor Navigation Improvements would not result in an increase in local traffic at points of access to, or egress from, Port of Virginia facilities and would not have a direct effect on traffic congestion or the burden of truck traffic on surrounding surface roads. The predicted number of deep draft vessel calls when comparing the future with project would be less than the future without project, because more cargo could be carried in fewer ships. The overall effects would be permanent, minor, and beneficial for navigation.	Expected impacts to transportation would be similar to the NAA/FWO, except that navigation traffic flow would be improved as compared with the No Action/Future Without Project Alternative. The overall effects would be permanent, minor, and beneficial for navigation.

NAA/FWO = No Action Alternative/Future Without Project Alternative

6.1 Geology, Physiography, and Topography

Environmental Consequences

No Action/Future Without Project Alternative

Per the GRR/EA, new dredging of the Norfolk Harbor Navigation Improvements and maintenance dredging operations, dredged material placement/disposal, and navigation within the ROI would continue. The existing sediment within the dredging footprint in the channel would continue to be removed, most of which, from a geologic perspective, is recently-deposited fine sands, silts, mud, and unconsolidated clay. Continued use of any of the potential dredged material placement/disposal sites will have a negligible to minor adverse effect on topography, geology, or physiography. Continued maintenance of the channel system should have no effect on seismicity because the ROI is not within a seismically-active geologic setting. Virginia Port growth is anticipated to increase throughout the next 50 years, and a new port facility is planned, which may increase the number of vessels transiting the ROI. This may also increase the dredging demands within the waterway.

Effects to the geology, physiography, seismicity, and topography from implementation of the No Action/Future Without Project Alternative are predicted to be negligible to minor and permanent.

Action Project Alternative

Impacts to geology, physiography, seismicity, and topography with implementation of Action Alternative, would be similar to those described for the No Action/Future Without Project Alternative: negligible to minor, and permanent.

No geologically significant minerals would be affected, and the project would have no effect on seismicity or physiographic processes, such as the development of landforms. Because there are no bedrock or confining geologic layers within the ROI, none would be affected, and no blasting of the substrate will be conducted to achieve the proposed depths.

Compared to current operations, there would be very minor increased material placement/disposal at the CIDMMA, DNODS, or NODS and associated topographic changes with implementation of the Action Alternative as compared to the No Action/Future Without Project Alternative.

6.2 Bathymetry, Hydrology, and Tidal Processes

Affected Environment

The lower Chesapeake Bay attained its current configuration after the end of the last Ice Age and has been relatively stable for the last three thousand years (Bratton et al. 2002), although waters have continued to slowly rise over this time, due to glacial rebound and now the addition of human-induced climate change (Schulte et al. 2015) (Figure 6-1). Norfolk Harbor has been in use since shipping into and out of Chesapeake Bay began and has been deepened to accommodate larger ships over the decades. This channel was formed naturally as a drowned river valley (in this case the James), the main shipping channel follows this natural bathymetry. This dredging has not significantly altered the tidal prism of the lower Chesapeake Bay, due to the small size of the channel relative to the size of the Chesapeake Bay. Initial dredging to

ensure at least -40 feet of depth occurred during 1917-1927 (VIMS 1993). Additional deepening to -45 feet occurred in 1967, to -50 feet in 1986. The current authorized depth at this time is -55 feet, though most of the channel is at -50 feet at this time. Modifications to MA1have the potential to affect the hydrodynamics of the lower Chesapeake Bay, including the mouth of the James River, and the Elizabeth River, including its bathymetry, hydrology, and tidal processes.

Figure 6-1 shows the bathymetry of the region of influence and the vicinity.

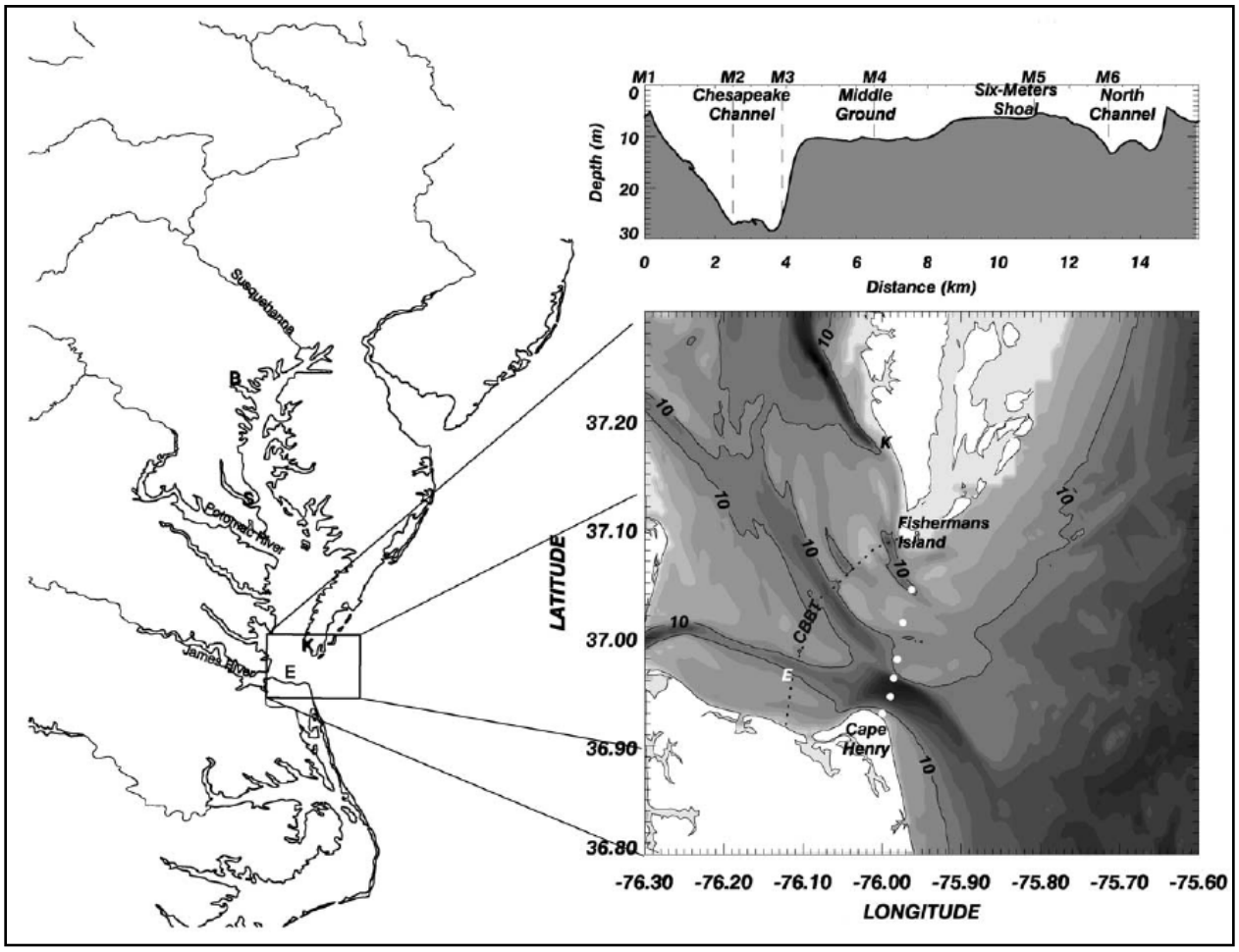

Figure 6-1: Bathymetry of the Region of Influence and Vicinity (from Valle-Levinson et al. 2002).

The typical tidal range in the ROI is approximately 2.85 feet, salinity varies from 20-30 ppt (parts per thousand) though this varies significantly with time of the month (spring and neap tides) as well as due to storm activity, which can create significant storm surges well beyond the normal tidal range. Tides are diurnal in the Chesapeake Bay, with two high and low tides per day. The mean discharge rate of Chesapeake Bay is approximately 2,500 m^3/sec, over 80% of which is supplied by three rivers (the Susquehanna, Potomac, and James Rivers) (Goodrich 1988). ROI waters are sufficiently mixed so that anoxic waters are not typical. Deep channels can go anoxic in the summer, particularly in the mid to upper Chesapeake Bay, causing a significant “dead zone” of hypoxic waters. The bathymetry of the ROI ranges from intertidal shallows to the deep

channels, which generally lie within the immediate ROI where dredging is proposed and typically range in depth from approximately -20 feet inside and/or natural and unmaintained channels to -50 feet within the channel itself.

Environmental Consequences

No Action/Future Without Project Alternative

With implementation of the No Action/Future Without Project Alternative, there would be no additional impacts to bathymetry, hydrology, and tidal processes, over what has already been evaluated under the GRR/EA; this alternative assumes that all of the deepening and/or widening of channels of the Norfolk Harbor Navigation Improvements project would take place. Therefore, the following existing channels would be deepened: the Atlantic Ocean Channel, the Thimble Shoal Channel (and additional sections of the Thimble Shoal Channel would be widened), the Norfolk Harbor Entrance Channel, the Newport News Channel, and Anchorage F. The additional dredging would deepen the existing Atlantic Ocean Channel from a required depth of -52 feet to a required depth of -59 feet. Periodic maintenance dredging and existing dredged material placement/disposal will be done as needed to maintain current channel depths and widths, as well as those of associated anchorages.

As described previously in the GRR/EA, this is expected to alter the bathymetry in the navigation channels, deepening it and removing all the sediments currently occupying this area. This may also potentially increase the tidal prism in the area of the channel. This bathymetric alteration may influence effects of the tides, the benthic community, and/or water quality and these impacts are discussed further in the Water Quality and Benthic Fauna sections. The change in tidal prism is very minor compared to the size of the Chesapeake Bay/Atlantic Ocean confluence and no substantial impacts are expected resulting in a minor, permanent effect. The channel will be deepened to a maximum of approximately 10 percent, which could allow for a small (less than approximately one percent difference) change in bottom salinity in the channel area. This is a minor change in hydrology that will have a minor effect on local salinity and is not expected to substantially alter the salinity of lower Chesapeake Bay. It is expected that there will be a minor, permanent effect on salinity.

Therefore, effects to bathymetry, hydrology, and tidal processes from implementation of this Alternative are predicted to be permanent and minor.

Action Project Alternative

The additional dredging that would occur with implementation of the Action Alternative will be to the north and south of Thimble Shoal Channel and will deepen the proposed footprint from approximately 35 feet to 56 feet, with approximately 3:1 side slopes to the north and south. This is a larger differential of dredging depth than that of the Thimble Shoal Channel itself, which would be dredged from 50 feet to 56 feet. The estimated square feet of benthic bottom disturbance associated with implementation of the Action Alternative are provided in Table 6-2. However, because the dredging would take place north and south of the existing Thimble Shoal channel deepening, the effects would be very similar to those of the NAA/FWOP Alternative: adverse, temporary to permanent, and minor.

Table 6-2: Summary of estimated dredging depths (-), durations and volumes over the lifecycle of the Action Alternative, for the Report/SEA. Maximum depths listed for the Action Alternative are unlikely and not anticipated to be reached but identified to evaluate maximum environmental impacts.

		Estimated Construction					Estimated Maintenance (50 Years)		Estimated Construction and Maintenance (50 Years)	
Segment	Required Depth (feet, MLLW)	Estimated Maximum Depth (feet, MLLW)	Estimated Maximum Dredging Volume- all allowable and nonpay (cubic yards)	Estimated Maximum Dredging Duration (months)	Estimated Total Land Disturbance - Maximum (square feet)	Change/Delta (increase) in Land Disturbance - Maximum (square feet)	Estimated 50 Year Total of Maintenance Volume (cubic yards)	Estimated 50 Year Total - Maintenance Dredging Duration (months)	Estimated Maximum Volume-Total Allowable and Non-pay + Maintenance Volume (cubic yards)	Estimated Maximum Construction + 50-year Maintenance Dredging Duration (months)
Thimble Shoal Channel MA1 (5.1 miles that are 200 feet north and south of the existing Thimble Shoal Channel)	-56	-61	6,170,000	18[A]	11,863,428	11,863,428	2,607,750	36	8,777,750	54

[A]18 months is active dredging duration based on one large hopper dredge being assigned to the project. Duration of work will extend across at least one 2.5 month-long voluntary seasonal dredging restriction that could extend the total duration to approximately 21 months.

6.3 Hazardous, Toxic, and Radioactive Waste

Affected Environment

The ROI includes the areas of MA1 and MA2, dredged material placement sites, the effluent discharge area from the CIDMMA, and areas transited by dredging vessels/equipment. The ROI includes areas outside of the dredging footprint where potential contaminants could be spread by suspension and movements of sediments and within the water itself. The geographic extent of impacts is dependent upon factors such as the type of dredging equipment, the dredging depth, and environmental conditions such as wind and currents (USACE 1983).

The description of hazardous and/or toxic wastes, classified by the Resource Conservation and Recovery Act (RCRA) in the ROI are as described in the 2018 Norfolk Harbor Navigation Improvements General Reevaluation Report/EA. The following new marine sediment data and testing within the area adjacent to MA1 and within the boundaries of MA2 have been completed since the last Environmental Assessment in 2018:

Recent Marine Sediment Data in the ROI

Marine Sediment Data from Marine Protection Resources and Sanctuary Act (MPRSA) Section 103 - Dredged Material Characterization Reports

USACE and the Virginia Port Authority completed sampling, testing and MPRSA concurrence from EPA for the Thimble Shoal Channel West (TSC-W) in 2018 and Thimble Shoal East (TSC-E) and MA2 (MA2) in 2021 documenting the dredged material characterization and lack of HTRW for placement at DNODS or NODS.

Thimble Shoal Channel - West

Marine sediment samples were evaluated in two dredging areas for 11 statute miles of TSC-W. Twenty-three locations were evaluated in Dredging area A from HRBT to Crumps Bank and 20 locations were evaluated from Crump's Bank to the CBBT. TSC-W sediments met the criteria for the Limiting Permissible Concentrations for water quality criteria, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement of the dredged material at either the DNODS or the NODS is acceptable. All placement activities must be conducted in accordance with the DNODS or the NODS Site Management and Monitoring Plan (SMMP) and according to the conditions established in the letter dated 21 April 2021 (Appendix C). Concurrence is conditioned upon implementation of the above requirements and is valid for a term of three years from July 20, 2019 until July 20, 2022 (Appendix C).

Thimble Shoal Channel - East and MA2

To ensure the dredged material suitability from the TSC-E and MA 2 for placement at DNODS, a recent marine sediment evaluation was conducted. USEPA-approved reference sites located at Willoughby Bank and in the Chesapeake Bay reference site, and the Atlantic Ocean Control site. Testing was completed in 2020 for placement at DNODS and NODS. TSC-E/MA2 sediments meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement of the dredged material at either the DNODS or the NODS is acceptable. All placement activities must be conducted in accordance with the DNODS, or the NODS Site Management and Monitoring Plan (SMMP) and the conditions established in the letter dated 21 April 2021 (Appendix C). Concurrence is conditioned upon implementation of the above requirements and is valid for a term of three years from April 21, 2021 until April 21, 2024 (Appendix C).

The tested material did not contain any prohibited materials from 40 CFR Section 227.5 which includes radioactive waste, chemical or biological warfare, persistent inert synthetic or natural materials that may float or remain in suspension, and nor did it interfere with legitimate uses of the ocean. In addition, the materials did not contain more than trace amounts of contaminants (as defined by 40 CFR 227.6). Sediments did not contain constituents expected to adversely affect aquatic organisms Testing confirmed Limiting Permissible Concentration (LPC) compliance for all phases of dredged material including liquid phase, liquid and suspended particulate phase, and solid phase.

Environmental Consequences

No Action/Future Without Project

Existing and future dredging and dredged material placement/disposal may result in a shift in the location of sediment-bound contaminants. Detectable releases of contaminants from disturbed sediments into the water column are not anticipated as potential contaminants would be anticipated to remain bound to the sediment. According to the GRR/EA (USACE 2018), extensive sediment testing conducted over the last decade within the ROI has consistently met guidelines for upland and offshore ocean disposal It is expected that future maintenance dredging will continue to have a similar, negligible level of impact and will remain within dredged material placement/disposal limits at the CIDMMA and open ocean disposal sites. This is not expected to have any substantive long-term adverse impacts in the ROI.

Monitoring of NPL sites by the responsible party and the tracking of hazardous waste, toxic waste and radioactive waste generators throughout the ROI will continue through applicable state and Federal programs. Existing SMMPs and Ocean Dumping laws will continue to protect dredged material placement/disposal sites from receiving contaminated sediments that could impact the ROI.

Action Project Alternative

The implementation of the Action Alternative would not cause any substantial change in the chemical constituents or concentration of contaminants in the sediment or elutriate released from the CIDMMA or in the placement/disposal sites. Implementation of the Action Alternative is not anticipated to result in any generation or regulated release of a HTRW. Detectable releases of contaminants from disturbed sediments into the water column are not anticipated, as potential contaminants would be anticipated to remain bound to the sediment.

Any dredged material will be subject to existing disposal SMMPs, Ocean Dumping laws, and Section 103 MPRSA compliance. These guidelines along with the USACE Upland Testing Manual will continue to protect placement/disposal sites. The marine sediments along 11 statute miles of TSC met the criteria for the Limiting Permissible Concentrations for water quality criteria, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement of the dredged material at either the DNODS or the NODS is acceptable. Therefore, redistribution of contaminants resulting from dredging and dredged placement/disposal would be negligible and are not expected to have any substantive long-term adverse impacts in the ROI.

6.4 Water Quality

Affected Environment

The ROI includes the areas around the navigation channel at MA1, transit lanes to and from offshore dredged material placement sites, and waters of the. The ROI includes areas outside of the dredging footprint where water quality impacts such as increased levels of Total Suspended Solids, turbidity, and potentially nutrient fluctuations may occur. The geographic extent of water quality impacts is dependent upon factors such as the type of dredging equipment, the dredging depth, and environmental conditions such as wind and currents (USACE 1983).

Environmental Setting

The ROI is located at the convergence of the brackish waters of the James River and its confluence with Lower Chesapeake Bay waters. The Chesapeake Bay is a slightly stratified estuary which forms where tidal activity is strong and river volume is moderate. A saltwater wedge moves from the ocean west through the ROI causing salinity shifts and circulation patterns as freshwater from tributaries drain into the mainstream of the Chesapeake Bay, local ROI salinities are typically 21-24 PPT. In the Chesapeake Bay, the halocline is present, but less pronounced than in more stratified estuaries. Seawater moves landward along the bottom and is diluted progressively landward with freshwater moving out towards the Chesapeake Bay mouth as circulation is primarily driven by the movement of fresh water from the north and salt water from the south. Daily tidal currents in and out of the Chesapeake Bay enhance mixing of the two layers. As seawater moves landward and river water moves seaward, they are influenced by the Coriolis Effect. Nutrients and other materials are mixed and resuspended in the area where fresh and saltwater meet. This area is called the zone of maximum turbidity and it is located within the ROI.

The quality of the surface waters in the ROI is dependent upon the water quality of the Chesapeake Bay mainstem and the tributaries draining into the watershed. The following tributaries affect the water quality of the ROI: Elizabeth River, York River, James River, Lafayette River, Lynnhaven River, and Norfolk Harbor proper (CBP 2016a). Chesapeake Bay Foundation publishes a “State of the Chesapeake Bay Report” every two years. The report is based on the best available information about the Chesapeake Bay for indicators representing three major categories: pollution, habitat, and fisheries. Monitoring data serve as the primary foundation of the report, supplemented by field observations. In 2016, the overall health of the Chesapeake Bay was reported to be a C-, which is considered an increase from the 2014 Report. Federal, state, and non-profit initiatives throughout the Chesapeake Bay are designed to help the Chesapeake Bay meet the goals and recommendations established in the report to continue improving the Chesapeake Bay’s health.

Impaired Waterways

The USEPA established a Total Maximum Daily Load (TMDL) for the Chesapeake Bay watershed on December 29, 2010. The TMDL identified the nitrogen, phosphorus, and sediment reductions that each Chesapeake Bay jurisdiction needs to achieve for the Chesapeake Bay to meet water quality standards. The TMDL included Phase I Water Implementation Plans developed by States within the Chesapeake Bay watershed. The Commonwealth of Virginia Phase I Water Implementation Plan outlined the actions expected of the wastewater sector, urban/stormwater sector, agriculture sector, and on-site sewage sector to meet statewide nutrient and sediment reduction goals. There are many impaired waterways contributing to the water quality of the ROI. An annual Virginia Water Quality Assessment 305(b)/303(d) Integrated Report summarizes findings and makes recommendations for a list of impaired waters by VDEQ.

The Chesapeake Bay and its tidal tributaries contain 291 designated uses. Each of these designated uses—also known as aquatic habitats—has its own set of criteria for Dissolved Oxygen, water clarity/underwater grasses and chlorophyll a designed to protect those uses. If the Chesapeake Bay and its tidal tributaries are to function as a healthy ecosystem, all water

quality standards must be met. In the vicinity of the ROI, there are TMDLs established by VDEQ for the Lower James River Watershed for enterococci bacteria.

The determination whether the Commonwealth's waters support their applicable designated uses as mandated by Section 305(b) of the Clean Water Act is made by VDEQ and reported annually to USEPA based on monitoring data. There are six designated uses that may be applied to surface waters: aquatic life, fish consumption, shellfishing, recreation, public water supply, and wildlife. Virginia's water quality standards define the water quality needed to support each of these uses by establishing the numeric criteria for comparison of physical and chemical data. If a waterbody contains more of a pollutant than is allowed by the water quality standards, it will not support one or more of its designated uses. Such waters are considered to have an "impaired" quality. An "impairment" refers to an individual parameter or characteristic that violates a water quality standard. Local waters of the project ROI are not impaired (Figure 6-2).

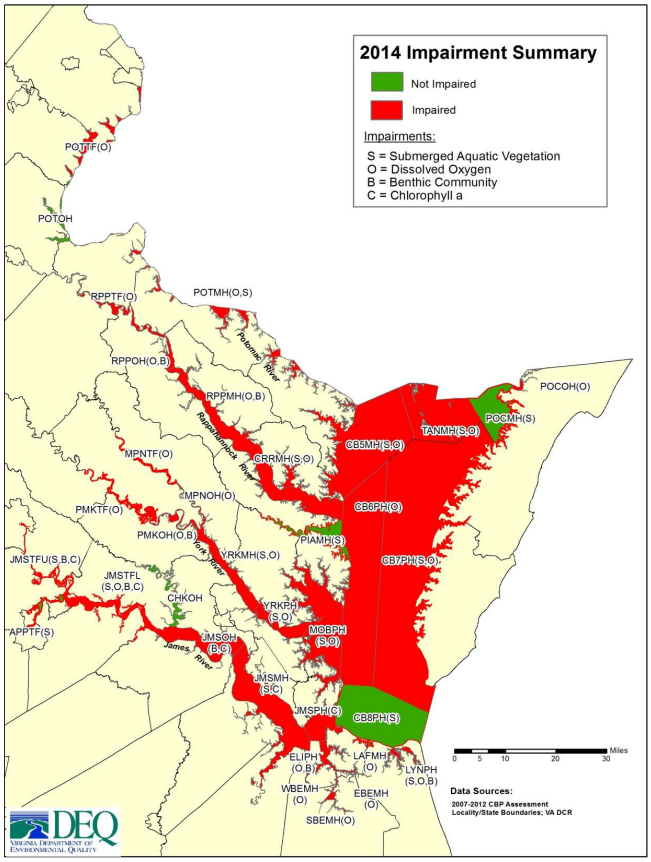

Figure 6-2: Impairment Status of the Chesapeake Bay Aquatic Use (VDEQ 2014).

Dredged Material Testing and Placement Areas: Currently suitable dredged material from navigation channels in the ROI are placed in USEPA designated and congressionally authorized locations. Dredged materials from the AOC and the TSC are placed at the NODS and DNODS, and this is proposed for MA1 if it cannot be used beneficially for beach nourishment due to inappropriate sediment type. Ocean dredged material placement is regulated under Section 103

of the Marine Protection Resources and Sanctuaries Act of 1972, Public Law 92-532 (MPRSA). Any proposed placement of dredged material into ocean waters must be evaluated using criteria published by the USEPA in Title 40 of the Code of Federal Regulations, Parts 220-228 (40 CFR 220-228). The primary purpose of Section 103 of the MPRSA is to limit and regulate adverse environmental impacts of ocean placement of dredged material. Dredged material proposed for ocean placement must comply with 40 CFR 220-228 (Ocean Dumping Regulations) and 33 CFR 320-330 and 335-338 (USACE Regulations for discharge of dredged materials into waters of the U.S.) prior to being issued an ocean placement permit. The technical evaluation of potential contaminant-related impacts that may be associated with ocean placement of dredged material is conducted in accordance with 40 CFR 220-228, the *Ocean Testing Manual*. These testing requirements are used to ensure dredged material meets acceptable criteria prior to disposal.

There have been SMMPs developed for NODS and DNODS (Appendix A) by the USEPA in conjunction with the USACE to ensure use of the designated sites will not result in adverse environmental impacts, such as impacts to water quality.

Virginia Pollutant Discharge Elimination System (VPDES) Permits: Section 402 of the Clean Water Act established the National Pollutant Discharge Elimination System (NPDES) program to limit pollutant discharges into streams, rivers, and Chesapeake Bays. In the Commonwealth of Virginia, VDEQ administers the VPDES Program. The VDEQ issues VPDES permits for all point source discharges to surface waters, to dischargers of stormwater from Municipal Separate Storm Sewer Systems (MS4s), and to dischargers of stormwater from Industrial Activities. Virginia Stormwater Management Program (VSMP) permits to dischargers of stormwater from Construction Activities. Both VPDES General and Individual permits are issued by VDEQ.

Individual permits are issued by VDEQ to both municipal and industrial facilities (Table 1-14). Permit requirements, special conditions, effluent limitations, and monitoring requirements are determined for each facility on a site-specific basis to meet applicable water quality standards. In the immediate vicinity of the ROI, there are 35 Individual permits issued by VDEQ for discharges of pollutants as of April 2016. There are nine major dischargers of pollutants of which seven are attributed to the Hampton Roads Sanitation District and two attributed to Huntington Ingalls in Newport News. The other 26 permitted dischargers are considered “minor” by VDEQ standards (VDEQ 2015).

General permits are permits written for a general class of dischargers. In Virginia, general permits must be written as permits and adopted as regulations. Since they are regulations, they must be adopted using the Administrative Process Act (APA) requirements, which specify a standard adoption process and public participation/public input procedures. There are no general permits issued in the immediate vicinity of the ROI.

Clean Water Act, Section 401 Permits, Water Quality Certification: In order to comply with Section 401 of the Clean Water Act, USACE maintains a Virginia Water Protection Permit (VWP or Water Quality Certification) for Operations and Maintenance (O&M) dredging in Harbor channels of the ROI. The Commonwealth of Virginia, Department of Environmental Quality (VDEQ) grants these permits to protect wetlands and surface waters. These permits can be found in Appendix I of the 2018 Norfolk Harbor GRR/EA.

Existing Section 401 Permits (Virginia Water Protection Permits)

a. **Newport News Channel (VWP Permit #:14-0749):** This 15-year Virginia Water Protection Permit (also referred to as a Water Quality Certification) was issued on December 3, 2014 and authorizes impacts to 643 acres of subaqueous bottom for mechanical or hydraulic maintenance dredging of the Newport News Federal Navigation Channel and the two associated anchorage basins. Dredged material disposal is via direct pump into the CIDMMA or via direct pump or bottom dump scow into the Craney Island Rehandling Basin. Dredging is authorized to a maximum allowable dredge depth of -55 feet MLLW in the channel and -48 feet MLLW in the two anchorage basins. Maximum allowable depths include all overdepth, advanced maintenance, and margin of error.

b. **Norfolk Harbor from Sewells Point to Lamberts Point (VWP Permit #13-0856):** This 15-year Virginia Water Protection Permit was issued on September 18, 2013 and authorizes impacts to maintain the existing 800 foot – 1,800-foot-wide Norfolk Harbor Sewells Point to Lamberts Point Bend Channel to a maximum allowable depth of -55 feet MLLW. New and maintenance dredging of subaqueous bottom to maintain Anchorage F and it approach to -55 feet MLLW is also permitted. Maintenance dredging of subaqueous bottom to maintain the Sewells Point East Anchorage and its Approach and the Naval Maneuvering Area to the maximum allowable depth of -50 MLLW is also authorized. The final permit feature is the maintenance dredging of subaqueous bottom to maintain the Sewells Point West Anchorage and its Approach to -45 feet MLLW.

Procedure for Clean Water Act, Section 401, Water Quality Certification: In 2015, USACE developed an agreement with VDEQ (letter dated October 2, 2015) concerning the need for obtaining VWP permits and 401 certifications utilizing the Coastal Zone Management Act Determination process. Pursuant to this letter, USACE requested State 401 certification through coordination of this NEPA and CZMA document for the construction and future maintenance dredged material discharges associated with the Norfolk Harbor Project to include placement at CIDMMA and other CIDMMA maintenance associated activities. VDEQ granted their concurrence in January 2018 and it is included in Appendix I, of the 2018 Norfolk Harbor GRR/EA.

MPRSA, Section 103, USEPA Concurrence: For Operations and Maintenance dredging in the AOC and the TSC, a VWP Permit is not required. These channels are outside jurisdictional state waters. In place of this permit, maintenance dredging is subject to the provisions of the Marine Protection Research and Sanctuaries Act (MPRSA). Dredged material placement for these channels must comply with MPRSA, Section 103 and receive concurrence with USEPA that dredged material meets the Ocean Disposal Criteria.

Existing USEPA Concurrence

Thimble Shoal Channel - West

Marine sediment samples were evaluated in two dredging areas for 11 statute miles of TSC-W. Twenty-three locations were evaluated in Dredging area A from HRBT to Crumps Bank and 20 locations were evaluated from Crump's Bank to the CBBT. TSC-W sediments met the criteria for the Limiting Permissible Concentrations for water quality criteria, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement of the dredged

material at either the DNODS or the NODS is acceptable. All placement activities must be conducted in accordance with the DNODS or the NODS Site Management and Monitoring Plan (SMMP) and according to the conditions established in the letter dated 21 April 2021 (Appendix C). Concurrence is conditioned upon implementation of the above requirements and is valid for a term of three years from July 20, 2019 until July 20, 2022 (Appendix C).

Thimble Shoal Channel - East and Meeting Area 2

To ensure the dredged material suitability from the TSC-E and MA2 for placement at DNODS, a recent marine sediment evaluation was conducted. USEPA-approved reference sites located in Willoughby Bank and in the Atlantic Ocean. Testing was completed in 2020 for placement at DNODS and NODS. TSC-E/MA2 sediments meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement of the dredged material at either the DNODS or the NODS is acceptable. All placement activities must be conducted in accordance with the DNODS or the NODS Site Management and Monitoring Plan (SMMP) and the conditions established in the letter dated April 21, 2021 (Appendix C). Concurrence is conditioned upon implementation of the above requirements and is valid for a term of three years from April 21, 2021 until April 21, 2024 (Appendix C).

Atlantic Ocean Channel (USEPA Concurrence letter with MPSRA, Section 103 on May 15, 2015) USEPA concurred with the MPRSA, Section 103 Evaluation and testing to authorize continued maintenance dredging of AOC (AOC). The AOC is congressionally authorized to a depth of -57 feet MLLW but is currently maintained at -52 feet MLLW width of 1,000 feet. Maintenance of AOC requires the removal of approximately 300,000 cubic yards every three years. The material will be placed at DNODS in accordance with 40 CFR 228.15. This concurrence letter can be found in Appendix I, of the 2018 Norfolk Harbor GRR/EA.

Environmental Consequences

No Action/Future Without Project

Norfolk Harbor Navigation Improvements and existing dredging operations, dredged material placement/disposal, effluent discharges from the CIDMMA, and navigation within the ROI would continue. These effects were fully evaluated in the GRR/EA (USACE 2018), and the reader is referred to that document for further detail.

All dredging would comply with current Water Quality Permits for Newport News Channel and Norfolk Harbor Channel. Sediments will be tested in accordance with the *Evaluation of Dredged Material for Discharge in Waters of the U.S.- Testing Manual* (USEPA 1998) and the USACE Manual, *Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing Manual* (USACE 2003) prior to commencement of dredging to ensure appropriate placement/disposal of dredged material. Dredged material that meets sediment testing requirements for the CIDMMA would continue to be placed in the CIRB or directly into one of the containment cells at CIDMMA. Material would be transported to the upland containment cells at CIDMMA by hydraulic pipeline if hydraulically dredged or by barge/scow if mechanically dredged and bottom dumped at in CIRB or directly hydraulically offloaded and pumped into a containment cell at CIDMMA. Effluent discharge from the CIDMMA would continue to be discharged to the Elizabeth River via spillways. Effluent discharges would be visually monitored and tested for Total Suspended Solids. The dredging operations and the

discharge of effluent from the CIDMMA would result in temporary, adverse impacts to water quality that are negligible to minor.

All dredging will comply with current SMMPs for NODS and DNODS and Section 103 of MPRSA. The USEPA will continue to monitor LPCs biannually at NODS and DNODS, and USACE will provide pre and post hydrographic surveys of ocean placement of maintenance materials.

Overall impacts to water quality with current operations are temporary, adverse, and negligible to minor. Changes in salinity and decreases in Dissolved Oxygen, and flushing rates are anticipated to cause permanent, adverse impacts to water quality that are negligible and minor in nature. Changes to N, P, and Chla are in general minor (< 5%) and not significant. The placement of these dredged materials would cause temporary, adverse impacts to the water quality of the placement sites; however, these impacts would be considered minor and within USEPA limits. Temporary and negligible to minor adverse impacts to water quality that result from current maintenance operations that include increased Total Suspended Solids, turbidity, and nutrient levels would continue.

Action Project Alternative

Implementation of the Action Alternative will result in similar effects as described above; however on a much smaller scale proportional to the amount of dredging. There may be a temporary increase in Total Suspended Solids and turbidity in the dredging footprint and adjacent areas following dredging activities; a slight, temporary increase in the level of dissolved nutrients (N and P) in the water column; and temporary, adverse impacts to the water quality of the placement sites. Dredged material would be subject to the testing requirements described above and in the GRR/EA. Implementation of the Action Alternative is anticipated to result in adverse impacts that would be temporary to permanent and negligible to minor to water quality.

6.5 Vegetation, Wetlands, and Submerged Aquatic Vegetation

Environmental Consequences

No Action/Future Without Project Alternative

There is no submerged aquatic vegetation (SAV) or wetlands in the ROI; therefore, none would be affected. Placement/disposal of dredged material may alter the topography, and consequently alter any existing vegetation colonizing the CIDMMA. However, this is an existing dredged material facility that is ever-changing in response to new material discharges from many different navigation channels, rather than any type of natural wetland or riparian ecosystem. The environmental impacts of the development and use of CIEE, which is currently under construction, were already examined in an Environmental Impact Statement (EIS) for that project (2006) and impacts have been mitigated.

Therefore, with implementation of the No Action/Future Without Project Alternative, adverse impacts on vegetation would be temporary to permanent, and negligible.

Action Project Alternative

Similar to the No Action/Future Without Project Alternative, there would be no impact to SAV or wetlands. Adverse effects on vegetation would be limited to those at CIDMMA, and would be temporary to permanent, and negligible.

6.6 Benthic Fauna

Affected Environment

The benthic communities of the lower Chesapeake Bay are complex and include an array of fauna that play critical roles in the food web. The typical Chesapeake Bay ecosystem includes epifauna (organisms that live attached to surfaces on the Chesapeake Bay bottom) such as oysters, sponges, sea squirts, seas stars, and barnacles and infauna that burrow into bottom sediments such as worms, clams, and other tunneling organisms.

Benthic communities have varied roles in the Bay ecosystem. Filter feeders such as clams, oysters, and sponges clarify and clean the waters of the Chesapeake Bay, through their biological processes, removing particulate matter and potentially toxic materials. As primary and secondary consumers, these organisms pass the energy of primary producers (phytoplankton) to higher levels of the food web. Many benthic species are food for economically important species such as blue crabs (*Callinectes sapidus*), striped bass (*Morone saxatilis*), spot (*Leiostomus xanthurus)*, and croaker (*Micropogonias undulatus)* (CBP 2016c).

The ROI for benthic fauna includes the areas transited by dredging vessels/equipment, areas of navigation channel and MA1 dredged, and dredged material placement/disposal areas. The ROI also includes the area of any circulation patterns shifts and water quality impacts that has the potential to impact benthic fauna. The geographic extent of water quality impacts is dependent upon factors such as the type of dredging equipment, the dredging depth, and environmental conditions, such as wind and currents (USACE 1983).

Channel Characterization: The navigation channel adjacent to MA1 addressed in this report were characterized in Section 1.6 of this report. The bottom composition of these areas is summarized in Figure 6-3. This classification of substrates was created in 2015 from the NOAA geodatabase for the Natural Resources Technical Report for the Hampton Roads Crossing Study (VDOT 2016). The channel substrate in the ROI was classified sand with no shell, muddy sand with no shell, and small patches of sandy mud with shell.

The VMRC manages submerged bottom (outside Federal navigation channels) in public trust in addition to managing both recreational and commercial saltwater fishing in the Commonwealth of Virginia. The agency is responsible for shellfish regulation and private leasing of submerged bottom as well as encroachment on these resources under Section 28.2 -1203 of the Virginia Code. Impacts to benthic resources are evaluated by VMRC when determining whether to issue a permit to encroach upon submerged bottom.

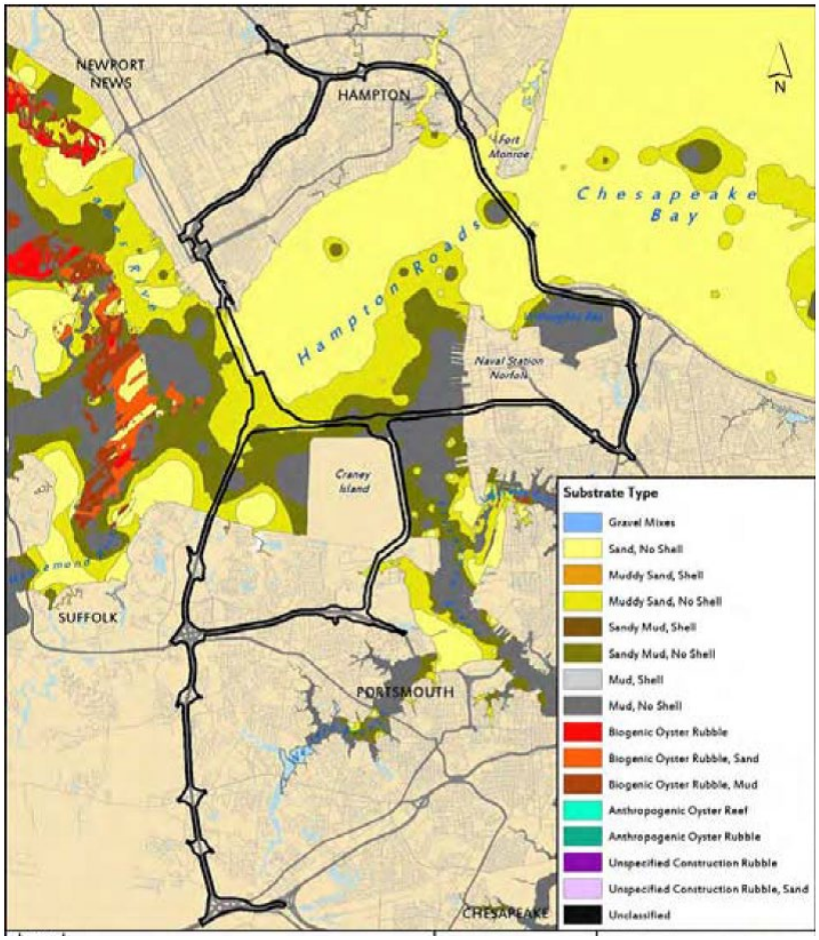

Figure 6-3: Bottom composition (VDOT 2016).

Resources in the ROI

Clam Resources: The hard clam (*Mercenaria mercenaria*), a bivalve mollusk, is common in Chesapeake Bay and lower James River. It can be found in waters with salinities greater than 25 ppt. (Whetstone et al. 2005) and at depths from the shoreline to -60 feet (CBP 2016a). This commercially harvested species occurs naturally along the Atlantic Coast from Canada to Florida. Hard clams are found, in decreasing order of abundance, in soft bottoms with shell, sand flats, sand/mud flats, and on muddy bottoms (Pratt 1953; Wells 1957). They are typically harvested between 4 and 8 years of age when they reach commercial size. In addition to their economic value, hard clams play important roles ecologically as filter feeders, nutrient cyclers, and is an important prey species for gulls, tautogs, waterfowl, cownose rays, blue crabs and oyster drill. The hard clam is considered an important commercial species in Chesapeake Bay and can commonly be found in Norfolk Harbor (Figure 6-4), with high densities between Monitor–Merrimac Memorial Bridge–Tunnel (MMBT), Interstate 664 Bridge west of CIDMMA, and the Hampton Roads Bridge–Tunnel (HRBT) (Mann et al. 2005). Low densities are found in the project footprint.

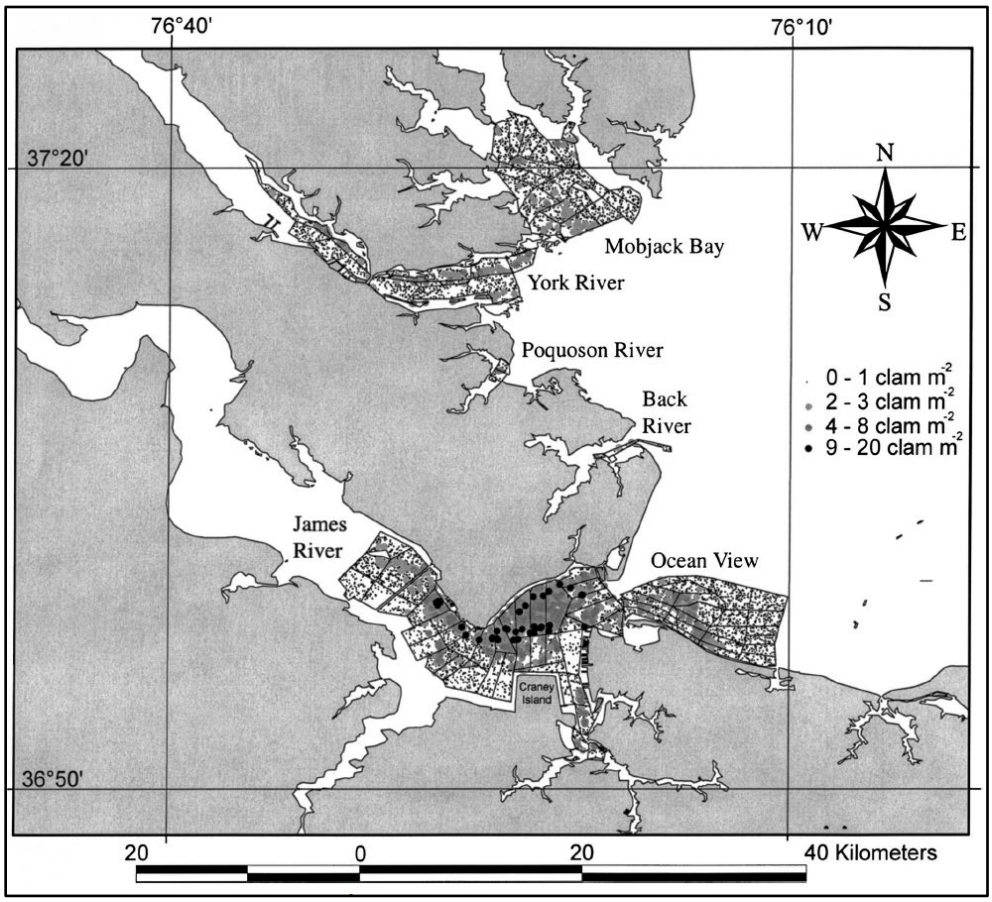

Figure 6-4. Northern Quahog (Hard Clam) Mercenaria mercenaria Abundance and Habitat Use in Chesapeake Bay (Mann, R. Harding, J., et al 2005).

Shellfish Condemnation Zones*:* The Virginia Department of Health (VDH) Division of Shellfish Sanitation is responsible for protecting the health of the consumers of molluscan shellfish and crustacea by ensuring that shellfish growing waters are properly classified for harvesting, and that molluscan shellfish and crustacea processing facilities meet sanitation standards. The regulations protect shellfish consumers through water quality monitoring, growing area assessments, education, and regulatory programs. Waters of the project ROI are not condemned at MA1, though the DNODS area is condemned and there are waters upstream of the proposed dredging that are also condemned.

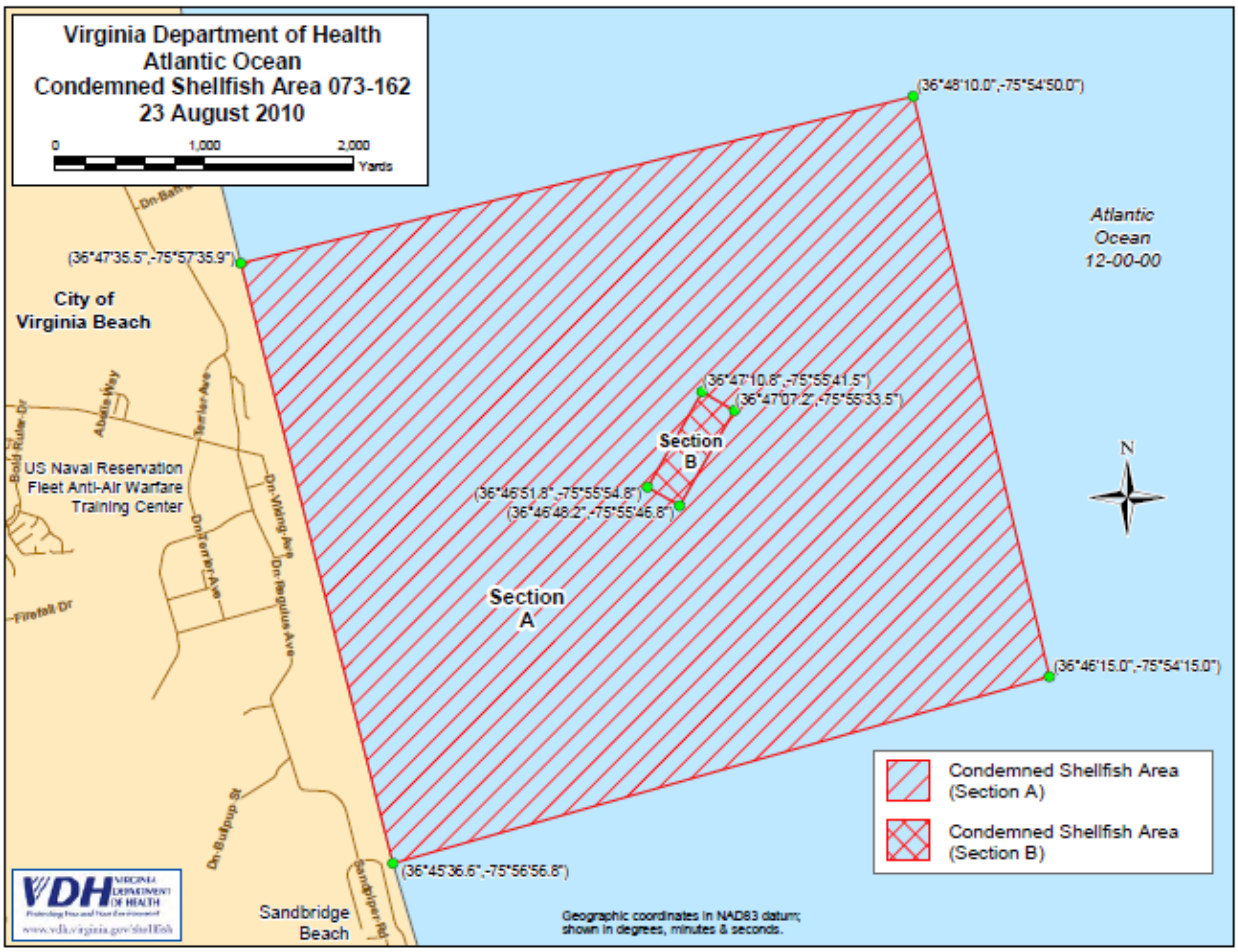

Figure 6-5. Condemned Shellfish Area at Dam Neck Ocean Disposal Site.

Eastern Oyster Resources: The eastern oyster (*Crassostrea virginica*) is considered an important commercial fishery in the Chesapeake Bay and prefer a depth range of two to twenty-six feet in brackish or salt water. Although this fishery has declined over the years due to overharvesting, pollution and disease and loss of habitat (Schulte 2017), state, Federal, and local agencies as well as nongovernmental organizations have been successfully implementing programs to increase oyster populations. Locations of natural (relict) or artificial oyster reefs are all at least several miles from the ROI and are not within or adjacent to the proposed channel dredge sites and dredged material placement/disposal areas. There are no designated private oyster lease areas managed by VMRC within the ROI.

The eastern oyster does not prefer the depths or salinities in the other locations of the ROI. The AOC, NODS, and DNODS have salinities greater than 30 ppt and depths in excess of 40 feet and, therefore, these locations do not contain suitable oyster habitat.

Blue Crab Resources: The blue crab is an important benthic prey source for a variety of predators, including striped bass (Manooch 1973, Walter and Austin 2003, Walter et al. 2003), American eel (Wenner and Musick 1975), Atlantic croaker (Overstreet and Heard 1978a, Overstreet and Heard 1978b), and red drum (Jaworski 1972, Bass and Avault 1975, Scharf and Schlicht 2000, Guillory and Prejean 2001). They can tolerate a wide range of salinity in the

Chesapeake Bay from lower Chesapeake Bay waters (up to 32 ppt) to the upper reaches of its tributaries (Tan and Van Engel 1966, Ballard and Abbott 1969, Tagatz 1971, Guerin and Stickle 1992). Mating occurs from May through October in tributaries and middle and upper waters (Van Engel 1958), peaking in July and August (McConaugha et al. 1983, Epifanio et al. 1984, Jones et al. 1990, Epifanio 1995). Gravid females extrude fertilized eggs as a mass, called a sponge, from their aprons (Pyle and Cronin 1950). As the embryos in the sponge develop, female crabs migrate towards the mouth of Chesapeake Bay to spawn in these high-salinity waters, while males remain in less saline waters (Van Engel 1958, Millikin and Williams 1984, McConaugha 1988). Eggs hatch most successfully at salinities of 20 to 32 ppt (Sandoz and Rogers 1944, Costlow and Bookhout 1959, Davis 1965), and planktonic blue crab larvae, or zoeae, develop in coastal waters above the continental shelf (Epifanio et al. 1989, Epifanio 2007). After about six to eight weeks and several molts, zoeae metamorphose into benthic megalopae, which reinvade the Chesapeake Bay (Epifanio and Garvine 2001) and eventually undergo metamorphosis into the juvenile stage after reaching nursery grounds (Metcalf and Lipcius 1992, Etherington and Eggleston 2000). Megalopae and juveniles migrate up Chesapeake Bay and into all of its tributaries (DeVries et al. 1994, Forward et al. 1997, 2003). Adult crabs of both sexes overwinter in the muddy bottoms of deeper channels (Van Engel 1958, Schaffner and Diaz 1988), while juveniles more often overwinter in shallower areas (Van Engel 1958).

According to the 2021 Chesapeake Bay Blue Crab Advisory Report, the start of the 2021 crabbing season saw 158 million adult female crabs in the Chesapeake Bay. This number is based on the results of the winter dredge survey and is tracked by the Chesapeake Bay Program as an indicator of Chesapeake Bay health. There is a designated VMRC Virginia Blue Crab Sanctuary located within portions of the ROI. Geographic locations (Figure 6-6) extend into the AOC and along the Atlantic Ocean beaches. The Blue Crab Sanctuary regulations restrict commercial and recreational harvest of blue crabs between the months of May through September.

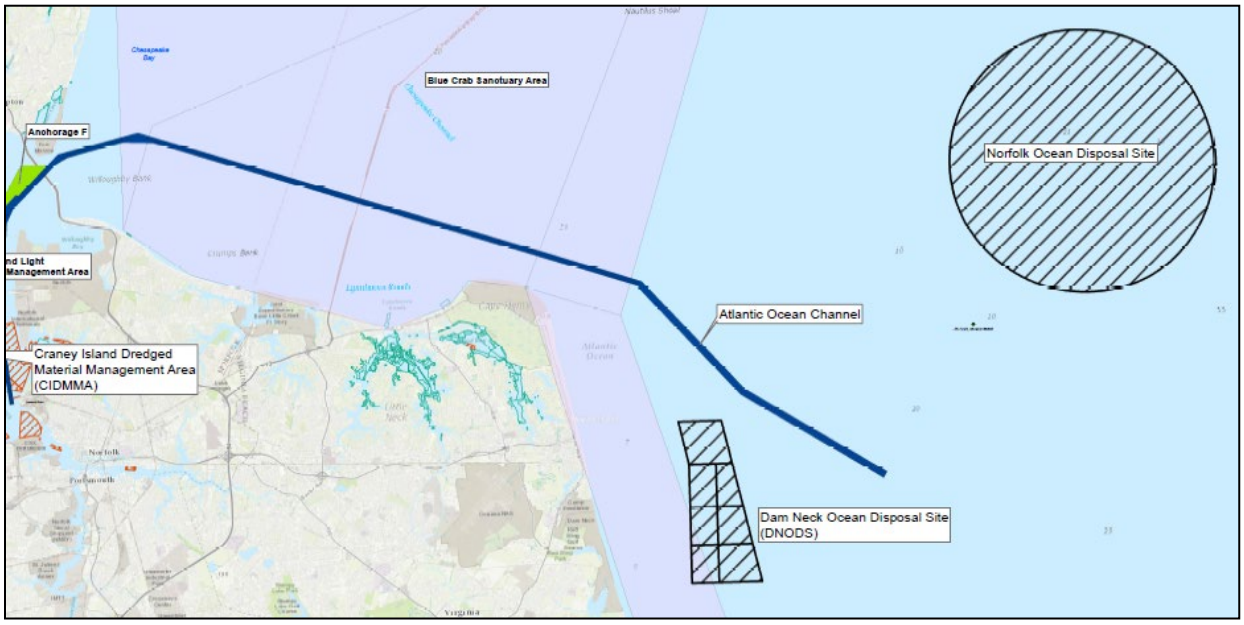

Figure 6-6. Blue Crab Sanctuaries in the ROI and Adjacent Areas.

Horseshoe Crab Resources: Horseshoe crabs (*Limulus polyphemus*), are a benthic arthropod found in the Chesapeake Bay. Between 2010 and 2014, over 1.5 million pounds of horseshoe crabs were commercially landed in Virginia (NOAA 2016). Horseshoe crabs play an important ecological role in the food web. Horseshoe crab species support several important commercial fisheries, are used for biomedical purposes, and are considered an important food source for migratory shorebirds and sea turtles. Adult horseshoe crabs prefer depths of less than 30 m (Button and Ropes 1987). Spawning habitats are typically protected sandy beaches adjacent to large intertidal sand flats (Thompson 1998). Nursery areas for juvenile (prosomal width <160 mm) horseshoe crabs are usually intertidal sand flats (Rudloe 1981; Thompson 1998). Adults have no known specific habitat requirements but may migrate to the continental shelf in the fall to overwinter. Chesapeake Bay is used in the summer months as a summer nursery area and as an overwintering site in the winter months. Shorebirds primarily feed on horseshoe crab eggs exposed on the surface, but sufficient surface eggs are available only if horseshoe crabs are spawning at high densities. Sea turtles feed on adult horseshoe crabs, but their diet depends on relative abundance of other prey species as well. Horseshoe crab mortality includes natural mortality (beach strandings, predation, diseases, etc.), and fishing mortality (horseshoe crabs are used as bait and in the biomedical industry), including by catch mortality.

Horseshoe crabs molt or shed their shell to grow. Molting occurs several times during the first two to three years and about once a year afterwards. Molting occurs approximately 16 to 17 times over a period of 9 to 11 years before sexual maturity is reached and once mature, it is believed they no longer molt. Females reach maturity one year later than males and consequently, go through an additional molt. Mature horseshoe crabs then repeat what has occurred for years, an annual spring migration to inshore spawning areas. If a horseshoe crab can survive the rigors of spawning, it may live to 18 years of age.

Horseshoe crabs are well known for their highly visible mating activities. Spawning in the Chesapeake usually begins in late May when large numbers of adults move onto beaches to mate and lay eggs. The peak in spawning activity usually coincides with the full moon and evening spring tides. Adults prefer beach areas within Chesapeake Bays and coves which are protected from rough water. Eggs are laid in clusters or nests along the beach, usually between high and low tide. Several nests are made during one beach trip and females will return on successive tides to lay more eggs. Females can produce approximately 88,000 per year. Egg development usually takes about a month and once hatched, larvae usually swim around in the shallow intertidal areas near the beaches where they were spawned until they settle to the bottom and molt. Juvenile horseshoe crabs spend their first and second summer on the intertidal flats and then begin moving offshore.

Adult horseshoe crabs feed mainly on marine worms and shellfish including razor clams and soft-shelled clams. Because they lack jaws, horseshoe crabs crush and grind their food items using the spiny bases of their legs and then push the small food particles into their mouths. Horseshoe crabs can tolerate a wide range of temperatures and can survive in low oxygen environments. As long as their book gills are kept moist, horseshoe crabs can survive out of the water for extended periods of time, especially to spawn.

This fishery is managed through the Atlantic States Marine Fisheries Commission which has created and amended the Horseshoe Crab Fishery Management Plan. In the VIMS Trawl Survey Catch Summary for January 1955 through December 2017, 584 Horseshoe Crabs identified (representing <0.01% of resources surveyed). The VMRC (through 4 VAC 20-900-10 et Seq.) has been regulating this fishery resource in accordance with this Commission by establishing licensing requirements and exemptions for the harvesting of horseshoe crabs by

hand. The VMRC also established commercial fisheries management measures for horseshoe crabs, including an annual commercial quota for horseshoe crabs that comply with the provisions of the Interstate Fishery Management Plan for Horseshoe Crab (VMRC 2016e).

Benthic Index of Biological Integrity:

The existing overall health of the general benthic community at the mouth of the James River in lower Chesapeake Bay is evaluated yearly by the Chesapeake Bay Program. This program establishes an Index of Biological Integrity (IBI-Score) for Benthic Habitat in the Chesapeake Bay and its tributaries. In the ROI, there are multiple stations gathering data on this topic (CBP 2016a). In the most recently published data, the Benthic Habitat or IBI-score for the lower Chesapeake from the Atlantic Ocean to the James River was determined to be moderately good and meeting the goals of the Chesapeake Bay program with an IBI-score of greater than three. (UMCES 2013). The nearest IBI monitoring station is several miles upriver from the project ROI, at the mouth of the Elizabeth River and these stations have a healthy IBI score. It is highly likely that the IBI score in the project ROI of MA1 and local waters around it is similar.

Environmental Consequences

No Action/Future Without Project

The Norfolk Harbor Navigation Improvements project, as well as existing maintenance dredging operations, dredged material placement, and navigation within the ROI, would continue. The existing and projected future adverse impacts to the benthic community resulting from dredging and dredged material placement/disposal are temporary with the impacted benthic community expected to rapidly recolonize after the dredging operations cease. The organisms that colonize the benthic community are typically a limited suite of small, opportunistic species with a short life cycle that are adapted to soft bottom environments with frequent disturbance. Within the warm-temperate waterbody in the ROI, recovery of the benthic community is expected in approximately two years or less (Wilbur et al. 2008; Stickney and Perlmutter 1975).

Additionally, benthic organisms outside the dredging footprint will be impacted temporarily by increased levels of Total Suspended Solids and turbidity from dredging and dredged material placement, some of which will settle on top of them, possibly burying them under a layer of silt several centimeters in depth. The siltation of benthic organisms may prevent or reduce respiration and/or foraging for filter-feeding organisms. However, the sediment plume during dredging operations is not significant enough to result in more than minor mortality of benthic life outside the channel, as quantities of Total Suspended Solids released should not result in burial of the benthos deep enough such that they will be unable to survive.

Dredging activities often generate no more increased suspended sediments than commercial shipping operations, bottom fishing or than those generated during severe storms (Parr et al. 1998). Furthermore, natural events such as storms, floods and large tides can increase suspended sediments over much larger areas and for longer periods than dredging operations (International Association of Dredging Companies 2015). It is therefore often very difficult to distinguish the environmental effects of dredging from those resulting from natural processes or normal navigation activities (Pennekamp et al. 1996).

Dredging and dredged material placement/disposal operations will cause minor, adverse impacts to the benthic community resulting from direct removal or entrainment of benthic organisms, strikes and crushing of benthic organisms, and turbidity/siltation effects that could include burial and potentially impact respiration of benthic organisms. Increased open ocean disposal would occur after CIDMMA reaches capacity. The existing and projected future adverse impacts to the benthic community are temporary.

As the GRR/EA noted, some permanent, potential shifts in salinity and Dissolved Oxygen may occur with implementation of the Action Alternative from the increased depths in the channel. This could potentially reduce the B-IBI, however, most species found in the channel are quite tolerant of lower Dissolved Oxygen than more motile life, such as fish and blue crabs. However, the hydraulic modeling (Wang et al. 2017) conducted to simulate conditions of the Action Alternative indicate that this change would be negligible to minor and would not result in a composition change in the benthic community.

Therefore, effects to the benthic community from implementation of the No Action/Future Without Project Alternative are predicted to be temporary and minor in nature.

Action Project Alternative

Following implementation of the Action Alternative, there would be little change in the composition and abundance of the benthic community, as Norfolk Harbor is already subject to recurring dredging and dredged material placement activities. The additional dredging of MA1 would be a slight increase impacts to the benthic community, relative to the much larger Norfolk Harbor Channel Improvements project. Accordingly, impacts to the benthic community also would slightly increase as open ocean disposal would increase with the Action Alternative.

Overall, impacts would be at the same threshold level of impact as the No Action/Future Without Project Alternative: adverse, temporary, and minor; however, the relative level of impact with the Action Project Alternative would be slightly higher due to the increased duration and scope of dredging, and dredged material placement/disposal. Therefore, with implementation of the Action Alternative we would anticipate impacts would remain to be adverse and minor and temporary.

6.7 Plankton Community

Environmental Consequences

No Action/Future Without Project

Per the GRR/EA, new and existing dredging operations, dredged material placement, and navigation would continue. Temporary and negligible adverse impacts to the plankton community that result from current dredging and navigation and dredged material placement/disposal operations include entrainment, burial/siltation, and reduced light levels that may affect phytoplankton productivity.

Project Action Alternative

Similar to the effects evaluated under the GRR/EA, dredging construction and maintenance and dredged material placement/disposal is anticipated to cause additional entrainment and burial/siltation of the local plankton community as compared to current operations. With implementation of the action alternative, dredging construction, dredged material placement, and maintenance will cause temporary increases in Total Suspended Solids and turbidity and in the water column in the dredging footprint and nearby adjacent areas, though this additional dredging is relatively minor relative to the scope of the entire Norfolk Harbor Channel system. The increases in Total Suspended Solids and turbidity are anticipated to last for a duration of approximately 24 hours following the cessation of dredging. The increase in Total Suspended Solids and turbidity will decrease light penetration in the water column and may temporarily impact phytoplankton productivity. Although dredging has the potential to release nutrients bound in the sediments into the water column, no phytoplankton blooms have been associated with dredging operations in the ROI based on more than 30 years of dredging history within the ROI and adjacent areas.

While these adverse impacts may result in injury and mortality to the local plankton community, the impacts are temporary and negligible due to the limited area of impact relative to the Chesapeake Bay and its tributaries and the ability for the local plankton community to rapidly recover.

6.8 Fishery Resources and Essential Fish Habitat

Affected Environment

The ROI for fishery resources and Essential Fish Habitat includes the areas transited by dredging vessels/equipment, areas of navigation channel expansion at the proposed site of MA1 by 200 feet North and South of the present channel from the edges of the existing 1,000-foot-wide channel, and dredged material placement/disposal areas, which for the proposed work are DNODS and/or NODS, both offshore dredged material placement sites. The ROI also includes the area of any circulation patterns shifts and water quality impacts that has the potential to impact fishery resources and Essential Fish Habitat. The geographic extent of water quality impacts is dependent upon factors such as the type of dredging equipment, the dredging depth, and environmental conditions such as wind and currents (USACE 1983).

This country's largest estuary, the Chesapeake Bay, is ranked third in the nation for fisheries; only the Atlantic and Pacific Ocean exceed Chesapeake Bay catch (U.S. Fish and Wildlife Service 2013). The Chesapeake Bay and its tributaries provide fishing grounds for both commercial and recreational users. Approximately 350 species of fish are known to inhabit the Chesapeake Bay Region. Of these fish species, only 32 species are year-round residents of the Chesapeake Bay (Chesapeake Bay Program 2016; National Wildlife Foundation 2016). The remaining species enter the Chesapeake Bay either from freshwater tributaries or the Atlantic Ocean to reproduce, feed, or find shelter.

The fish species in the Chesapeake Bay Region fall into two categories: resident and migratory. Resident fishes tend to be smaller than migratory species. Migratory fishes fall into two categories: catadromous or anadromous. Catadromous fishes live in freshwater and travel to

high-salinity oceanic water to spawn, while anadromous fishes travel from oceanic, or high salinity areas, to spawn in freshwater streams and rivers. Common resident species include the Chesapeake Bay anchovy, Atlantic silverside (*Menidia menidia*) killifish (Cyprinodontidae), blennies (Bleniidae), skilletfish (*Gobiesox stumosus*), gobies (Gobiidae), pipefish (*Syngnathus spp.*), lined seahorse (*Hippocampus erectus*), oyster toadfish (*Opsanus tau*), blackcheek tonguefish (*Symphurus plagiusa*), hogchoker (*Trinectes maculatus*), windowpane (*Scophthalmus aquosus*), white perch (*Morone americana*), yellow perch (*Perca flavescens*), and silver perch (*Bidyanus bidyanus*). Common anadromous species found in the ROI include: alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), American shad *(Alosa sapidissima)*, striped bass (*Morone saxatilis*), and white perch (*Morone americana*). The alewife, blueback herring, and shad species have spawning and nursery areas upstream in the James River and other coastal tributaries and use Hampton Roads for passage between upstream and coastal habitats (Klauda et al. 1991a, 1991b). Striped bass and white perch also move through Hampton Roads to spawning and nursery areas upstream in the James River and other coastal tributaries (Setzler-Hamilton 1991a, 1991b).

Hedgepeth et al. (in Priest 1981) concluded that temperature is the major factor determining the winter distribution of fishes, while food availability is the major factor controlling the summer distribution of fishes. They concluded fishes primarily use the Elizabeth and lower James Rivers for three reasons 1) nursery grounds for juvenile spot, Atlantic croaker, alewife, blueback herring, American shad, striped bass, and weakfish; 2) adult feeding grounds for spot, Atlantic croaker, weakfish, summer flounder, and 3) spawning grounds for important forage species such as Chesapeake Bay anchovy and Atlantic silverside. The observations of Hedgepeth et al. (in Priest 1981) determined that dredging operations in the project area will have a greater effect on juvenile and forage fishes than on the adult fishes found at summer feeding grounds.

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act, as amended October 11, 1996, defines the term "Essential Fish Habitat" as the “waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity”. The act applies to Federally managed species and requires Federal agencies to identify and describe EFH for fisheries that may be impacted by a potential project. Using the NOAA (2016) Guide to Essential Fish Habitat Designations in the Northeastern United States, EFH for 32 species was identified to potentially occur within the ROI. Due to this being a validation report, with a detailed EFH assessment that covered all of these species for the initial GRR/EA, the USACE re-initiated consultation with NOAA without producing an additional EFH assessment. For a detailed description of EFH and associated managed species anticipated to occur in the ROI as well as potential impacts to EFH from implementation of the Action Alternative, refer to the Essential Fish Habitat Assessment (Appendix H of the 2018 Norfolk Harbor GRR/EA).

Environmental Consequences

No Action/Future Without Project Alternative

The GRR/EA included an extensive discussion describing how current and future dredging and navigation operations may affect egg, larval, juvenile, and adult life stages of fishes within the

ROI. The GRR/EA also included an Essential Fish Habitat (EFH) Assessment, and consultation was completed with the National Marine Fisheries Service (NMFS).

The adverse effects include direct removal or burial, turbidity/siltation effects, shifts in dissolved oxygen and salinity, entrainment, visual and noise disturbances, and alteration of habitat. The impacts to fish species from Total Suspended Solids and turbidity are directly related to: the species tolerance, exposure rate, duration of the exposure, and life stage. Deposition of suspended sediments may induce impacts to fish eggs and larvae through deposition, abrasion, and or smothering, especially in the dredging and disposal areas (Wilbur and Clarke 2001). Increased open ocean disposal would be anticipated after the CIDMMA is filled to capacity, which could increase impacts to fish resources.

In summary, potential impacts to fish and fish habitat from the No Action Alternative/Future Without Project Alternative, as described in the GRR/EA, result from dredging vessels transiting to dredging locations, dredging, and dredged material placement/disposal. Increased dredged material placement/disposal would occur at the CIDMMA, DNODS, and NODS as compared to current operations. Dredging and open ocean dredged material disposal can impact water quality. Decreases in light penetration in the water column can result in behavioral responses from fishes due to the disturbance effect and potentially limit visibility. Increased depths from dredging in estuarine environments also has the potential to alter salinity levels within the dredging footprint and can also potentially result in changes in Dissolved Oxygen levels. Dredging and open ocean disposal also will alter fish habitat and can result in burial and smothering of some species. Dredging has the potential to release nutrients and/or contaminants from sediments, which can impact fishes, prey, and habitat. Fish may be impacted by noise disturbances which may cause species to flee the area of impact or potentially alter other behaviors, including foraging success. Underwater noise generated by dredging may impact fish species and the soundscape of the habitat in the project area, however, population-level impacts are not anticipated. Fishes and their habitat could potentially be impacted by releases of MEC/UXO), although this would be highly unlikely. The extent of the impact depends on hydraulic processes, sediment texture and composition, chemical content of the sediment and pore water matrices, and the behavior and life stage of the fish species.

The temporary increase in Total Suspended Solids and turbidity in the water column and at the open ocean disposal sites have the potential to directly impact fishes and fish habitat. It is anticipated that impacts to benthic habitats will involve the potential loss and displacement of non-motile benthic organisms at the open ocean disposal sites. Entrainment is defined as the direct uptake of aquatic organisms by the suction field generated at the suction intake. Due to the open-water environment of the Norfolk Harbor, the likelihood of vessel strikes to managed fish species and their prey is possible, but is not anticipated to be a substantial threat due to the limited amount of time the dredging vessels/equipment will be operating and the ability of motile fishes to move away from dredging impacts. At the conclusion of the consultation, Best Management Practices (BMPs) to avoid adverse effects were included in the GRR/EA. With implementation of these BMPs, adverse effects were found to be temporary to permanent, and minor.

Project Action Alternative

Implementation of the Action Alternative, Meeting Area 1, may adversely impact EFH in similar ways as described in the Norfolk Harbor Navigation Improvements GRR/EA and 2018 EFH Assessment. However, adverse effects would be on a far more limited scale than the Norfolk Harbor Navigation Improvements GRR/EA, as the dredging is confined to Meeting Area 1, and disposal would occur at existing designated dredged material placement sites.

The USACE has re-initiated EFH consultation with NMFS, and consultation is currently ongoing. Implementation of the Action Alternative is anticipated to result in temporary and permanent, negligible to minor adverse impacts to fish and fish habitat, including EFH. Effects to Habitat Areas of Particular Concern (HAPC) for the sandbar shark are also expected to be adverse and minor. Impacts would largely be temporary, though minor changes in salinity and dissolved oxygen may be permanent but insignificant. No substantial adverse impacts to EFH including the HAPC for the sandbar shark would be anticipated. Best management practices as described in the 2018 EFH Assessment, and also included in Chapter 7 of this document, would be implemented to avoid and minimize impacts to EFH to the maximum, practical extent.

6.9 Wildlife

Environmental Consequences

No Action/Future Without Project

The Norfolk Harbor Navigation Improvements project and existing maintenance dredging operations, dredged material placement/disposal, and navigation within the ROI would continue. These actions may flush wildlife, such as birds, out of the area temporarily. The increased Total Suspended Solids and turbidity resulting from dredging operations may temporarily disrupt foraging abilities for some wildlife. This results in temporary, negligible to minor, adverse impacts to wildlife.

This dredging and dredged material placement/disposal potentially impacts some of the prey species of birds. However, because of the already disturbed nature of the majority of the ROI and the amount of other available habitat for prey species, current dredging does not have any substantial impact on any prey invertebrate or fish populations. The dredging and dredged material placement has a temporary, negligible to minor, adverse impact to invertebrates and fish. Placement/disposal of dredged material at the CIDMMA also is anticipated to create additional wildlife habitat, which will create permanent, minor, beneficial impacts to wildlife at the CIDMMA.

Therefore, with implementation of the No Action/Future Without Project Alternative, impacts are temporary to permanent, negligible to minor, and beneficial to adverse.

Project Action Alternative

Relative to the NAA/FWOP, the effects would be the same, except for the increase in duration and dredged material disposal. However, the impact threshold would remain the same: implementation of the Action Project Alternative is anticipated to result in wildlife impacts that would be temporary to permanent, negligible to minor, and adverse to beneficial.

6.10 Special Status Species

Affected Environment

The ROI consists of the areas transited by dredging vessels/equipment, areas of navigation channel dredged and dredged material placement sites. The ROI includes the area of anticipated circulation patterns shifts and potential water quality impacts. The geographic extent of water quality impacts is dependent upon factors such as the type of dredging equipment, the dredging depth, and environmental conditions such as wind and currents (USACE 1983). The ROI also includes the range of noise impacts as they pertain to special status species.

This section provides a summary of the special status species that are known or have the potential to occur in the Action Area.

Federally listed Species and Critical Habitat

Animals and plants listed as endangered or threatened are protected under the ESA. According to the ESA, an "endangered species" is defined as any plant or animal species in danger of extinction throughout all or a substantial portion of its range. A "threatened species" is any species likely to become an endangered species in the foreseeable future throughout all or a substantial part of its range. "Proposed Species" are animal or plant species proposed in the Federal Register to be listed under Section 4 of the ESA. "Candidate species" are species for which the USFWS and NMFS have sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA. Critical habitat is designated per 50 CFR parts 17 or 226 and defines those habitats that are essential for the conservation of a Federally threatened or endangered species and that may require special management and protection.

Species that are federally listed under Section 7 of the Endangered Species Act of 1973, as amended (ESA) with the potential to occur in the ROI are provided in Table 6-3. No critical habitat occurs in the ROI.

Table 6-3. Federally listed species known or with the potential to occur in the Region of Influence (USFWS 2021a; USFWS 2021b; NMFS 2018; Watts 2016).

Taxonomic Category/Common Name	Scientific Name	Status	Critical Habitat
Birds			
Eastern black rail	*Laterallus jamaicensis ssp. jamaicensis*	T	N
Piping plover	*Charadrius melodus*	T, E	Y*
Red knot	*Calidris canatus rufa*	T	N
Roseate tern	*Sterna dougallii*	E	N
Fish			

Taxonomic Category/Common Name	Scientific Name	Status	Critical Habitat
Atlantic sturgeon (all DPSs)	*Acipenser oxyrinchus*	E	Y*
Shortnose sturgeon	*Acipenser brevirostrum*	E	N
Mammals			
Blue whale	*Balaenoptera musculus*	E	N
Fin whale	*Balaenoptera physalus*	E	N
North Atlantic right whale	*Eubalaena glacialis*	E	Y*
Northern long-eared bat	*Myotis septentrionalis*	T	N
Sei whale	*Balaenoptera borealis*	E	N
Sperm whale	*Physeter macrocephalus*	E	N
West Indian manatee	*Trichechus manatus*	T	Y*
Reptiles			
Green sea turtle (North Atlantic DPS)	*Chelonia mydas*	T	Y*
Hawksbill sea turtle	*Eretmochelys Imbricata*	E	Y*
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	N
Leatherback sea turtle	*Dermochelys coriacea*	E	Y*
Loggerhead sea turtle (Northwest Atlantic DPS)	*Caretta caretta*	T	Y*

DPS = Distinct Population Segment; E = Endangered; T = Threatened; Y = Yes; N = No; P = Proposed; ^Species status is reported as it pertains to the DPS/Action Area; *Critical Habitat not located in Region of Influence/Action Area. The monarch butterfly (*Danaus plexippus*) is a candidate species that has the potential to occur in the ROI.

There would be no anticipated suitable habitat or occurrence of the following species in the ROI: American alligator (*Alligator mississipiensis*), red-cockaded woodpecker (*Picoides borealis*), seabeach amaranth (*Amaranthus pumilus*), and the northeastern tiger beetle (*Cicindela dorsalis dorsalis*).

A detailed description of Federally listed species and their habitat and is provided the 2021 Biological Assessment submitted to the USFWS that is located in Appendix C and the 2018 Biological Opinion for the Construction and Maintenance of Chesapeake Bay Entrance Channels and use of Sand Borrow Areas for Beach Nourishment (NMFS 2018). Please note that all of the species listed in Table 6-3 are also state listed in the Commonwealth of Virginia with the same status level as described for the Federal listing. Additional state listed species are described in the next section.

State Listed Endangered and Threatened Species

Table 6-4 lists additional state listed species that have the potential to occur within a three-mile radius of the ROI (Virginia Department of Wildlife Resources (VDWR) 2021). State listed birds have the potential to forage within, migrate through, and stopover in the ROI.

Table 6-4. Additional State Listed Species with the Potential to Occur within a Three-mile Radius of the Region of Influence (VDWR 2021).

Common Name	Scientific Name	State Status
Birds		
Gull-billed tern	*Gelochelidon nilotica*	ST
Henslow's sparrow	*Centronyx henslowii*	ST
Loggerhead shrike	*Lanius ludovicianus*	ST
Peregrine falcon	*Falco peregrines*	ST
Wilson's plover	*Charadrius wilsonia*	SE
Mammals		
Little brown bat	Myotis lucifugus	SE
Ratinesque's eastern big eared	*Corynorhinus ratinesquii*	SE
Tri-colored bat	*Perimyotis subflavus*	SE
Reptile		
SE=State Endangered; ST=State Threatened		

Marine Mammals

The Marine Mammal Protection Act of 1972, as amended (MMPA) prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. In reference to the MMPA, a marine mammal is a species found in the U.S. that is classified into one of the following four distinct groups: cetaceans (whales, dolphins, and porpoises), pinnipeds (seals, sea lions, and walruses), sirenians (manatees and dugongs), and marine fissipeds (polar bears and sea otters). Only cetaceans, pinnipeds, and sirenians have the potential to occur in the ROI. All marine mammals in the U.S. are protected under the MMPA.

The term "take" per the MMPA is defined as harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal.

A comprehensive listing of marine mammals documented to occur throughout the coastal waters of Virginia as documented in the marine mammal stranding record from 1988-2013 (Barco and Swingle 2014) is provided in Appendix C. Documented occurrences of marine mammals in the ROI per survey and/or marine stranding data are also indicated (Aschettino et al. 2017-2015; Swingle et al. 2017-2010; Virginia Aquarium Foundation/Virginia Aquarium Stranding Response Program 2017a-2017b). The humpback whale, West Indies Distinct Population Segment, the only humpback whale population segment that occurs in Virginia, is no longer Federally listed but is still protected under the MMPA.

Species Protected under the Migratory Bird Treaty Act of 1918 and Executive Order 13186 (EO)

The Migratory Bird Treaty Act (MBTA) and Executive Order 13186 (EO) requires agencies to protect and conserve migratory birds and their habitats. Any activity that results in the take of migratory birds or eagles is prohibited unless authorized by the USFWS. Migratory birds are defined as those described by the USFWS in the 50 CFR 10.13.

Migratory birds' nest throughout North America, some as far north as the Arctic. In late summer and fall, they migrate south for the winter. Some winter in the southern United States, Mexico, the Caribbean or Central America while others go as far as South America. Each spring they return north to their breeding grounds. Many migratory songbirds, shorebirds, and raptors rest and refuel in the Chesapeake Bay Watershed during their spring and fall migrations. Others winter south and return to the Chesapeake Bay watershed each spring to breed. (USFWS 2016c). For a listing of migratory birds with the potential to occur in the ROI, please refer to Appendix C.

Bald Eagles Protected under the American Bald and Golden Eagle Act of 1972

Previously listed as Federally endangered, the bald eagle (*Haliaeetus leucocephalus*) has made a comeback and is no longer Federally listed. It is currently protected under the American Bald and Golden Eagle Act, and the Migratory Bird Treaty Act (MBTA).

A large raptor, the bald eagle has a wingspread of about seven feet. Adults have a dark brown body and wings, white head and tail, and a yellow beak. Juveniles are mostly brown with white mottling on the body, tail, and undersides of wings. Bald eagles typically breed and winter in forested areas adjacent to large bodies of water. However, such areas must have an adequate food base, perching areas, and nesting sites. Throughout its range, it selects large, super-canopy roost trees that are open and accessible. Nests are constructed from an array of sticks placed in an interwoven pattern. Other materials added as fillers may include grasses, mosses, and even corn stalks. A single bald eagle nesting site is located in the ROI on the northeast outskirts of the Craney Island (The Center for Biological Diversity 2021).

The ROI is not located in a Bald Eagle Concentration Area.

Migratory Bird Habitat at the Craney Island Dredged Material Management Area

The CIDMMA provides habitats to a diversity of migratory bird species that utilize shallow water, beach, and open flats (USFWS 2002). A variety of bird species reside, breed, migrate through, and/or overwinter there. More than 270 bird species have been reported to occur on the island including waterfowl, shorebirds, wading birds, birds of prey, and other passerine species. The CIDMMA is used as a stopover area for waterfowl and shorebirds during migration events (USFWS 2002). The site is also inhabited by other waterbirds including terns, gulls, wading birds, and osprey (USFWS 2002). Peregrine falcons are known to hunt on the site because of the availability of open habitat and bird prey species (Davis 1988 in USFWS 2002).

Migratory birds, including threatened or endangered species, species of concern, and other protected species use this area as foraging and breeding grounds. Nesting areas are posted with signs and are closed during the breeding season. Ground nesting birds reported to nest on CIDMMA include: least tern (*Sterna antillarum*), killdeer (*Charadrius vociferus*), willet (*Tringa semipalmata*), black-necked stilt (*Himantopus mexicanus*), avocet (*Recurvirostra americana*), horned lark (*Eremophila alpestris*), and night hawk (*Chordeiles minor*) (USFWS 2002). Least tern nesting numbers have varied year to year. The Norfolk District has constructed a shoreline stabilization project that incorporates habitat for ground nesting species along with vegetated wetlands. The USACE implements regular mammalian predator control program. Since 2010,

Least tern numbers have varied from 101 to 563 confirmed adult least terns with confirmed nests ranging from 28 to 281 nests.

Piping plover is a Federally threatened species that previously nested at CIDMMA from 1989 – 1997, although only in very limited numbers (ranging from 1 to 5 pairs) (USFWS 2002). It is thought they responded positively to the management measures that were implemented for the least terns. Because the management measures were stopped and chick foraging areas on the outside of the perimeter dike and the interior became unavailable, piping plover have not nested on the site (USFWS 2002). Without additional management efforts, piping plover nesting is not anticipated to occur at CIDMMA (USFWS 2002).

Environmental Consequences

No Action Alternative/Future Without Project Alternative

The effects of this alternative are as described in the GRR/EA.

Action Project Alternative

A detailed assessment of the potential impacts of implementation of the Action Project Alternative on Federally listed species is provided in the Biological Assessment submitted to the USFWS in 2021 provided in Appendix C and as described in the NMFS (2018) Biological Opinion provided in Appendix C. Best management practices planned for implementation are described in these documents as well. The results of the effect assessments are summarized in Table 6-5 and Table 6-6. Although some adverse impacts to habitat and potential incidental take of Atlantic sturgeon and green sea turtles, Kemp's ridley sea turtles and loggerhead sea turtles are anticipated, these adverse impacts are not anticipated to jeopardize the continued existence of any Federally listed species. There would be no impacts to critical habitat as none occurs in the ROI/Action Area. We would expect impacts to state listed bats to be similar to those described for the northern long-eared and Indiana bats as described in the Biological Assessment submitted to the USFWS that is found in Appendix C. Potential impacts to state listed birds would be as those described in the migratory birds' section.

Table 6-5. Federally Listed Species Conclusions (Within the Jurisdiction of the National Marine Fisheries Service).

Species / Resource Name	Endangered Species Act Section 7 Determination	Notes / Documentation
Atlantic sturgeon (All DPS)	May Affect, Likely to Adversely Affect	Entrainment from hopper dredging may result in injury and mortality. Collisions with dredging vessels would be unlikely. Dredging would result in a temporary loss and impact to prey species. Dredging may result in a disturbance effect where sturgeon leave the Action Area from the increased levels of Total Suspended Solids, turbidity, and noise. Sea turtle relocation trawling could

Species / Resource Name	Endangered Species Act Section 7 Determination	Notes / Documentation
		result in sturgeon captures causing a temporary stress effect.
Shortnose sturgeon	May Affect, Not Likely to Adversely Affect	There is no documented occurrence of the shortnose sturgeon in the ROI and this species would not be anticipated to occur in the ROI/Action Area; any potential effects would be discountable.
Blue whale, fin whale, north Atlantic right whale, sei, and sperm whale	May Affect, Not Likely to Adversely Affect	Collisions with dredging vessels would be unlikely based on their low operating speeds. Dredging may impact prey species and cause whales to leave the Action Area from the dredging turbidity plume and noise disturbances. Any potential effects would be insignificant.
Sea turtles: green (North Atlantic DPS), Kemp's ridley sea turtle, and loggerhead sea turtle (Northwest Atlantic DPS)	May Affect, Likely to Adversely Affect	Entrainment in hopper dredging may result in injury and incidental take. Dredging may impact prey species and cause sea turtles to leave the Action Area from the dredging turbidity plume. Relocation trawling could result in injury, incidental take, or a temporary stress effect. There is no sea turtle nesting in the ROI/Action Area.
Hawksbill sea turtle	May Affect, Not Likely to Adversely Affect	There is no documented occurrence of the hawksbill sea turtle in the Action Area and there is no preferred habitat for this species in the Action Area. This species would not be anticipated to occur in the Action Area. Any potential effects would be discountable.
Leatherback sea turtle	May Affect, Not Likely to Adversely Affect	Due to their large size and swimming capabilities, dredge entrainment or interactions would not be anticipated. There may be some temporary disturbance effects from plumes from dredging operations. Any potential effects would be insignificant.

Table 6-6: Federally Listed Species Conclusions and Bald Eagle Determination (Within the Jurisdiction of the U.S. Fish and Wildlife Service)

Species / Resource Name	ESA Section 7 / Eagle Act Determination	Notes / Documentation
American alligator	No Effect	There is no documented occurrence of the American alligator in the Action Area and there is no preferred habitat for this species in the Action Area. This species would not be anticipated to occur in the Action Area.
Eastern black rail	May Affect, Not Likely to Adversely Affect	The presence of this species in the Action Area at the CIDMMA would be considered a highly rare occurrence. Any potential effects from dredged material placement at Craney Island would be discountable.
Piping plover, red knot, and roseate turn	May Affect, Not Likely to Adversely Affect	The project may slightly impact flight and foraging behaviors but would have an insignificant impact.
Red-cockaded woodpecker	No Effect	There is no habitat for this species in the Action Area and therefore, this species would not be anticipated to occur in the Action Area.
West Indian manatee	May Affect, Not Likely to Adversely Affect	Manatees would be transient species and would not likely occur in the Action Area. Effects would be discountable.
Northern long-eared bat and Indiana bat	No Effect	No suitable foraging or roosting habitat is located in the Action Area. There are no known hibernacula in the Action Area. The project would not be anticipated to affect flights if they occur in this area.
Sea turtles: green, hawksbill, Kemp's ridley, leatherback, and loggerhead	No Effect (within the jurisdiction of the U.S. Fish and Wildlife Service)	There is no nesting habitat in the ROI/Action Area.
Seabeach amaranth	No Effect	There is no documented occurrence of seabeach amaranth in the Action Area and there is no preferred habitat for this species in the Action Area. This species would not be anticipated to occur in the Action Area.

Species / Resource Name	ESA Section 7 / Eagle Act Determination	Notes / Documentation
Northeastern beach tiger beetle	No Effect	There is no documented occurrence of the northeastern tiger beetle in the Action Area. This species would not be anticipated to occur in the ROI.
Bald eagle	Unlikely to disturb nesting bald eagles. Does not intersect with eagle concentration area	There is a solitary nest documented at the northwestern outskirts of the Craney Island (The Center for Conservation Biology 2021). Foraging may be temporarily disturbed during project construction. Any potential impacts to nesting or foraging would be anticipated to be temporary and insignificant.
Monarch butterfly (candidate species)	May Affect, Not Likely to Adversely Affect	Craney Island would not be anticipated to provide preferable foraging or breeding habitat based on the dominant vegetation types in the Action Area. Any potential disturbance effects from dredged material placement operations at the CIDMMA would be insignificant.

Marine Mammals

According to Todd et al. (2014), there are few studies on the effects of dredging on marine mammals due to dredging activities in isolation. In terms of direct effects, vessel collisions with marine mammals are possible, but improbable because dredges operate either in a stationary position or at low speeds. We would anticipate a potentially higher risk of vessel interactions with marine mammals in the future either with or without implementation of the Action Project Alternative as compared to current conditions because the predicted number of vessel calls is anticipated to increase. In comparison of the future with and without implementation of the Action Project Alternative, we would anticipate the risk of vessel strikes is less with the Action Project Alternative because of the anticipated reduced deep draft vessel calls as compared to the future without Action Project Alternative. Because it is uncertain from the marine mammal and vessel interaction stranding where strikes have occurred, it is difficult to estimate potential future increases in vessel interactions that could potentially occur. Because vessel speeds are not anticipated to increase with implementation of the Action Project Alternative, we would not anticipate that the strike risk hazard to increase from increased vessel speed but rather just the sheer potential of impact from the increased future number of vessel calls compared to existing conditions.

The risk of injury to listed whales from collisions with dredge-related vessels is considered discountable considering the species mobility and slow speed of the dredge vessels (10 knots or

less) and associated barges and scow. Also, trained personnel that know how to recognize the presence of threatened and endangered whale and sea turtle species will be onboard at all times to help ensure that vessel interactions are avoided. No marine mammal strikes with dredge-related vessels has ever been reported to occur in dredging sites at the Norfolk Harbor and Channels.

Within a noisy harbor area such as the Norfolk Harbor, ongoing exposure to underwater noise may cause causing a masking effect such that the noise of an oncoming vessel may not be detected (Whale and Dolphin Conservation Society 2006). Whales may often habituate to the noisy harbor and simply not respond to an oncoming vessel as they are so adapted to the sound of vessels (Whale and Dolphin Conservation Society 2006). According to Todd et al. (2014), there are few studies on the effects of dredging on marine mammals due to dredging activities in isolation. Todd et al. (2014) notes that while dredging noise levels vary greatly and depend partly on the method and the material being dredged, limited data seem to indicate that dredging is unlikely to cause physiological damage to marine mammal auditory systems. They note that it is more likely to lead to temporary masking and behavioral disturbances. In addition, effects of turbidity are often localized with minimal direct impact on marine mammals (Todd et al. 2014).

In comparison of the future with and without implementation of the Action Project Alternative, we would anticipate the potential for noise related impacts to be relatively less with the Action Project Alternative because of the reduced vessel calls as compared to the future without project conditions. However, with implementation of either alternative, the risks increase over time because of the anticipated increase in vessel calls. However, the noise impacts associated with dredging operations would increase slightly with the Action Alternative as compared to the No Action/Future Without Project Alternative because of the increased dredging durations and frequencies. Noise generated by bucket, cutterhead, or hopper dredge activities would not be expected to affect migration, nursing, breeding, feeding, or sheltering. Marine mammals that may occur in the ROI are accustomed to the busy harbor of which the ROI is a portion. They are also highly mobile, and it is expected that they would typically move away from dredging operations and noise. We would not anticipate any Level A or Level B harassment to marine mammals from noise-related impacts caused by implementation of the Action Project Alternative.

In addition, effects of turbidity are often localized with minimal direct impact on marine mammals (Todd et al. 2014). Todd et al. (2014) note that indirect effects are more complex, and less understood. In general, literature has suggested that dredging can cause reductions in biomass and varying levels of prey availability, depending on the surrounding conditions. However, it is also noted that marine mammals can likely compensate for small-scale changes in prey by switching prey species or moving to other foraging areas (Todd et al. 2014). The ROI for this project is also limited relative to the surrounding area available for use; therefore, the species are likely to move and forage elsewhere during the operation.

The USACE has never documented a take of any marine mammals during its previous dredging operations in the ROI and no harassment is anticipated with the noise impacts generated by the implementation of the Project Action Alternative; therefore, an incidental take or harassment authorization in accordance with the MMPA is not anticipated. No further coordination under the MMPA is anticipated.

Any potential impacts to marine mammals would be temporary, minor adverse impacts.

Species Protected under the Migratory Bird Treaty Act of 1918 and Executive Order 13186

The CIDMMA is anticipated to be full of dredged material within the next 50 years. Therefore, there could be additional dredged material placement at the NODS as compared to current operations. The lack of replacement of sandy material over time at CIDMMA, may negatively impact some migratory birds that utilize the sandy material for nesting and foraging habitat. However, increased upland habitat may benefit foraging habitat for other types of migratory birds. Also, once fully constructed, and habitats are created, CIEE is anticipated to increase certain types of avian foraging, nesting, and resting habitats.

Although piping plovers previously nested at the CIDMMA, the nesting habitat there has degraded and is not currently suitable for piping plover nesting. No future plans to resume the nesting management program to improve the nesting habitat are anticipated. Migratory birds will have the potential to forage, rest, and/or migrate through the ROI. The noise and temporary turbidity plume caused by dredging and dredged material placement actions may cause migratory birds to move away from the disturbance; however, we would expect this to be a negligible to minor, and temporary impact that would not substantially impact their long-term foraging or breeding success. The dredging and dredged material placement operations will have a temporary, negligible to minor adverse impact to benthic invertebrates and fish. This could potentially impact some of the prey species of migratory birds. The shifts in salinity, temperature, and sea level rise all have the potential to result in shifts in prey species availability which could also cause detrimental effects to migratory birds. However, because of the already disturbed nature of the majority of the ROI and the amount of other available habitat for prey species, we would not anticipate the Action Alternative to have any substantial impact on any prey invertebrate or fish populations.

With implementation of the Action Alternative, dredging volumes and durations would increase and disturbances to migratory birds could increase slightly. Therefore, if migratory birds were in the Action Area, we would anticipate a slight increase in disturbance effects that would range from negligible to minor impacts (birds temporarily moving away from the impact area) from implementation of the Action Project Alternative.

Another potential threat to special status species is injury or incidental take resulting from MEC/UXO detonation Munitions of Explosive Concern (MEC)/Unexploded Ordinance (UXO) or contact with contaminants leaching from MEC/UXO that occur in the ROI. However, this is not anticipated to be a substantial threat as the USACE deploys MEC/UXO screening devices on dredges where there is risk of MEC/UXO detonation.

6.11 Air Quality

Affected Environment

The ROI for air quality is defined by the USEPA's regulatory boundary of the Hampton Roads Area, which comprises the cities of Chesapeake, Hampton, Newport News, Norfolk, Poquoson,

Portsmouth, Suffolk, Virginia Beach, and Williamsburg, and the counties of Gloucester, Isle of Wight, James City, and York, Virginia.

Pursuant to the Clean Air Act, as amended, the USEPA Office of Air Quality Planning and Standards has set National Ambient Air Quality Standards (NAAQS) for six air pollutants, called "criteria" pollutants: carbon monoxide, nitrogen dioxide, ozone, lead, particulate matter (less than 10 microns and less than 2.5 microns), and sulfur dioxide.

The USEPA has set NAAQS for each criteria pollutant, which represents the maximum allowable atmospheric concentrations allowed in order to ensure protection of public health and welfare. The VDEQ, Division of Air Quality, has adopted the NAAQS in its USEPA-approved State Implementation Plan (SIP) and approved monitoring program (USEPA 2015).

The Clean Air Act Section 176(c)(4) established the General Conformity Rule, which USEPA implemented through rulemaking in 1993 and most recently amended in 2010 (75 FR 17253). The General Conformity Rule implements the Clean Air Act's requirement that Federal actions occurring in nonattainment and maintenance areas shall not hinder local efforts to control air pollution. Nonattainment areas are Air Quality Control Regions (AQCRs) that are in violation of one or more of the NAAQS. Maintenance areas are AQCRs that USEPA previously designated as nonattainment areas but have been subsequently been designated as attainment and are subject to a maintenance plan.

Following the revocation of the 1997 Ozone NAAQS, the Hampton Roads Intrastate AQCR was in full attainment of all NAAQS. However, based on *South Coast Air Quality Management District v. Environmental Protection Agency*, 882 F. 3d 1138 (D.C. Cir. 2018), AQCRs that were redesignated to attainment (i.e., maintenance areas) for revoked NAAQS are now required to prepare a second maintenance plan. The USEPA has recommended that general conformity procedures be followed for the 1997 NAAQS for Ozone in the Hampton Roads Intrastate AQCR, for which the region was previously in "maintenance."

When subject to conformity procedures, Federal agencies are required to demonstrate Federal actions "*conform with*" (i.e., do not undermine) the approved SIP for their project's geographic area. The purpose of conformity is to (1) ensure Federal activities do not interfere with the air quality budgets in the SIPs; (2) ensure actions do not cause or contribute to new violations; and (3) ensure attainment and maintenance of the NAAQS. The attainment and nonattainment designations for the Commonwealth of Virginia for all the NAAQS are codified at 40 CFR 81.347.

The Commonwealth of Virginia has maintained a network of air monitoring stations in Virginia since 1980 and the ROI falls within the AQCR 6[1] as defined in 9 VAC5-20-200 as the Hampton Roads Intrastate AQCR (VDEQ 2015).

[1] [1] The area consists of the cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg, and the counties of Isle of Wight, James City, Southampton, and York, Virginia.

Environmental Consequences

No Action/Future Without Project Alternative

Per the Norfolk Harbor Navigation Improvements GRR/EA, new and existing dredging operations, dredged material placement, and navigation would continue in the ROI. Current maintenance operations would continue to generate emissions from the combustion of fuel used to operate vessels and equipment (e.g., dredge operation, pumps, transportation, and final dredged material placement/disposal).

Implementation of the No Action/Future Without Project Alternative would result in adverse, temporary impacts to air quality that are minor.

Action Project Alternative

Air emissions resulting from combustion of fuel during construction and maintenance operations would increase very slightly with implementation of the Action Project Alternative, as compared to the No Action/Future Without Project Alternative because of the increased duration of construction and maintenance operations.

With implementation of either the No Action/Future Without Project Alternative or the Action Alternative, the overall number of vessel calls is anticipated to increase over time. Therefore, fuel combustion emissions resulting from deep draft navigation in the Norfolk Harbor would increase over time regardless of whether the Action Project Alternative is implemented. However, the anticipated number of vessel calls with implementation of the Action Alternative would be less than future conditions without implementation of the Action Alternative. This is because the existing, larger vessels in the fleet would transport the same quantity of cargo more efficiently (i.e., fewer trips to move the annual quantity of cargo). Therefore, in future conditions with implementation of the Action Alternative we would anticipate fewer emissions resulting from deep draft vessels as compared to future conditions without implementation of the Action Alternative.

Based upon USEPA's recommendation, USACE prepared a general conformity applicability analysis and a RONA demonstrating that the emissions caused by the project are *de minimis* and will not interfere with the state's plans to attain and maintain NAAQS for air quality. A general conformity determination is not required. The recommended RONA and the emissions analysis are included in the Environmental Appendix C. By undertaking this general conformity applicability analysis, USACE does not commit to preparing such analyses for future projects in the Hampton Roads Intrastate AQCR 1225.

Overall, similar to the No Action/Future Without Project Alternative, implementation of the Action Project Alternative would result in temporary, minor impacts to air quality. The increases in construction and maintenance-related emission from implementing this alternative would not be predicted to result in substantial changes to regional or global-climatic air quality.

6.12 Climate Change

Affected Environment

The ROI for the climate change and sea level rise analysis is limited to the waters of the Norfolk Harbor as well as the shorelines and adjacent upland areas proximate to the proposed navigation improvements and dredged material placement/disposal sites.

Human-induced climate change and global warming have been observed during the 20th and 21st centuries and have resulted in rising global and local sea levels. Analysis in the AR6 report states that “Global mean sea level increased by 0.20 [0.15 to 0.25] m between 1901 and 2018. The average rate of sea level rise was 1.3 [0.6 to 2.1] mm yr–1 between 1901 and 1971, increasing to 1.9 [0.8 to 2.9] mm yr–1 between 1971 and 2006, and further increasing to 3.7 [3.2 to 4.2] mm yr–1 between 2006 and 2018 (high confidence).” Human influence was cited as the unequivocal main driver of these SLR increases since at least 1971 (IPCC, 2021). Locally, the RSLR (relative sea-level rise) has been higher than the global mean, due to a SLR “hotspot” that exists on the East coast of North America (Koeberl et al., 1996; Kleinosky et al., 2007; Barbosa & Silva, 2009; Yin et al., 2009; Boon et al., 2010; Sallenger Jr. et al., 2012). This higher rate is driven by Oceanic currents influence local sea level rise on the Atlantic Coast due to temperature and salinity changes in the Atlantic Ocean, which cause pressure gradients between the Gulf Stream and coastal waters to decrease, which then cause coastal waters to rise (Sallenger et al. 2012) and glacial rebound, which causes the earth’s crust in the southern Bay region to subside. As a result of these factors, local, relative sea level rise (RSLR) on the mid-Atlantic Coast of the United States from North Carolina northward is occurring at approximately twice the global mean rate, and the rate of sea level rise is accelerating both globally and locally. Data from the Sewells Point tidal gauge indicate that Hampton Roads has experienced an increase of 1.15 feet of relative sea level rise between 1927 and 2006 (HRTPO 2013). Subsidence is responsible for more than half (53%) of the measured relative sea level rise in the Chesapeake Bay area (HRPDC 2011). Sea level rise due to climate change is now the dominant factor in relative sea level rise whereas as only 2.10 mm/yr of the present rate of sea level rise of 4.85 mm/ is due to subsidence (Schulte et al. 2015).

The U.S. National Climate Assessment (2012) has established a range of global sea level rise predictions for the year 2100 that all predict sea level rise and range in the predicted value from 0.7 feet on the low end to 6.6 feet as a high prediction with intermediate values between the extremes (U.S. National Climate Assessment 2012).

Changes to relative sea level can result from a number of factors including faulting and consolidation of sediments in fill structures, and sediment compression caused by groundwater withdrawals (Boon 2010). The USACE engineering documents require that planning studies and engineering designs evaluate the entire range of possible future rates of sea-level change, represented by three scenarios of “low”, “intermediate”, and “high” sea-level change (USACE 2013; USACE 2014) (See Section 5.10). The local rate, determined by the USACE, using the Sewells Point tide gauge, which is within the project ROI and has been operating for 80 years, was determined using the USACE sea level rise predictor (USACE 2017), and the results can be seen in Figure 6-7.

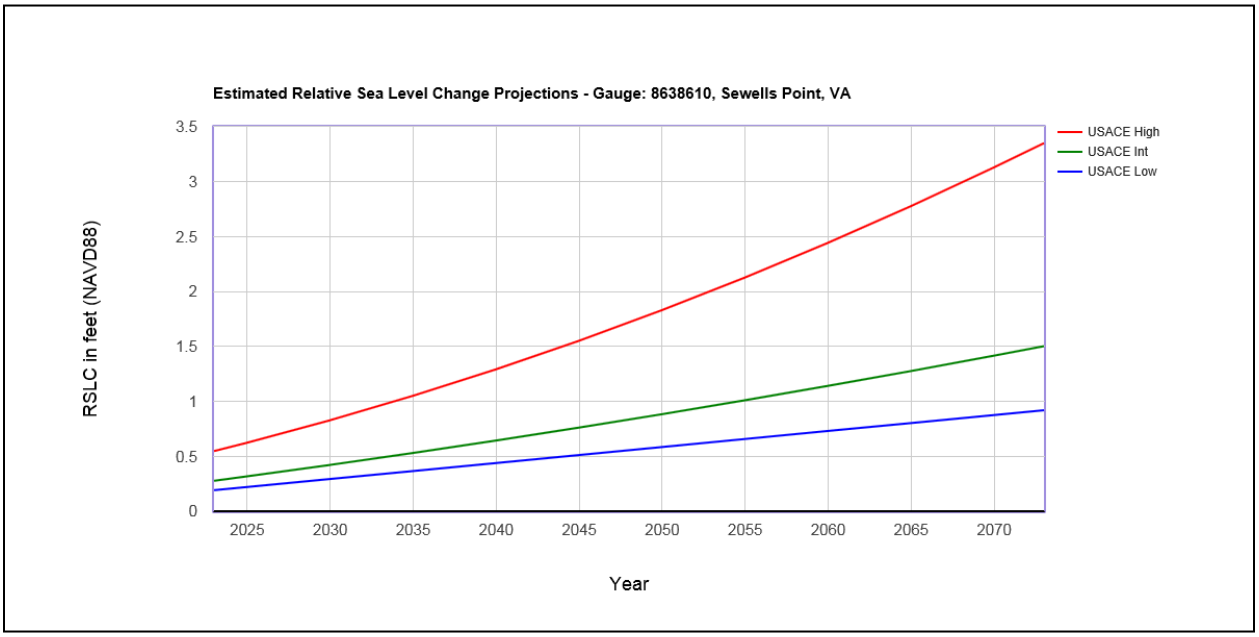

Figure 6-7: Relative Sea Level Rise in the project ROI, lower Chesapeake Bay.

In 2013, the USACE published Engineering Technical Letter 1100-2-1, “Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation” (USACE 2014) and Engineering Regulation ER-1100-2-8162, “Incorporating Sea Level Change into Civil Works Programs” (USACE 2013), which provide guidance to the USACE for how to incorporate sea level change for civil works projects.

Environmental Consequences

No Action/Future Without Project Alternative

Per the GRR/EA, existing and new dredging operations, dredged material placement, and navigation would continue in the ROI. Current maintenance operations would continue to generate emissions from the combustion of fuel used to operate vessels and equipment (e.g., dredge operation, pumps, transportation, and final dredged material placement/disposal).

With implementation of the No Action/Future Without Project alternative, existing greenhouse gas-producing activities within the ROI, as well as climate change, would be predicted to continue and relative sea level rise would be expected to continue to rise over the 50-year period of analysis. As previously described in the Air Quality Section, implementation of the No Action/Future Without Project Alternative does have minor impacts to air quality but this would not substantively impact global-climatic air quality.

Action Project Alternative

With implementation of either the No Action/Future Without Project Alternative or the Action Alternative, the overall number of vessel calls is anticipated to increase over time. Therefore, greenhouse gas emissions resulting from deep draft navigation in the Norfolk Harbor would increase over time regardless of whether the Action Project Alternative is implemented.

However, the anticipated number of vessel calls with implementation of the Action Alternative would be less than future conditions without implementation of the Action Alternative. This is because the existing, larger vessels in the fleet would transport the same quantity of cargo more efficiently (i.e., fewer trips to move the annual quantity of cargo). Therefore, in future conditions with implementation of the Action Alternative we would anticipate fewer greenhouse gas emissions resulting from deep draft vessels as compared to future conditions without implementation of the Action Alternative.

Climatic changes such as sea level rise and increasing global temperatures are predicted to continue. Predicted climate change impacts such as increased ocean temperatures, ocean acidification, sea level rise, and changes in currents, upwelling and weather patterns, have the potential to cause changes in the nature and character of the estuarine ecosystem in the ROI. The pH within surface waters will likely drop as ocean acidification occurs. Climate change is anticipated to potentially increase winter and spring nutrient loading into the Chesapeake Bay (Najjar et al. 2010). The higher temperatures, lower dissolved oxygen levels, and increased phytoplankton productivity may result in more frequent hypoxic conditions (low dissolved oxygen conditions) in the water column. The anticipated higher temperatures and carbon dioxide levels in the Chesapeake Bay may result in increases in harmful algal blooms (Najjar et al. 2010). From the modeling results located in Appendix J of the 2018 Norfolk Harbor GRR/EA, most of larger salinity differences (2-3 ppt) occur near upstream of the estuary at the limit of salinity intrusion. The differences are smaller elsewhere (~ 1.5 ppt or less). In all scenarios, the bottom salinity exhibits more increase than does the surface salinity in moving upstream. The largest changes are expected in the Lower James River near and upstream of the proposed dredging/current navigation channel (Liu et al. 2017). Differences in N, Phosphorus P, and Chlorophyll a (Chla) (measure of phytoplankton productivity) all appear to be relatively minor due to sea level rise,

As a result of climate change, global temperatures and sea level are expected to rise in the foreseeable future. Sea level rise may result in an increase in salinity in upstream areas that could affect breeding sites and survival of early life stages for fish (eggs, larvae, and young of the year). There could be shifts in breeding habitat availability and timing, and the effects of this change on fish populations could be detrimental although relatively uncertain at this time. The shifts in salinity, temperature, and sea level rise all have the potential to result in shifts in prey species availability, which could also cause detrimental effects to fish resources and habitats.

Existing greenhouse gas-producing activities within the ROI (e.g., navigation and other transportation, industry, commerce, military, and recreation) would be expected to continue throughout the 50-year period of analysis.

However, implementation of the Action Project Alternative would have very minor impacts to air quality, but this would not substantively impact global-climatic air quality.

6.13 Floodplains

Affected Environment

Through Executive Order (EO) 11988, Federal agencies are required to evaluate all proposed actions within the 1% annual chance (100-year) floodplain. Actions include any Federal activity involving 1) acquiring, managing, and disposing of Federal land and facilities, 2) providing Federally undertaken, financed, or assisted construction and improvements, and 3) conducting Federal activities and programs affecting land use, including, but not limited to, water and related land resources planning, and licensing activities. In addition, the 0.2% annual chance (500-year) floodplain should be evaluated for critical actions or facilities, such as storage of hazardous materials or construction of a hospital. The EO provides an eight-step process to evaluate activities in the floodplain that generally includes 1) determine if the proposed action is in the floodplain, 2) provide public review, 3) identify and evaluate practicable alternatives to locating in the 1% annual chance floodplain, 4) identify the impacts of the proposed action, 5) minimize threats to life and property and to natural and beneficial floodplain values and restore and preserve natural and beneficial floodplain values, 6) reevaluate alternatives, 7) issue findings and a public explanation, and 8) implement the action. Proposed actions may have limited impacts such that the eight-step process may vary or be reduced in application, which is the case for this project.

The ROI for the proposed work in MA1 is offshore waters at the confluence of the James River and lower Chesapeake Bay, approximately 4 miles offshore of the City of Norfolk and 3.1 miles west of Fort Monroe. The proposed placement areas are NODS and DNODS, both of which are offshore sites out in the Atlantic Ocean. Both Norfolk and Fort Monroe have floodplain areas, though both are a significant distance away from the proposed dredging in MA1.

Environmental Consequences

No Action/Future Without Project

For this Alternative, a portion of the dredged material from the Norfolk Harbor Channel Improvement project would go to CIDMMA. As a waterfront facility built within the harbor, CIDMMA is located near/within the 1% annual chance tidal floodplain. The dredging process itself would have no effect on flood plains.

Although not shown as a mapped floodplain by FEMA, dike overtopping at CIDMMA from heavy rainfall is possible, which could impact people, property, and the environment, but appears to be unlikely as the facility has been tested from several significant rainfall flood events going back to Hurricane Floyd in 1999 and most recently Hurricane Mathew. As a best management practice, spillways are used to draw down water levels if a large rainfall event is forecasted. Considering the dike cross section/footprint size and scale relative to the interior containment areas, it appears a future dike breach/failure is also considered unlikely. If overtopping or a breach/failure occurred, it appears most of the spillage would most likely be contained on site as sheet flow, as there is a buffer of land from the dikes to the adjacent body of water or properties at a minimum of 300 feet.

With inspections, operation, maintenance, and safety plans that are in place at CIDMMA, there should be minimal threats to loss of life and injury, damage to property, and impacts to the

environment. There is strict guidance in place for safety and accident prevention, sediment and erosion control, spill prevention and cleanup, environmental compliance and protection, historic preservation, and procedures for placing dredged material, operating the spillways, and maintaining adequate freeboard for normal pumping operations and also for rain and wind events.

Therefore, with implementation of the No Action/Future Without Project Alternative, we would anticipate any potential adverse impacts to the floodplains to be negligible and temporary. Per the GRR/EA, existing and new dredging operations, dredged material placement, and navigation would continue in the ROI. Current maintenance operations would continue to generate emissions from the combustion of fuel used to operate vessels and equipment (e.g., dredge operation, pumps, transportation, and final dredged material placement/disposal).

With implementation of the No Action/Future Without Project alternative, existing greenhouse gas-producing activities within the ROI, as well as climate change, would be predicted to continue and relative sea level rise would be expected to continue to rise over the 50-year period of analysis. As previously described in the Air Quality Section, implementation of the No Action/Future Without Project Alternative does have minor impacts to air quality but this would not substantively impact global-climatic air quality.

Action Project Alternative

For this alternative, it is possible that some of the dredged material may be placed at CIDMMA. Therefore, the effects of the Action Project Alternative would be expected to be similar to the No Action Alternative: potential adverse impacts to the floodplains would be negligible and temporary.

6.14 Noise and Vibration

Environmental Consequences

No Action/Future Without Project Alternative

Per the GRR/EA, new and existing dredging operations, dredged material placement/disposal, and navigation within the ROI would continue. Maintenance of existing channel depths, to include dredging and dredged material placement/disposal would continue to produce intermittent noise and vibration within the ROI. There would be no increase in the duration of current maintenance operations, and noise generated from dredging would dissipate relatively quickly.

Implementation of the No Action/Future Without Project Alternative is predicted to result in temporary, minor adverse noise and vibration impacts within the ROI.

Action Project Alternative

Compared to the No Action/Future Without Project Alternative, implementation of the Action Project Alternative would result in a minor increase in the duration of dredging operations, to include dredging, dredged material placement/disposal, and transiting of navigation channels within the ROI. The noise and vibration produced by dredging vessels is predicted to dissipate a relatively short distance from the dredging operations, though this may be dependent on wind

speed and direction. However, it is anticipated that noise inputs from project implementation would not significantly increase ambient noise levels in the human environment or affect sensitive noise receptors.

Implementation of the Action Project Alternative is predicted to result in temporary, minor adverse noise and vibration impacts within the ROI.

6.15 Occupational Health and Safety

Affected Environment

The occupational health and safety (OSH) environment in the ROI of this project would be in the work of navigating to dredging sites and dredged material placement/disposal sites, dredging operations to deepen and widen channels within Meeting Area 1 by 200 feet North and South of the present channel from the edges of the existing 1,000 foot wide channel, and placing the dredged materials at placement/disposal sites. Risk factors in this OSH environment include operation of heavy equipment, potential exposure to hazardous materials in the dredged material and water, and navigational hazards (American National Standards Institute 2011).

Phases of work each have their own set of potential hazards. Dredging projects involve the following phases of work:

- Mobilization
- Hydrographic surveying
- Hauling gear maintenance and cable replacement
- Hazards to navigation
- Pipeline installation
- Dredging
- Trip wire replacement
- Disposal site activities
- Severe weather precautions
- Demobilization

Contractors are required to prepare an Accident Prevention Plan (APP) for review by USACE safety staff prior to begin given notice to proceed with work (U.S. Army Corps of Engineers. EM-385-1-1). The APP specifies the safety and occupational health plan, responsible personnel and their OSHA certifications, safety training for all personnel, protective equipment, Clothing and Personal Protective Equipment (PPE) are typically required for workers. PPE includes:

- Appropriate clothing for weather conditions;
- Steel toed boots;
- Hard hat;
- Protective eyewear matched to work type (e.g., cutting or welding);
- Work vest/personal floatation device; and
- Hearing protection if exposed to various decibel levels for a scale of time periods.

Safety hazards in dredging operations are evident in a USACE safety checklist for dredges. Safety concerns include food safety, personal hygiene, vermin, first aid and emergency medical

care, eye injuries, water safety, fire hazards, electrical hazards, slip and fall hazards, and equipment hazards. There are a total of 40 items on the checklist (USACE, 2009).

Munitions of Explosive Concern/Unexploded Ordnance Safety

Contract requirements are added to USACE dredging contracts where Munitions of Explosive Concern/Unexploded Ordnance (MEC/UXO) might be encountered during dredging activities. This involves safety support and avoidance of potential unexploded ordnance and exploded ordnance, inert ordnance, and ordnance fragments and similar explosives debris material (defined and identified in these specifications as "Munitions and Explosives of Concern"(MEC), within the dredging area during performance of dredging activities. Various sizes of munitions, both live and inert may be encountered in former coastal artillery ranges of Fort Story, Fort Monroe, and Fort Wool. Additionally, the Coast Artillery command of the US Army maintained remotely operated defensive minefields during World War II, and German U-Boats laid offensive magnetic mines around the channel near Cape Henry.

The contract for the Thimble Shoal and Cape Henry Maintenance Dredging project required the contractor to develop a MEC Safety and Work plan. Parts of the dredging areas for this project were within the Fort Story Inner Coastal Defense Range. Elements of the MEC Safety and Work plan included; a) a dredge intake screening device that would prevent passage of any material greater than 1.25 inches in diameter, although the openings could have another dimension up to 6 inches; b) screening devices would be made of rugged steel or composite material, one-piece or welded members, and constructed to cover the entire area where installed; c) screening devices would be removable for easy replacement if damaged; d) finally the contractor would maintain adequate replacement parts and/or additional screening to insure production for the work does not stop due to damaged screens. Additionally, a Government provided Ordnance and Explosives Safety Specialist (OESS) was to provide pre-dredging MEC safety training on the dredge prior to the commencement of dredging activities. In the event MEC was identified, the contractor’s personnel were to leave the vicinity, contact Navy Explosive Ordnance Disposal, and notify the Contracting Officer’s Representative.

The waters of the project area have been the scene of naval warfare in conflicts since the 17th century. Explosive shells, although first used in Western warfare as far back as the 15th century, did not become commonly used until the 19th century. The first year of the Civil War saw activity by warships and shore batteries around Hampton Roads and the Elizabeth River, but these amounted to shore batteries or gunboats firing a few, mostly short, rounds at each other until the Battle of Hampton Roads. This famous first duel of ironclad warships began with the CSS Virginia (Merrimack) and a few Confederate gunboats launching attacks on the blockading Union fleet, sinking two major warships and damaging a third. Returning the next day the USS Monitor was waiting for the Virginia, and a day long battle between the two slugging it out with hundreds of rounds ensued. Also in the fray were the guns of other Union and Confederate vessels and shore batteries of the Union.

Although no warfare in the Spanish American War took place, coast artillery installations at Fort Monroe and Fort Wool practiced their gunnery leaving many rounds on the bottom of the Chesapeake Bay, and a large area there is currently designated as part of the Military Munitions Response Program. World War I gave incentive to bolster these defenses. Sinking of merchant ships along the Eastern Seaboard happened during World War I, but there were no recorded

sightings of U-Boats in or near the Chesapeake Bay. U-boats are known to have laid mines off New York where ships struck mines, and may have off the Chesapeake Bay, but no sinking or mines were reported in Virginia. This would be much different during World War II.

Although the United States stayed out of the conflict in Europe for more than two years, even Isolationists did not object to bolstering coastal defenses. Massive new guns, up to 16 inches in bore, were mounted at Cape Henry and Cape Charles (McGovern 2008). The firing arcs of these batteries may hold many unexploded shells on the seafloor. Although the batteries were never brought to bear on enemy ships, practice firings were carried out. Also falling under the U.S. Army Coastal Defense Command were defensive minefields. These were armed remotely, from bunkers with switchboards. Once armed the 'horned mines' were set off by contact with a ship's hull, although they could also be directly detonated from the control bunkers. There were several mine fields at the entrance to Chesapeake Bay and the approaches to Hampton Roads. Altogether there were some 800 mines deployed. Distressingly, in the process of planting, maintaining, and removing the mines some 218 were lost (Albright 2013). These buoyant mines were anchored to the bottom, but if their cables were broken, or they lost buoyancy they could drift or sink anywhere.

Germany wasted no time in dispatching U-boats to the American coast after declaring war on the U.S. in December 1941. By the winter of 1942 scores of ships were being sunk by the German submarine fleet along American shores. In June of 1942 U-701 included the laying of magnetic mines in its patrol off the coast of Virginia and North Carolina (U-Boats.net 2012). The U-boat laid 15 of these mines in a winding line along the shipping lane, and centered just off Cape Henry. Five ships struck the mines, with two sunk, the others badly damaged. Three of the mines were detonated by minesweepers, and one may have been set off during a depth charge attack on a false contact by American destroyers (Blair 1996). The other four or five remain unaccounted for. Note C on NOAA Chart No. 12222 (NOAA 2009) warns mariners: "Danger Area, Area is open to unrestricted surface navigation but all vessels are cautioned neither to anchor, dredge, trawl, lay cables, bottom, nor conduct any other similar type of operation because of residual danger from mines on the bottom." In the summer of 1943 U-566 laid 12 magnetic mines off Cape Charles (Shomette 2007). None of these are known to have been set off ships, or swept, and remain unaccounted for.

Failed attacks by U-boats may have left undetonated torpedoes, and counter attacks by anti-submarine vessels may have left depth charges off the mouth of Chesapeake Bay. On July 23, 1965 the trawler *Snoopy* was dredging for sea scallops 58 miles southeast of the entrance to the AOC. On retrieving the port trawl a torpedo was found to be lodged in the device. While attempting to dislodge the torpedo, the weapon exploded, completely destroying the *Snoopy* and killing eight of her crew (U.S. District Court, 1967). Even in peacetime, ordnance has been lost in an area busy with warships. Chart No. 12222 notes unexploded depth charges a mile off Chicks Beach, Virginia from April 1956, and explosives lost in Hampton Roads in 1962 near Anchorage F.

Environmental Consequences

No Action/Future Without Project Alternative

Contract requirements are added to USACE dredging contracts where Munitions of Explosive Concern/Unexploded Ordnance (MEC/UXO) might be encountered during dredging activities.

This involves safety support and avoidance of potential unexploded ordnance and exploded ordnance, inert ordnance, and ordnance fragments and similar explosives debris material (defined and identified in these specifications as "Munitions and Explosives of Concern"(MEC), within the dredging area during performance of dredging activities. Various sizes of munitions, both live and inert may be encountered in former coastal artillery ranges of Fort Story, Fort Monroe, and Fort Wool. Additionally, the Coast Artillery command of the US Army maintained remotely operated defensive minefields during World War II, and German U-Boats laid offensive magnetic mines around the channel near Cape Henry.

The contract for the Thimble Shoal and Cape Henry Maintenance Dredging project required the contractor to develop a MEC Safety and Work plan. Parts of the dredging areas for this project were within the Fort Story Inner Coastal Defense Range. Elements of the MEC Safety and Work plan included; a) a dredge intake screening device that would prevent passage of any material greater than 1.25 inches in diameter, although the openings could have another dimension up to 6 inches; b) screening devices would be made of rugged steel or composite material, one-piece or welded members, and constructed to cover the entire area where installed; c) screening devices would be removable for easy replacement if damaged; d) finally the contractor would maintain adequate replacement parts and/or additional screening to insure production for the work does not stop due to damaged screens. Additionally, a Government provided Ordnance and Explosives Safety Specialist (OESS) was to provide pre-dredging MEC safety training on the dredge prior to the commencement of dredging activities. In the event MEC was identified, the contractor's personnel were to leave the vicinity, contact Navy Explosive Ordnance Disposal, and notify the Contracting Officer's Representative.

Existing safety risks would be mitigated to the maximum, extent practical through following a Work Safety Plan that incorporates standard work practices for screening/handling MEC/UXO, avoidance of slip and fall hazards, handling contaminated sediment, and wearing appropriate Personal Protective Equipment (PPE). Hazards from MEC/UXO's can be mitigated through identification by reviewing magnetometer surveys of past and new archaeological surveys. Ordnance identified could then be avoided or disposed of with assistance of qualified explosive ordnance disposal personnel.

With implementation of the No Action/Future Without Project Alternative, new and maintenance dredging would continue, and existing, temporary safety risks described in the Affected Environment Section that are at a negligible to minor level of impact would continue.

Action Project Alternative

Construction dredging is assumed to present similar occupational health and safety risks as the No Action/Future Without Project Alternative. However, the duration of exposure to occupational safety and health risks would increase slightly with implementation of the Action Project Alternative as compared to the No Action/Future Without Project Alternative. Implementation of the Action Alternative as compared to the No Action/Future Without Project Alternative would have slightly increased potential exposure to chemical and ordnance hazards should they be encountered, but to date all contaminated sediments and ordnance encountered by dredging in the area has been safely handled. In addition, based on existing MPRSA sediment testing conducted within portions of the ROI, no contaminated sediments are known to occur in the ROI. Although the Action Alternative has slightly higher durations of exposures to occupational safety

and health hazards, entailing slightly more risk than the No Action/Future Without Project Alternative, the occupational safety and health risks would be very similar and remain at a temporary and negligible to minor level of impact.

The increased level of dredging and dredged material placement/disposal activities, and exposure to occupational health and safety hazards would be mitigated as described above. With the mitigative measures described above, implementation of the Project Action Alternative would be similar to the No Action/Future Without Project Alternative: adverse effects on safety would be temporary, and negligible to minor.

6.16 Utilities

Environmental Consequences

No Action/Future Without Project

The Norfolk Harbor Channel Improvements and existing maintenance dredging operations, dredged material placement/disposal, and navigation within the ROI would continue. The GRR/EA had indicated that based on available information, it appears the 55-Foot Channel in the Norfolk Harbor Entrance Reach to be deepened, may have the potential for temporary, adverse impacts to the U.S. Navy's DeGaussing Range, with its sensors at -57 feet. The GRR/EA indicated that any potential impacts to the Degaussing Range would be avoided or fully mitigated. If the USN determines there will be a risk to the Range from dredging operations, future deeply laden ships or anchor drag, under conditions of their Corps permit, the USN would be required to relocate the sensors to deeper depths to accommodate the channel, at USN expense. During detailed surveys and channel design studies to be performed during the Preconstruction Engineering and Design phase, additional coordination among the project team and USN representatives would be conducted to validate project dredging requirements with respect to the Navy's needs.

By 2018, two fiber optic utility lines known as MAREA and BRUSA, were installed 1.5 meters below the existing bottom until they exit the 100-foot-wide perimeter around DNODS. However, any placement of material over these utility lines would have no impact on these resources.

Therefore, the No Action/Future Without Project Alternative, is anticipated to cause temporary, adverse impacts to the DeGaussing Range if relocation is necessary, but additional detailed channel studies and coordination will be conducted in PED to verify this course of action. Any potential impacts would be avoided or fully mitigated by relocation of the range by the Navy. Otherwise, existing utilities would remain intact and continued maintenance of the channel system should have no effect on utility infrastructure

Action Project Alternative

When compared with the No Action/Future Without Project Alternative, which includes the Norfolk Harbor Channel Improvements, there would be no additional impacts to utilities in the ROI, with implementation of Action Alternative

With implementation of the Action Alternative, placement of the dredged material at the CIDMMA, DNODS, and NODS is expected to have no effect on utility infrastructure.

It is not anticipated that the NAA/FWOP or the Action Alternative's placement activities at DNODS will have adverse impacts on the MAREA and BRUSA fiber optic lines because both the deepening of the channel and the crossing of DNODS was a consideration in the design of the utility installation. Any impact to the cable lines would be negligible and fully mitigated by relocation at the owner's expense.

6.17 Cultural Resources

Affected Environment

The National Historic Preservation Act (NHPA) of 1966 (as amended) sets federal policy for historic preservation. Section 106 of the NHPA and its implementing regulations at 36 CFR § 800, require the lead Federal agency to assess the potential effects of an undertaking on historic properties that are within the proposed undertaking's Area of Potential Effect (APE). Undertaking means a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; and those requiring a Federal permit, license, or approval (36 CFR § 800.16[y]). Historic properties are those listed in or eligible for listing in the National Register of Historic Places (NRHP) and include prehistoric and historic districts, sites, structures, buildings, or objects.

The APE/ROI for MA1 encompasses the dredge widening and associated slopes for MA1, the areas for proposed dredge disposal, and areas where potential visual/noise effects to the setting, feeling and association of a historic property could occur. The visual/noise APE for cultural resources is defined as areas within approximately one mile of dredging activities.

Based on USACE and DHR records, the APE has been previously surveyed. Underwater remote sensing surveys identified four areas as potential shipwrecks: 44NR0051, 44NR0053, 44NR0054 and 44NR0055. The NRHP eligibility of the four sites is unevaluated, but for the purposes of this analysis, these sites are assumed to require avoidance. In addition, the eastern extent of the previously recorded DHR Site 114-5471 Civil War Battle of Hampton Roads (Battle of the Ironclads) that is potentially NRHP-eligible for its association with historic events (Criterion A) is in the APE. This area is also noted by the National Park Service American Battlefield Protection Program as potentially eligible for the NRHP. The only historic property within the visual/noise APE is Site 114-5471.

Environmental Consequences

No Action/Future Without Project Alternative

With the No Action Alternative, conditions surrounding the submerged archaeological sites in the APE would remain unchanged if the Action Project Alternative is not implemented. Maintenance dredging would still occur in the existing Thimble Shoal Channel and one-way traffic when larger ships need to transit the channel would continue. Large storms could still impact known

submerged archaeological resources in the APE by adding sediment, taking sediment away, or moving archaeological components.

Action Project Alternative

Archaeological sites 44NR0051 and NR0053 are well outside the proposed dredging area and slopes for MA1 as proposed under the Action Project Alternative and would not be affected. Site 44NR0054 is situated within the existing the navigation channel but is deeper at -64.2 to -65.4 ft MLLW than the proposed dredging. Also, the proposed dredging would occur in the 200 ft widening area to either side of the Thimble Shoal Channel for MA1, and thus Site 44NR0054 would be avoided. Site 44NR0055 would be avoided as its buffer is over 40 ft south of the proposed dredge and slope area of MA1. The only historic property within the visual/noise APE for cultural resources is the Civil War Battle of Hampton Roads Site 114-5471. Although dredging for MA1 could have a visual and noise impact to Site 114-5471 with the dredge and equipment, it would be temporary and result in no permanent adverse effects. The addition of larger vessels side by side in the proposed MA1 in the vicinity of Site 114-5471 in the western extent of the channel would not be substantially different from existing visual and noise conditions. Standard specifications requiring avoidance of 44NR0054 and NR0055 would be included in the advertised plans for construction. The standard specification governing procedures in the event of discovering previously unknown cultural resources during construction would also be included in the advertised plans. This would require ceasing disturbance activities in the immediate vicinity of the discovery, notification procedures, and consultation with SHPO and Native American tribes regarding the evaluation and treatment of the discovery. The Action Project Alternative undertaking would therefore result in no adverse effect to historic properties per 36 CFR §800.5(b).

6.18 Aesthetics

Environmental Consequences

No Action/Future Without Project Alternative

New and existing dredging operations, dredged material placement, and navigation would continue in the ROI. During deepening of the existing Norfolk Harbor Channels, dredging equipment and equipment used for material placement would be operating within the ROI viewshed. When completed, the Craney Island Eastward Expansion will change the appearance of the CIDMMA from a dredged material handling and placement area to a working port facility including bulkheads, wharves, vessel berths, containers, and cranes (USACE 2006). This addition of the Eastward Expansion infrastructure will be similar to many other views of Port of Virginia and U.S. Navy facilities operating within the ROI (USACE 2006).

Implementation of the No Action/Future Without Project alternative would result in no predicted changes to the visual resources within the ROI and the aesthetic environment of the ROI would continue to be that of a working waterfront with a mix of adjacent land uses. Routine maintenance dredging of the Norfolk Harbor would be expected to occur nearly every year during the 50-year period of analysis with approximately 1.5 million CY removed and disposed of per year

Action Project Alternative

During initial construction and subsequent maintenance dredging over the 50-year period of analysis, dredging equipment and equipment used for material placement would be operating within the ROI viewshed, near areas already being dredged under the No Action/Future Without Project Alternative. The temporary viewshed impacts resulting from dredging operations with implementation of the Action Alternative as compared to the No Action/Future Without Project Alternative would be similar but would increase because of the increased dredging durations and frequencies. As such, the presence of the equipment within the viewshed would not represent any new feature in the visual landscape that is not already present under the No Action/Future Without Project alternative. Therefore, the effect of implementing Action Project Alternative on the aesthetic resources within the ROI would be adverse, temporary, and negligible.

6.19 Recreation

Environmental Consequences

No Action/Future Without Project Alternative

The Norfolk Harbor Channels, as well as existing dredging operations, dredged material placement, and navigation would continue in the ROI.

While new and maintenance dredging and material placement activities are ongoing, areas adjacent to the dredging and placement actions would be unavailable for recreation and represent a temporary and negligible loss of recreation within the ROI. Implementation of the No Action/Future Without Project alternative would result in no permanent changes to the recreational opportunities within the ROI. Recreation within the ROI would be predicted to continue to be primarily influenced by the busy waterborne traffic and ‘working waterfront’ of the Norfolk Harbor project.

Action Project Alternative

During initial construction and subsequent maintenance dredging over the 50-year period of analysis, dredging and material placement operations would be within approximately the geographic area as would be affected under the No Action/Future Without Project alternative, except that there would be widening to the north and south of the Thimble Shoal Channel, where depths currently range from 33 to 50 feet deep. Additionally, the dredging equipment and methods would expect to be the same as, or similar to, the equipment currently used for maintenance dredging of the Norfolk Harbor project. As such, any interference with recreation within the ROI would be essentially the same as under the No Action/Future Without Project alternative, but for a longer duration. The effect of implementing Action Project Alternative on the recreational resources within the ROI would be adverse, temporary, and negligible for the original construction and permanent and negligible for the maintenance actions over the 50-year period of analysis.

6.20 Socioeconomics

Affected Environment

The Affected Environment for Socioeconomics was previously described in Chapter 3, Future Without Project, Socioeconomics.

Environmental Consequences

No Action/Future Without Project Alternative

Long-term, the improved navigation channel would allow more efficient movement of cargo. but would not be anticipated to result in changes in the overall quantity of cargo being moved. The effect on the socioeconomic character of the ROI from implementing the No Action/Future Without Project alternative would be beneficial and minor from existing dredging maintenance and dredged material placement/disposal operations.

Action Project Alternative

Implementation of the Action Project Alternative would result in increases in dredging durations and frequencies as compared to implementation of the No Action/Future Without Project Alternative and would result in a temporary, beneficial minor increase in the local economy within the ROI. Long-term, the Action Project Alternative, with its new Meeting Area, would allow more efficient movement of cargo than the No Action/Future Without Project Alternative; but again, it is not expected to result in changes in the overall quantity of cargo being moved. However, there would be no substantive predicted influx of new people hired, no substantive changes in local employment, and no substantive changes to income within the ROI.

Implementation of the Action Project Alternative would not result in measurable changes to environmental resources that individuals involved in subsistence fishing or hunting utilize and would not create disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, or Native American tribes.

6.21 Transportation

Environmental Consequences

No Action/Future Without Project Alternative

As described in the GRR/EA, new and existing dredging operations, dredged material placement, and navigation would continue in the ROI. Maintaining the existing channels would not require any road-based transportation aside from employees driving to and from work during construction.

Continued efforts by the Port of Virginia, in coordination with local municipalities, to identify and implement ways of decreasing traffic associated with routine Port operations would be expected to continue. Because the Port of Virginia anticipates that the share of freight transported by truck will continue to decrease in the future (e.g., 40 to 50-percent of cargo handled by the Port may eventually be transported by rail (HRTPO 2015b)), the burden of truck traffic on surrounding surface roads would be predicted to proportionally decrease under the No Action/Future Without

Project alternative. Implementing the No Action/Future Without Project alternative would be predicted to result in no changes to the regional traffic and surface road congestion within the ROI.

Action Project Alternative

The dredging equipment and methods utilized to construct and maintain the Action Project Alternative would be expected to be the same as the equipment currently used for the Thimble Shoal Channel portion of the Norfolk Harbor Channel Improvement. Because the dredged material generated most likely would be placed at DNODS, but may also be placed in CIDMMA or NODS, disposal, implementing the Action Project Alternative would have no direct effect on traffic congestion.

Over the period of analysis, implementing the Action Project Alternative would result in fewer, but marginally larger vessels calling on the Port of Virginia facilities. In the future, larger vessels would transport the same quantity of cargo more efficiently (i.e., fewer trips to move the annual quantity of cargo). The infrastructure at the Port of Virginia is already of sufficient size and capacity to accommodate the larger vessels and efficiently move cargo to or from vessels. As such, implementing the Action Project Alternative would not result in an increase in local traffic at points of access to, or egress from, Port of Virginia facilities.

As with the No Action/Future Without Project alternative, continued efforts by the Port of Virginia, in coordination with local municipalities, to identify and implement ways of decreasing traffic associated with routine Port operations would be expected to continue. Because the Port of Virginia anticipates that the share of freight transported by truck will continue to decrease in the future (e.g., 40 to 50-percent of cargo handled by the Port may eventually be transported by rail), the burden of truck traffic on surrounding surface roads would be predicted to not be affected by implementing the Action Project Alternative.

There are no planned deviations from the NED plan. For this Report, the NED is the Recommended Plan/ Preferred Alternative. There is no Locally Preferred Plan.

7 RECOMMENDED PLAN (PREFERRED ALTERNATIVE)

7.1 Description of the Recommended Plan

The primary decision criteria for identifying the National Economic Development (NED) Plan includes reasonably maximizing net annual benefits while remaining consistent with the Federal objective of protecting the nation's environment. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. For this report, the contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation.

The Preferred Alternative referred to as the Recommended Plan (RP) is the NED Plan which includes:

- Widening the TSC-West/MA1 to 1,400 feet and deepening to a required depth of -56 feet for 5.1 statute miles and associated dredged material placement;
- Reaffirm the economic justification at current price levels of widening the TSC-East/MA2 to 1,300 feet wide and deepening to a required depth of -56 feet, as previously authorized.

The RP for this validation study includes construction and maintenance of these features. Dredged material placement could occur at the Dam Neck Ocean Disposal Site (DNODS), the Norfolk Ocean Disposal Site (NODS), and the Craney Island Dredged Material Management Area (CIDMMA) for this project. Portions of the dredged material may be suitable for beneficial use. Beneficial use projects are encouraged and would be coordinated separately from this project based on schedule and sponsor availability. They must also be individually authorized for such use. General operation and maintenance of the CIDMMA would continue with or without implementation of the Preferred Alternative.

The project construction began in 2020 and following construction, channel depths would be maintained over the 50-year lifecycle of the project. MA1 widens the 1,000 ft wide TSC-W by 200 feet on both sides for a total channel width of 1,400 ft and dredged to the required depth of -56 ft MLLW. Its primary purpose is to support two-way vessel traffic where currently traffic is restricted to one-way during transits of large vessels. Vessel simulations performed by Virginia Pilots confirmed the 1,400 ft width can accommodate two-way traffic of the project's design vessels and further mitigate the bank effects caused by the shallower water outside the channel.

The widening begins at the eastern channel bend (approximate Sta. 662+04) and extends approximately 3.6 miles east (Figure 7-1) until it reaches to the start of 1.5 mile long taper at Sta. 851+52. The channel returns to its existing 1,000 ft width at Sta. 930+72. This widening will encroach into the existing 450-foot-wide auxiliary channels that are designated along each side of the main channel without commensurate outward expansion of the auxiliary channel limits (Figure 7-1).

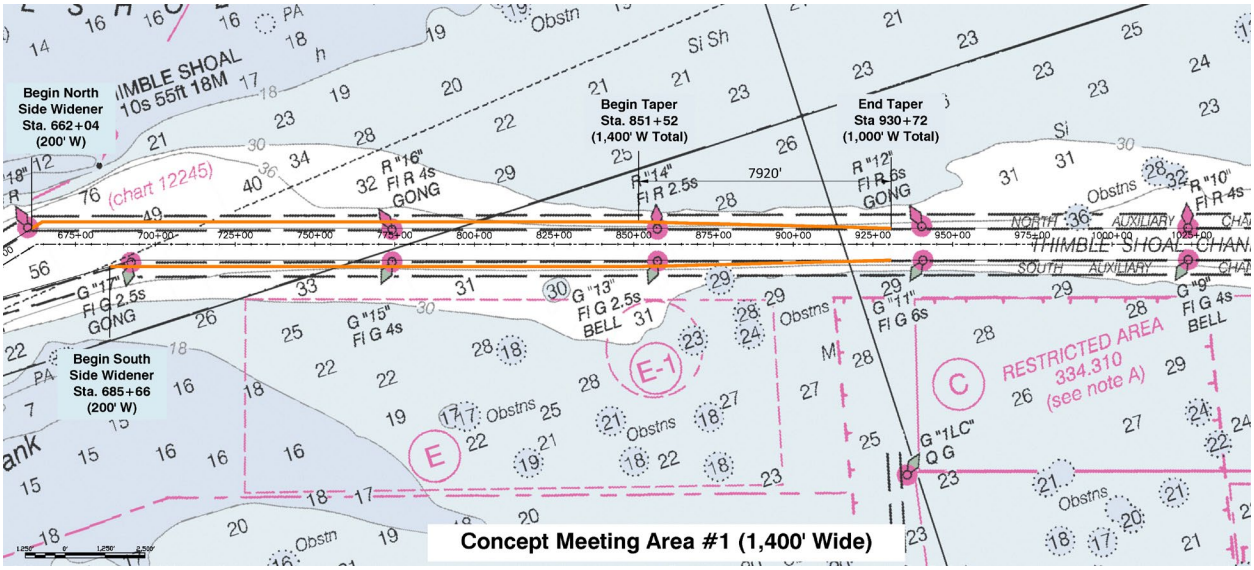

Figure 7-1. Meeting Area 1 Concept.

Factoring in the geometry of the bend at the west end of the widener, the actual dredging length of the north side widener is longer than the south side widener. Dredging MA1 is estimated to generate approximately 4.6 MCY of pay volume (based on -56 ft MLLW required depth plus one additional foot of allowable pay volume to -57 ft MLLW) and 5.0 MCY total volume (based on an average of 1 ft additional non-pay volume to -58 ft MLLW). As with the TSC-W new work dredged material, it is planned to be placed at DNODS. The dredged material from this area has not previously been deemed suitable for beneficial use applications in the region due to the high fines content. If a beneficial use opportunity becomes available, it will be pursued.

Side slopes of 3H:1V are anticipated based on existing conditions and will be confirmed with slope stability analyses of collected geotechnical borings from the project footprint.

Meeting Area 2:

Meeting Area 2 was included in the NED Plan and as part of the Recommended Plan of the GRR. This meeting area widens 150 feet on each side of the main TSC channel. Its economic justification has been reaffirmed at the FY2022 price levels and discount rate with an updated fleet forecast. Construction of this project element was already planned in 2nd Quarter FY2022, but the Report/SEA revealed a more robust BCR at the Federal Water Resources Discount Rate of 2.25% and the OMB Discount Rate of 7% than in the original GRR/EA.

7.2 Dredging and Dredged Material Management

The dredging of MA1 will take up to 18 months to complete for the new work. A total dredge volume of 4,957,785 CY (4,589,557 CY Pay Vol) is anticipated. MA1 will receive annual maintenance dredging of 52,155 cubic yards of material each year with a 50-year estimated volume of 2,606,750 cubic yards.

Construction material dredged from MA1 will be dredged by a hopper dredge with material placed at DNODS. The DNODS is currently designed and managed to hold approximately 50 MCY of dredged material. The Dam Neck SMMP states that future evaluation and management could increase this quantity. For context, as detailed in the NHC Dredged Material Management Plan (reference Engineering Appendix A), the potential new work volume to be placed in DNODS is approximately 16 MCY.

Maintenance material from MA1 will be placed at DNODS. The recommended plan will add an estimated 52,155 CY of maintenance material to DNODS on an annual basis. Appendix A (Engineering Appendix) provides additional details and descriptions of dredged material and preliminary engineering and design.

7.3 Disposal Area Modifications

Placement of dredged material at CIDMMA is limited to users within the geographic area of Norfolk Harbor and adjacent waters. In general, this includes the navigable waters of the ports of Norfolk, Portsmouth, Chesapeake, Hampton, and Newport News. In accordance with the authorizing document, CIDMMA is to be used for the benefit of the maintenance and development of navigation improvements serving Government and private interests. CIDMMA is authorized to handle all types of navigational dredged material, including material suitable and unsuitable for open ocean disposal.

The current management strategy for operating CIDMMA is based on Section 148 of the Water Resources Development Act (WRDA) of 1976 (P.L. 94-587) that states the “Chief of Engineers, shall…extend the capacity and useful life of dredged material disposal areas such that the need for new dredged material disposal areas is kept to a minimum.” CIDMMA storage capacity is periodically increased by raising the facility's dike height. Currently, the dikes have been raised to elevations ranging from +36 to +40 feet above MLLW, with the interior dike heights currently ranging from +33 to +36 feet above MLLW, which maintains 3 to 4 feet of freeboard.

The dikes at CIDMMA will continue to be raised as appropriate for future capacity needs. No disposal area modifications are necessary for the DNODS or for the NODS Site.

7.4 Beneficial Use of Dredged Material

Sediment samples for this segment (and experience from the deepening of the main channel) indicate the material is predominantly silts (~55%) and clays (~30%) and fine sands (~15%). Beneficial use opportunities for this type of material could not be identified. Regionally, there is a preference for sandier material to support dike construction at CIDMMA and beach nourishment efforts. As sediment sampling is accomplished, the Norfolk District team will continue to pursue beneficial use opportunities, if a purpose for this material is identified. Dredged material from MA2 may be beneficially used at local beaches adjacent to the project.

7.5 Operations and Maintenance Considerations

Operation and maintenance of the Recommended Plan will be a continuation of existing operation and maintenance practices. Maintenance dredging of the recommended plan will

occur on a nearly annual basis. Dredged material placement will follow the historical pattern of DNODS receiving material from Thimble Shoal Channel-West and MA1.

7.6 Recommended Plan Summary of Benefits

The Recommended Plan results in a BCR of 1.1 for MA1 and a BCR of 3.1 for MA2 at the Federal Water Resources Discount Rate of 2.25%. is explained as follows: MA1's net NED benefits of approximately $384,000 in AAEQ terms at FY22 price levels and using a discount rate of 2.25%. Net Costs of the Recommended Plan were provided by Virginia Port Authority. MA2's net NED benefits of approximately $2,508,000 in AAEQ terms at FY22 price levels and using a discount rate of 2.25%. Table 7-1 shows the economic costs and benefits associated with the MA1 and MA2.

Table 7-1. Summary of Recommended Plan Costs and Benefits (AAEQ – 2.25%)

Norfolk Harbor Widening Economic Update Preliminary Results		**AAEQ @ 2.25%**
Meeting Area 2 Analysis (Thimble Shoal East Widening)	FWOP	$237,274,000
	FWP	$233,592,000
	NED Benefits	$3,682,000
	NED Costs	$1,174,000
	Net NED Benefits	$2,508,000
	BCR	**3.1**
Meeting Area 1 Analysis (Thimble Shoal West Widening)	FWOP	$232,974,000
	FWP	$228,417,000
	NED Benefits	$4,557,000
	NED Costs	$4,173,000
	Net NED Benefits	$384,000
	BCR	**1.1**

7.7 Real Estate Considerations-Land Easements, Rights of Way, and Relocation Considerations

Policy Guidance Letter 44 (PGL 44), Relocation and Removals at Navigation (Harbor) Projects will still apply with the addition of MA1. This guidance discusses deep draft utility relocations. Deep draft utility relocation is defined as providing a functionally equivalent facility to the owner of an existing utility serving the public when such action is not a "relocation" and is necessary for the construction, operation, or maintenance of the general navigation features of the project, including those necessary to enable the removal of borrow material or the proper disposal of dredged or excavated material. In accordance with Section 101 (a)(4) of WRDA 86, as

amended, one-half of the cost of the deep draft utility relocation shall be borne by the utility owner and one-half shall be borne by the non-Federal sponsor. Actual costs of deep draft utility relocations borne by the non-Federal sponsor up to 50 percent of the total cost of the utility relocation will be creditable against the non-Federal sponsor's additional 10 percent share.

Where there is an obstruction to a navigation project that is within the navigation servitude, and that obstruction does not fit within the definition of a deep draft utility relocation as presented above, the obstruction will be removed at owner cost to accommodate the navigation project. Currently, there is no indication that any obstructions or utilities are in the project footprint.

The estimated real estate costs will not change with the addition of MA1. With the use of Navigational Servitude and Federally owned disposal sites, no real estate interests will be required. No utilities or obstructions have been identified for MA1; thus, the estimated real estate cost will remain $0.

7.8 Cost Sharing

Section 101 of the Water Resources Development Act of 1986 specifies project cost sharing between the Federal government and the non-Federal sponsor is based on material being dredged from waters deeper than 50 feet (cost-shared 50% Federal and 50% non-Federal). The non-Federal sponsor is also responsible for an additional payment of 10% of the cost of the general navigation features of the project in cash over a period not to exceed 30 years, at an interest rate determined. The non-Federal sponsor shall also pay 50% of the excess cost of operation and maintenance of the project over that cost which the Secretary determines would be incurred for operation and maintenance if the project had a depth of 50 feet. The non-Federal sponsor will provide all LERRs. Disposal necessary for the Federal project is cost-shared as a general navigation feature. The sponsor's costs for LERRs, are credited against the additional cash contribution. The increase in operations and maintenance costs due to the recommended plan is $1,263,678 per year, which will be cost shared 50% by the non-Federal sponsor and 50% by the Federal government. A breakdown of cost apportionment is shown in Table 7-2.

Table 7-2. MA1 & MA2 Cost Share

COST SHARE MEETING AREA 1 *Rounded to nearest whole dollar value	**Total Cost**	**Federal (50%)**	**Non-Federal (50%)**
Dredging Cost (Including Mob/Demob)	$70,996,000	$35,498,000	$35,498,000
Environmental Mitigation	$0	$0	$0
Monitoring	$0	$0	$0
Construction Management	$3,871,600	$1,935,800	$1,935,800
Preconstruction Engineering & Design	$2,637,142*	$1,318,571	$1,318,571
Contingency (10%)	$7,750,474	$3,875,237	$3,875,237
Lands & Damages	$0	$0	$0
Total New Work Cost	$85,255,216*	$42,627,608*	$42,627,608*
Annual O&M Costs	$1,263,678	$631,839	$631,839

COST SHARE MEETING AREA 2 *Rounded to nearest whole dollar value	Total Cost (100%)	Federal (50%)	Non-Federal (50%)
Dredging Cost (Including Mob/Demob)	$10,865,190	$5,432,595	$5,432,595
Environmental Mitigation	$0	$0	$0
Monitoring	$0	$0	$0
Construction Management	$916,600	$458,300	$458,300
Preconstruction Engineering & Design	$1,513,392*	$756,696	$1,513,392
Contingency (10%)	$ 1,329,518	$664,759	$664,759
Lands & Damages	$0	$0	$0
Total New Work Cost	$14,624,700	$7,312,350	$7,312,350
Annual O&M Costs	$678,608	$339,608	$339,608

Note: Both Meeting Areas have determined a cost of "Relocating Aids to Navigation" in the amount of $50K per Area. This cost is the responsibility of the U.S. Coast Guard and is not included in the Total Cost.

7.9 Financial Analysis of Non-Federal Sponsor's Capabilities

The non-Federal sponsor, the Virginia Port Authority, concurs with the financial responsibility as it pertains to the cost shares presented in Table 7-1. Under the WRDA 1986, as amended by Section 201 of WRDA 1996, Federal participation in navigation projects is limited to sharing costs for design and construction of the project.

The Virginia Port Authority's support of this Report and subsequent recommendation to authorize modification to the existing project was received on 10 November 2021 and is included in Appendix F.

Non-Federal interests are responsible for and bear all costs for acquisition of necessary lands, easements, rights-of-way, and relocations; terminal facilities; as well as dredging berthing areas and interior access channels to those berthing areas. Current policy requires the sponsor to document their ability to pay through submission of a self-certification of financial capability as described in CECW-PC memorandum dated June 12, 2007. An updated letter of financial capability will be provided by the Virginia Port Authority extending their support for the modification of the Norfolk Harbor Navigation Improvements Project by adding MA 1 (widening TSC) prior to the final approval of the Report/SEA.

7.10 View of the Non-Federal Sponsor

The Virginia Port Authority fully supports the Recommended Plan and has agreed to the cost sharing as outlined above. The sponsor's letter of intent for the final report dated 8 March 2017. The letter of intent contains the Virginia Port Authority's acceptance of, or desired departures from, the terms of the applicable model Project Partnership Agreement (PPA), including: 1)

applicable cost sharing and financial policies; 2) policies regarding provision and valuation of non-Federal lands, easements, rights-of-way, and disposal areas provided by the non-Federal sponsor; 3) policies governing non-Federal project construction; and 4) other provisions required by law and policy for new start construction projects.

7.11 Environmental Mitigation

No compensatory environmental mitigation is anticipated to be required with implementation of the RP. For a summary of avoidance and minimization measures to reduce any potential impacts to environmental resources please see Chapters 6 and 9 of this Report/SEA.

7.12 Risk and Uncertainty

Risk and uncertainty exist in the potential fluctuation of the Federal interest rate, changes in vessel operating costs, changes in mitigation costs, and deviations from vessel or cargo forecasts. Interest rates, forecasts, and vessel operating costs are discussed further in the Economic Sections.

8 SUMMARY OF BEST MANAGEMENT PRACTICES

Impact evaluations conducted during preparation of this EA have determined that no significant impacts would result from implementation of the Recommended Plan (also referred to as the Action Alternative or Preferred Alternative). This determination is based on a thorough review and analysis of existing resource information and coordination with knowledgeable, responsible personnel from the USACE and relevant local, state, and Federal agencies. No onsite compensatory wetland or other type of mitigation is anticipated to be required for this project. Below is a listing of planned best management practices/mitigation measures that are impact avoidance and minimization measures that would be implemented with the Action Alternative to the maximum, practical extent.

- Best management practices will be implemented during dredging to minimize disturbances to the environment. For example, agitation and operation of the cutterhead of a dredge will not begin until the cutterhead is in immediate contact with the substrate. A similar measure will be taken for hopper dredges. The dredge operator will not begin dredging until the draghead is in direct contact with the substrate. For both types of hydraulic dredges, this measure reduces the intake of water, and the potential uptake and entrainment of eggs, larvae, juvenile, and adult fish species. By lowering the cutterhead/draghead to the bottom, before starting the agitation and suction of water and sediment, potential impacts and losses of fish species and sea turtle entrainment in the vicinity of the dredge are minimized.
- To minimize air emissions associated with dredging vessels and dredge-related equipment, vessels and equipment will not be allowed to run idle and will be shut off to the extent practical when not in use.
- The NMFS will be contacted three days prior to the commencement of any dredging operations to ensure all appropriate reporting forms will be used.
- To minimize entrainment during dredging operations, Turtle Excluder Devices will be used on dragheads for hopper dredges. Turtle Exclusion Devices create a sand wave in front of the draghead and will "roll" a resting sea turtle on the bottom off to the side and out of the path of the draghead.
- National Marine Fisheries Service-approved observers will be present on all hopper dredges and perform 100% inspection of inflow and/or inspection of dragheads and turtle excluder devices when MEC/UXO screens are utilized.
- All dredge operators will be trained on measures of dredge operation that will minimize the take of sea turtles. All personnel performing dredging operations will be notified of the potential presence of sea turtles and the need to avoid collisions with sea turtles. All personnel are responsible for observing water-related activities for the presence of these species. All personnel shall be notified that there are civil and criminal penalties for harming, harassing, or killing listed or other protected species.
- If a sea turtle is observed within 100 yards (300 feet) of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle. Operation of any mechanical construction equipment shall cease immediately if a sea turtle is observed within a 50-foot radius of the equipment. Activities may not resume until the sea turtle has departed the project area of its own volition.

- Any collision with and/or injury to a sea turtle shall be reported within 24 hours to the NMFS's Protected Resources Division.
- The USACE will ensure all appropriate measures are taken to protect any sea turtles or listed sturgeon that survive hopper dredging entrainment. Although most sea turtles would not likely survive entrainment in hopper dredges, if a sea turtle were to survive the entrainment, the guidelines and procedures for handling live sea turtles entrained in hopper dredges as outlined in 50 CFR 223.206(d)(1) will be followed.
- Sea turtle relocation trawling will be initiated following the take of two sea turtles in a 24-hour period or four turtles within a two-month period.
- UXO screening devices shall be used on dredging equipment in locations with a potential threat of UXO detonation as defined by the USACE.
- Exposure to occupational health and safety hazards would be mitigated to the extent practical through adherence to an approved Work Safety Plan that incorporates standard work practices for handling contaminated sediments, screening/handling UXO, avoidance of slip and fall hazards, handling contaminated sediment, and wearing PPE.

9 ENVIRONMENTAL COMPLIANCE

Compliance with the following environmental laws (and implementing regulations) and Executive Orders is required for the project alternatives under consideration (note: this is not necessarily an exhaustive list of all applicable environmental requirements).

9.1 Table of Environmental Compliance, Executive Orders, and Permitting Requirements

Compliance with the following environmental laws (and implementing regulations) and Executive Orders is required for the project alternatives under consideration (Table 9-1) (note: this is not necessarily an exhaustive list of all applicable environmental requirements).

Table 9-1. Table of Environmental Compliance

Title of Law	U.S. Code	Compliance Status
Abandoned Shipwreck Act of 1987	43 United States Code (U.S.C.) 2101	Full Compliance
American Bald and Golden Eagle Protection Act of 1962, as amended	16 U.S.C. 668	Full Compliance; no take permit required
American Indian Religious Freedom Act of 1978	Public Law No. 95-341, 42 U.S.C. 1996	Full Compliance
Anadromous Fish Conservation Act of 1965	16 U.S.C. 757 a et seq	Full Compliance
Archaeological and Historic Preservation Act of 1974	Public Law 93-291 and 16 U.S.C.469-469c	Full Compliance
Archaeological Resources Protection Act of 1979	16 U.S.C. 470aa–470mm,	Full Compliance
Clean Air Act of 1972, as amended	42 U.S.C. 7401 et seq	Full Compliance; no conformity analysis required
Coastal Barrier Resources Act of 1982	Public Law 114-314	The project is not located in a designated coastal barrier zone and therefore, no coordination is necessary.
Clean Water Act of 1972, as amended	33 U.S.C. 1251 et seq	Full Compliance
Coastal Zone Management Act of 1972, as amended	16 U.S.C. 1451 et seq	Coordination ongoing
Comprehensive Environmental Responses, Compensation and Liability Act of 1980	42 U.S.C. 9601	Full Compliance
Deepwater Port Act of 1974, as amended	33 U.S.C. 1501	Full Compliance
Emergency Wetlands Resources Act	16 U.S.C. 3901-3932	N/A

Title of Law	U.S. Code	Compliance Status
Endangered Species Act of 1973	16 U.S.C. 1531	Full Compliance with NMFS. The 2018 Biological Opinion provided in Appendix C constitutes compliance with species under the jurisdiction of the NMFS. Informal ESA, Section 7 consultation has been reinitiated with the USFWS and is ongoing.
Estuary Protection Act of 1968	16 U.S.C. 1221 et seq	N/A
Fish and Wildlife Coordination Act of 1958, as amended	16 U.S.C. 661	Full Compliance; consultation has been completed; the FWCA Report was provided in 2018 and no additional FWCA Report is required.
Flood Control Act of 1970	33 U.S.C. 549	Full Compliance
Land and Water Conservation Act	16 U.S.C. 460	Full Compliance
Magnuson-Stevens Fishery Conservation and Management Act	16 U.S.C. 1801	Consultation with the NMFS has been reinitiated and consultation is ongoing.
Marine Mammal Protection Act of 1972, as amended	16 U.S.C. 1361	Full Compliance; no incidental harassment authorization is required.
Marine Protection, Research, and Sanctuaries Act of 1972	33 U.S.C. 1401	Full Compliance
Migratory Bird Conservation Act of 1928, as amended	16 U.S.C. 715	Full Compliance
Migratory Bird Treaty Act of 1918, as amended	16 U.S.C. 703	Full Compliance
National Environmental Policy Act of 1969, as amended	42 U.S.C. 4321 et seq	Full compliance upon signature of the FONSI
National Historic Preservation Act of 1966, as amended	16 U.S.C. 470	Coordination ongoing
National Historic Preservation Act Amendments of 1980	16 U.S.C. 469a	Coordination ongoing
Native American Graves Protection and Repatriation Act of 1990	25 U.S.C. 3001	Full Compliance
Noise Control Act of 1972, as amended	42 U.S.C. 4901	Full Compliance
Resource Conservation and Recovery Act of 1976	42 U.S.C. 6901 et seq	Full Compliance

Title of Law	U.S. Code	Compliance Status
River and Harbor Act of 1888, Section 11	33 U.S.C. 608	Full Compliance
River and Harbor Act of 1899	33 U.S.C. 401 et seq	Full Compliance
Safe Drinking Water Act of 1974, as amended	42 U.S.C. 300	Full Compliance
Submerged Lands Act of 1953	43 U.S.C. 1301 et seq	Full Compliance
Toxic Substances Control Act of 1976	15 U.S.C. 2601	Full Compliance

Table 9-2. Table of Executive Orders

Title of Executive Order	Executive Order Number	Compliance Status
Protection and Enhancement of Environmental Quality	11514/11991	Full Compliance
Protection and Enhancement of the Cultural Environment	11593	Full Compliance
Floodplain Management	11988	Full Compliance
Protection of Wetlands	11990	Full Compliance; there would be no adverse wetland impacts
Federal Compliance with Pollution Control Standards	12088	Full Compliance
Offshore Oil Spill Pollution	12123	Full Compliance
Federal Compliance with Right-to-Know Laws and Pollution Prevention	12856	N/A
Federal Actions to Address Environmental Justice and Minority and Low-income Populations	12898	Full Compliance
Protection of Children from Environmental Health Risks and Safety Risks	13045	Full Compliance
Invasive Species	13112	Full Compliance
Marine Protected Areas	13158	N/A
Consultation and Coordination with Indian Tribal Governments	13175	Coordination ongoing
Responsibilities of Federal Agencies to Protect Migratory Birds	13186	Coordination with the USFWS is ongoing
Facilitation of Cooperative Conservation	13352	N/A

Preparing the United States for Impacts of Climate Change	13659	Full Compliance
Planning for Federal Sustainability in the Next Decade (2015)	13693	Full Compliance

Table 9-3. Table of Permitting Requirements

Law	Agency Responsible	Permit, Agreement, Authorization, or Notification Required
American Bald and Golden Eagle Protection Act of 1962, as amended	USFWS	"Take" permit if any eagles are accidentally harmed or killed; no take permit is required
Comprehensive Environmental Responses, Compensation and Liability Act of 1980, as amended	U.S. Environmental Protection Agency (USEPA)	Full Compliance
Clean Water Act, Section 401*	VDEQ	No separate 401 Water Quality Certification required, per VDEQ correspondence. CWA compliance is assessed through the CZMA review process as documented by VDEQ.
Coastal Zone Management Act (CZMA)	VDEQ	CZMA Federal Consistency Concurrence
Endangered Species Act of 1973	NMFS	Biological Opinion with Incidental Take statement (Formal Consultation)
Endangered Species Act of 1973	USFWS	Concurrence Determination via Self-Certification Letter (Informal Consultation)
Fish and Wildlife Coordination Act (FWCA)	USFWS	FWCA Report
Magnuson-Stevens Fishery Conservation and Management Act	NMFS	Notification of any noncompliance; none anticipated
Marine Mammal Protection Act of 1972, as amended	NMFS	No Incidental Take Authorization anticipated
Marine Protection, Research, and Sanctuaries Act of 1972*	USEPA	Concurrence documentation with the USEPA
Migratory Bird Treaty Act of 1918, as amended	USFWS	"Take" permit; no take permit is required

Law	Agency Responsible	Permit, Agreement, Authorization, or Notification Required
National Historic Preservation Act of 1966, as amended	Advisory Council on Historic Preservation, Virginia Department of Historic Resources	Concurrence determination from the DHR.
Noise Control Act of 1972	USEPA	Notification of any noncompliance; none anticipated
Resource Conservation and Recovery Act of 1976	USEPA, VDEQ	Testing, quantification, and notification for any hazardous materials.

N/A = Not Applicable; VDEQ = Virginia Department of Environmental Quality; NMFS = National Marine Fisheries Service; USEPA = U.S. Environmental Protection Agency; USFWS = U.S. Fish and Wildlife Service

More information on the Detailed Environmental Compliance can be found in Appendix C.

9.2 List of Preparers

The Project Delivery Team members listed below provided substantial text to the Integrated Validation Report/Supplemental Environmental Assessment.

Table 9-4. List of Preparers

Name	Contribution/Education	Affiliation	Years of Experience
Susan Miller	Cultural Resources/M.A. Anthropology	USACE	30
Alicia Logalbo	Environmental Analyst/M.S., Biology	USACE	21
Jason O'Neal	GIS Mapping/B.S., Geology	USACE	17
J. Kevin White	GIS Mapping/B.S. Geography	USACE	2
David Schulte	Environmental Analysis/M.S., Marine Science	USACE	21
Todd Nettles	Economic Analysis/B.S., Economics	USACE	21
Jerry Diamantides	Plan Formulation & Economics/Ph.D. Economics	DMA	33

Name	Contribution/Education	Affiliation	Years of Experience
Idris Dobbs	Economic Analysis/B.S., Economics	USACE	13
Courtney Jackson	Economic Analysis/B.S., Economics	USACE	7
Kathy Perdue	Environmental Analysis, B.S. Environmental Science	USACE	29
Kimberly Koelsch	Plan Formulation and Environmental Analysis, B.A. Urban Affairs and Planning	USACE	10
Kristin Mazur	Project Management/Civil Engineering	USACE	22
Ira Brotman	Engineering and Costs/B.S., Civil Engineering	Moffatt and Nichol	27
Jennifer Shunfenthal	Plan Formulation/MS Environmental Management	USACE	8
Alicia Barrette	Real Estate	USACE	14
Keith Butler	Cost Engineering	USACE	19

10 AGENCIES, TRIBAL GOVERNMENTS AND PERSONS CONSULTED

Table 10-1 list the Agencies consulted with during this project. Consultation will be ongoing through the length of this report process.

Table 10-1: Agencies consulted.

Agency/Government	Names of Contact People
U.S. Navy (USN)	ADM John Scorby, USN, Michael King, Brian Ballard, Steve Jones, Mercedes Holland
U.S. Coast Guard (USCG)	Barbara Wilke, Ken Koestecki, Anthony Lloyd
US Coast Guard Sector Virginia	CPT Samson Stevens, USCG
National Marine Fisheries Service (NMFS)	David O'Brien Karen Greene
U.S. Environmental Protection Agency (USEPA)	Barbara Rudnick, Kevin Magerr
U.S. Fish and Wildlife Service (USFWS)	Troy Andersen, Julie Slacum
Virginia Department of Environmental Quality (VDEQ)	Bettina Sullivan
Virginia Marine Resources Commission (VMRC)	Steve Bowman, Randy Owen
Virginia Department of Agriculture and Consumer Services (VDACS)	Keith Tignor
Virginia Department of Historic Resources (VDHR)	Marc Holma, Samantha Henderson
Virginia Department of Game and Inland Fisheries (VDGIF)	Amy Ewing, David Whitehurst
Virginia Department of Conservation and Recreation (VDCR)	Ali Baird, Charley Banks, Bob Duncan, David Whitehearst, Renee Hypes
Virginia Institute of Marine Science (VIMS)	Mark Luchenbach
Catawba Indian Nation	Wenonah Haire, THPO
Chickahominy Indian Tribe	Wayne Adkins
Delaware Nation	Erin Paden
Delaware Tribe of Indians	Susan Bachor

Agency/Government	Names of Contact People
Monacan Indian Nation	Adrian Compton
Nansemond Indian Nation	Keith Anderson
Pamunkey Tribal Government	Shaleigh Howells
Rappahannock Tribe	Woodie Walker
Upper Mattaponi Tribe	Reggie Tupponce
Naval History and Heritage Command	Robert Neyland
City of Portsmouth, Virginia	Shannon E. Glover, Mayor De'Andre A. Barnes, Vice Mayor William E. Moody, Jr., City Council Lisa L Lucas-Burke, City Council Christopher Woodard, Jr.., City Council Paul J. Battle, City Council Dr. Mark M. Whitaker, City Council Robert Baldwin
City of Norfolk, Virginia	Dr. Kenneth C. Alexander, Mayor Martin A. Thomas, Jr., Vice Mayor Courtney R. Doyle, City Council Mamie B. Johnson, City Council Paul R. Riddick, City Council Thomas R. Smigiel, Jr., City Council Andria P. McClellan, City Council Susan McBride
City of Chesapeake, Virginia	Diane Kaufman, Jay Tate, Wanda Barnard-Bailey, Michael Barber, David Jurgens, Andrew Fox, Lennie Luke, Curtis Byrd, Steven Wright
City of Hampton, Virginia	Donnie Tuck, Mayor Jimmy Gray, Vice Mayor W.H. Hobbs, City Council Chris Bowman, City Council Steven Brown, City Council Eleanor Weston Brown, City Council Chris Osby Snead, City Council Terry O'Neil
City of Newport News, Virginia	McKinley Price, Mayor Saundra N. Cherry, Vice Mayor Marcellus L. Harris, III, City Council David H. Jenkins, City Council Sharon P. Scott, City Council

Agency/Government	Names of Contact People
	Tina L. Vick, City Council Dr, Patricia Woodbury, City Council Sheila McCallister
City of Virginia Beach, Virginia	Mark Reed
Chesapeake Bay Foundation	Christy Everett
Elizabeth River Project	Marjorie Mayfield Jackson Joe Rieger
Maritime History	David Howe
Commonwealth of Virginia	Elaine Luria, U.S. Congressmen, District 2 Bobby Scott, U.S. Congressmen, District 3 Donald McEachin, U.S. Congressmen, District 4 Brian Ball, Secretary of Commerce and Trade Ann Jennings, Secretary of Natural Resources
Chesapeake Beach City League	Bruce Johnson
Chesapeake Bay Bridge Tunnel District	Mike Crist

11 RECOMMENDATIONS

I concur with the findings presented in this report. The Recommended Plan is technically sound, economically justified, and socially and environmentally acceptable.

I recommend that the existing deep draft navigation project at Norfolk Harbor be modified to provide for implementation of MA1 in accordance with the recommended plan described herein, with such further modifications thereto as in the discretion of the Major Subordinate Command (MSC), may be advisable. Based on a review of existing data and coordination with Federal, state, and local agencies, there is no environmental mitigation required for construction of the Recommended Plan. For the purpose of calculating the Section 902 limit, the estimated first cost of the project is $85,225,216 including an estimated Federal share of $42,627,608 and an estimated non-Federal share of $42,627,608. The results of the economic analysis for MA1 and MA2 are in Table 11-1. At the Federal Water Resources Discount Rate of 2.25%, the average annual costs of MA1 are $4,173,000 and the average annual net NED benefits of MA1 are $384,000 with a benefit to cost ratio of 1.1. For MA2 at 2.25% Discount Rate, the average annual costs are $1,174,000. Average annual net NED benefits for MA2 are $2,508,000 with a benefit to cost ratio of 3.1 at 2.25%.

At the OMB Discount Rate of 7.0%, the average annual costs of MA1 are $7,810,000 and the average annual net NED benefits of MA1 are -$3,803,000 with a benefit to cost ratio of .5 at For MA2 at the 7.0% Discount Rate, the average annual costs are $1,762,000. Average annual net NED benefits for MA2 are $1,536,000 with a benefit to cost ratio of 1.9 at 2.25%.

Table 11-1. Norfolk Harbor Widening Economic Update Preliminary Results for MA1 and MA2.

Norfolk Harbor Widening Economic Update Preliminary Results		**AAEQ**	
		2.25%	**7%**
Meeting Area 2 Analysis (Thimble Shoal East Widening)	FWOP	$237,274,000	$234,210,000
	FWP	$233,592,000	$230,912,000
	NED Benefits	$3,682,000	$3,298,000
	NED Costs	$1,174,000	$1,762,000
	Net NED Benefits	$2,508,000	$1,536,000
	BCR	**3.1**	**1.9**
Meeting Area 1 Analysis (Thimble Shoal West Widening)	FWOP	$232,974,000	$230,352,000
	FWP	$228,417,000	$226,345,000
	NED Benefits	$4,557,000	$4,007,000
	NED Costs	$4,173,000	$7,810,000
	Net NED Benefits	$384,000	-$3,803,000
	BCR	**1.1**	**0.5**

The Recommended Plan conforms to the essential elements of the U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies and complies with other Administration and legislative policies and guidelines on project development. If the project were to receive funds for Federal implementation, it would be implemented subject to the cost sharing, financing, and other applicable requirements of Federal law and policy for navigation projects including WRDA 1986, as amended; and would be implemented with such modifications, as the Chief of Engineers deems advisable within his discretionary authority. Aids to navigation are to be funded by the U.S. Coast Guard. Federal implementation of the recommended project would be subject to the non-Federal sponsor agreeing to comply with Federal laws and policies, including but not limited to:

Provide, during the periods of design and construction, funds necessary to make its total contribution for commercial navigation equal to:

50 percent of the cost of design and construction of the general navigation features (GNFs) and mitigation (including mitigation LERR);

Provide all lands, easements, rights-of-way, relocations, and disposal areas (LERRs), including those necessary for the borrowing of material and the disposal of dredged or excavated material, and perform or assure the performance of all relocations, including utility relocations, all as determined by the Federal government to be necessary for the construction or operation and maintenance of the GNFs.

Pay with interest, over a period not to exceed 30 years following completion of the period of construction of the GNFs, an additional amount equal to 10 percent of the total cost of construction of the GNFs less the amount of credit afforded by the Government for the value of the LERR is provided by the sponsor for the GNFs. If the amount of credit afforded by the Government for the value of LERR, and relocations, including utility relocations, provided by the sponsor equals or exceeds 10 percent of the total cost of construction of the GNFs, the sponsor shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of LERR and relocations, including utility relocations, in excess of 10 percent of the total cost of construction of the GNFs.

Provide 50 percent of the excess cost of operation and maintenance of the project over that cost which the Secretary determines would be incurred for operation and maintenance if the project had a depth of 50 feet;

Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the outputs produced by the project, hinder operation, and maintenance of the project, or interfere with the project's proper function;

Provide, operate, and maintain, at no cost to the Government, the local service facilities in a manner compatible with the project's authorized purposes and in accordance with applicable

Federal and state laws and regulations and any specific directions prescribed by the Federal government.

Accomplish all removals determined necessary by the Federal government other than those removals specifically assigned to the Federal government;

Give the Federal government a right to enter, at reasonable times and in a reasonable manner, upon property that the Sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, and maintaining the GNFs.

Hold and save the United States free from all damages arising from the construction or operation and maintenance of the project, any betterments, and the local service facilities, except for damages due to the fault or negligence of the United States or its contractors.

Keep, and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence are required, to the extent and in such detail as will properly reflect total cost of the project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and local governments at 32 CFR, Section 33.20.

Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601–9675, that may exist in, on, or under LERR that the Federal government determines to be necessary for the construction or operation and maintenance of the GNFs. However, for lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigations unless the Federal government provides the sponsor with prior specific written direction, in which case the sponsor shall perform such investigations in accordance with such written direction.

Assume complete financial responsibility, as between the Federal government and the sponsor, for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under LERR that the Federal government determined to be necessary for the construction or operation and maintenance of the project.

Agree, as between the Federal Government and the non-Federal Sponsor, that the non-Federal Sponsor shall be considered the operator of the local service facilities for the purpose of CERCLA liability.

To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA.

Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, (42U.S.C. 1962d-5b) and Section 101(e) of the WRDA 86, Public Law 99-662, as amended,

(33 U.S.C. 2211(e)) which provide that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended, (42 U.S.C. 4601-4655) and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way necessary for construction, operation, and maintenance of the project including those necessary for relocations, the borrowing of material, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

Comply with all applicable Federal and state laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c)).

Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project.

Not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the sponsor's obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that such funds are authorized to be used to carry out the project.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher review levels within the executive branch. Consequently, the recommendation may be modified before it is transmitted to the Major Subordinate Command (MSC) as a proposal for authorization and implementation funding. However, prior to transmittal to the Congress, the State of Virginia, the Virginia Port Authority (the non-Federal Sponsor), interested Federal agencies, and other parties will be advised of any significant modifications and will be afforded an opportunity to comment further.

Brian P. Hallberg, PMP
Colonel, U. S. Army
District Commander

12 REFERENCES

Albright, Richard, 2013, Death of the Chesapeake: A History of the Military's Role in Polluting the Bay. Scrivener Publishing and John Wiley & Sons, Inc., Hoboken, NJ.

American National Standards Institute (ANSI/ASSE A10.15-1995 (R2011) Safety Requirements for Dredging

Aschettino, J. M., Engelhaupt, D., Engelhaupt, A., Richlen, M. 2017. Final mid-Atlantic humpback whale monitoring, Virginia Beach, Virginia: 2016/17 Annual Progress Report. Submitted by HDR, Virginia Beach, Virginia to Naval Facilities Engineering Command Atlantic.

Aschettino, J. M., Engelhaupt, D., Engelhaupt, A., Richlen, M. 2016. Mid-Atlantic humpback whale monitoring, Virginia Beach, Virginia: 2015/16 Annual Progress Report. Submitted by HDR, Virginia Beach, Virginia to Naval Facilities Engineering Command Atlantic.

Aschettino, J. M., Engelhaupt, D., Engelhaupt, A. 2015. Final mid-Atlantic humpback whale monitoring, Virginia Beach, Virginia: 2015/16 Annual Progress Report. Submitted by HDR, Virginia Beach, Virginia to Naval Facilities Engineering Command Atlantic.

Ballard, B. S., and W. Abbott. Osmotic accommodation in Callinectes sapidus Rathbun. 1969. Comparative Biochemistry and Physiology 29: 671–687.

Barco, S.B., Swingle, M. 2014. Marine mammal species likely to be encountered in the coastal waters of Virginia from analysis of stranding data. Prepared for the Virginia Department of Mines, Minerals, and Energy. Retrieved from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjL87763bWAhUIWCYKHf3qALgQFggoMAA&url=http%3A%2F%2Fwind.jmu.edu%2Foffshore%2Fvowda%2Fdocuments%2FVAQF_Scientific_Report_2014-07a_Marine%2520Mammals%2520.pdf&usg=AOvVaw0f_VXjD6D4y2L11nAmM0qN.

Bass, R. J., and J. W. Avault, Jr. 1975. Food habits, length-weight relationship, condition factor, and growth of juvenile red drum, Sciaenops ocellata, in Louisiana. Transactions of the American Fisheries Society 104: 35–45.

Barbosa S.M. and Silva, M.E. 2009. Low-frequency sea-level change in Chesapeake Bay: Changing seasonality and long-term trends. Estuarine, Coastal, and Shelf Science, 83(1), 30-38.

Blair, Clay, 1996, Hitler's U-Boat War: The Hunters 1939-1942, Modern Library, New York.

Boon, John D., John M. Brubaker, and David R. Forrest. 2010. Chesapeake Bay Land Subsidence and Sea Level Change: An Evaluation of Past and Present Trends and Future Outlook. Special Report No. 425 in Applied Marine Science and Ocean Engineering. (Virginia Institute of Marine Science, 2010) for the U.S. Army Corps of Engineers Norfolk District. Retrieved from: http://www.vims.edu/GreyLit/VIMS/sramsoe425.pdf.

Botton M.L. and J. W. Ropes. 1987. Populations of Horseshoe Crabs, Limulus polyphemus, on northwestern Atlantic Continental Shelf. Fishery Bulletin 85:805-812.

Bratton, J.F., Colman, S.M., Thieler, E.R. and Seal, R.R., 2002. Birth of the modern Chesapeake Bay estuary between 7.4 and 8.2 ka and implications for global sea-level rise. Geo-Marine Letters, 22(4), pp.188-197.

Chesapeake Bay Program (CBP). 2016. Retrieved from http://www.chesapeakebay.net/issues/issue/nutrients#inline.

Clarke, D.G., and D. H. Wilber. 2000. Assessment of potential impacts of dredging operations due to sediment resuspension. DOER Technical Notes Collection (ERDC TN-DOER-E9), U.S. Army Engineer Research and Development Center, Vicksburg, MS. Retrieved from www.wes.army.mil/el/dots/doer.

Costlow, J. D., Jr., and C. G. Bookhout. 1959. The larval development of Callinectes sapidus Rathbun reared in the laboratory. Biological Bulletin (Woods Hole) 116: 373–396.

Davis, C. C. 1965. A study of the hatching process in aquatic invertebrates: The blue crab, Callinectes sapidus, Rathbun, XXI. The nemerean, Carcinonemertes carcinophila (Kolliker). Chesapeake Science 6: 201–208.

DeVries, M. C., R. A. Tankersley, R. B. Forward, W. W. Kirby-Smith, and R. A. Luettich Jr. 1994. Abundance of estuarine crab larvae is associated with tidal hydrologic variables. Marine Biology 118: 403–413.

Engelhaupt, A., J. Aschettino, T.A. Jefferson, M. Richlen, and D. Engelhaupt. 2015. *Occurrence, Distribution, and Density of Marine Mammals Near Naval Station Norfolk & Virginia Beach, VA: Annual Progress Report. Final Report.* Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract No. N62470-10-3011, Task Orders 031 and 043, issued to HDR Inc., Virginia Beach, Virginia. 07 August 2015.

Epifanio, C. E. 1995. Transport of blue crab (Callinectes sapidus) larvae in the waters off Mid-Atlantic states. Bulletin of Marine Science 57: 713-725.

Epifanio, C. E. 2007. Biology of larvae. Pages 513–533 in V. S. Kennedy and L. E. Cronin, editors. The Blue Crab: Callinectes sapidus.

Epifanio, C. E., and R. W. Garvine. 2001. Larval transport on the Atlantic continental shelf of North America: a review. Estuarine Coastal And Shelf Science 52: 51–77.

Epifanio, C. E., C. C. Valenti, and A. E. Pembroke. 1984. Dispersal and recruitment of blue crab larvae in Delaware Bay, U.S.A. Estuarine, Coastal and Shelf Science 18: 1-12.

Etherington, L. L., and D. B. Eggleston. 2000. Large-scale blue crab recruitment: linking postlarval transport, post-settlement planktonic dispersal, and multiple nursery habitats.

Forward, R. B., Jr, J. Swanson, and R. Tankersely. 1997. Endogenous swimming rhythms of blue crab, Callinectes sapidus, megalopae: effects of offshore and estuarine cues. Marine Biology 127: 621–628.

Goodrich, D.M., 1988. On meteorologically induced flushing in three US east coast estuaries. Estuarine and Coast Shelf. Science 26, 11–121.

Guerin, J. L., and W. B. Stickle. 1992. Effects of salinity gradients on the tolerance and bioenergetics of juvenile blue crabs (Callinectes sapidus) from waters of different environmental salinities. Marine Biology 114: 391–396.

Guillory, V., and P. Prejean. 2001. Red drum predation on blue crabs. In Proceedings of the Blue Crab Mortality Symposium, Gulf States Marine Fisheries Commission, Ocean Springs, Mississippi. Foodweb—References (pp. 93-104).

Hampton Roads Transportation Planning Organization (HRTPO). 2011. Hampton Roads Regional Land Use Map. Retrieved from: http://www.hrpdcva.gov/uploads/docs/Hampton%20Roads%20Regional%20Land%20Use%20Map%20Report.pdf.

Hampton Roads Transportation Planning Organization (HRTPO). 2013. Hampton Roads Military Transportation Needs Study: Roadways Serving the Military and Sea Level Rise/Storm Surge. Retrieved from: http://www.hrtpo.org/uploads/docs/Roadways%20Serving%20the%20Military%20&%20Sea%20Level%20Rise-Storm%20Surge%20Report.pdf.

Hampton Roads Transportation Planning Organization (HRTPO). 2015b. State of Transportation in Hampton Roads 2015. Retrieved from: http://www.hrtpo.org/uploads/docs/State%20of%20Transportation%202015%20Final%20Report.pdf.

International Association of Dredging Companies. 2015. Figures in Dredging 2015. https://www.iadc-dredging.com/wp-content/uploads/2017/10/dredging-in-figures-2015.pdf.

Intergovernmental Panel on Climate Change. 2021. Climate Change 2021. Climate Change 2021, The Physical Science Basis, Summary for Policymakers.

Jaworski, E. 1972. The blue crab fishery, Barataria Estuary, Louisiana. Louisiana State University, Sea Grant Publication. LSU-SG-72-01. 112 p.

Jensen, A.S. and G.K. Silber. 2003. Large Whale Ship Strike Database. U.S. Department

Jones, C. M., J. R. McConaugha, P. J. Greer, and M. H. Prager. 1990. Estimates of spawning size of blue crab, Callinectes sapidus, in Chesapeake Bay, 1986-1987. Bulletin of Marine Science 46: 159-169.

Klauda, R.J., Fischer, L.W., Hall, Jr. L.W. and Sullivan J.A. 1991a. Alewife and Blueback Herring. In: S.L. Funderburk, S.J. Jordan, J.A. Mibursky, and D. Riley, eds., Habitat Requirements for Chesapeake Bay Living Resources, Second Edition. Habitat Objectives Workgroup, Living Resources Subcommittee, Chesapeake Research Consortium, Inc., Solomons, Maryland.

Klauda, R.J., Fischer, L.W., Hall, Jr. L.W. and Sullivan J.A. 1991b. American Shad and Hickory Shad. In: S.L. Funderburk, S.J. Jordan, J.A. Mibursky, and D. Riley, eds., Habitat Requirements for Chesapeake Bay Living Resources, Second Edition. Habitat Objectives Workgroup, Living Resources Subcommittee, Chesapeake Research Consortium, Inc., Solomons, Maryland.

Kleinosky, I.R., Yarnal, B, & Fisher, A. 2007. Vulnerability of Hampton Roads, Virginia to storm-surge flooding and sea level rise. Nat. Hazards. 40(I), 43-70.

Koeberl C, Poag, C.W., Reimold, W.U., & Brandt, D. 1996. Impact origin of the Chesapeake Bay structure and the source of the North American tektites. Science, 271(5253), 1263-1266.

Liu Z., Wang H. and Ye F. 2017. Incorporating Sea Level Change Scenarios into Norfolk Harbor Channels Deepening and Elizabeth River Southern Branch ,Navigation Improvements Study, Final Report. Virginia Institute of Marine Science, Special Report No. 457 In Applied Marine Science and Ocean Engineering. DOJ:10.21220/V5BX49.

Mann, R. Harding, J., Southworth, M., and Wesson, J. 2005. Northern Quahog (Hard Clam) Mercenaria Mercenaria Abundance And Habitat Use In Chesapeake Bay. Journal of Shellfish Research 24(2):509-516.

Manooch, C. S., III. 1973. Food habits of yearling and adult striped bass, Morone saxatilis (Walbaum),from Albemarle Sound, North Carolina. Chesapeake Science 14: 73–86.

McConaugha, J. R., D. F. Johnson, A. J. Provenzano, and R. C. Maris. 1983. Seasonal distribution of larvae of Callinectes sapidus (Crustacea: Decopoda) in the waters adjacent to Chesapeake Bay. Journal of Crustacean Biology 3: 582-591.

Metcalf, K S, and R. N. Lipcius. 1992. Relationship of habitat and spatial scale physiological state and settlement of blue crab postlarvae in Chesapeake Bay. Marine Ecology Progress Series 82: 143–150.

Millikin, M. R, and A. B. Williams. 1984. Synopsis of biological data on the blue crab Callinectes sapidus Rathbun. NOAA. NOAA Technical Report.

Najjar, R.G., Pyke, C.R., Adams, M.B., Breitburg, D., Hershner, C., Kemp, M., Howarth, R., Mulholland, M. R., Paolisso, M., Secor, D., Sellner, K., Wardrop, D., Wood, R. 2010. Potential climate-change impacts on the Chesapeake Bay. Estuarine, Coastal and Shelf Science 86, 1-20.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2016. Guide to Essential Fish Habitat Designations in the Northeastern United States. Retrieved from https://www.greateratlantic.fisheries.noaa.gov/hcd/STATES4/DelaNJ.htm.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2018. National Marine Fisheries Service Endangered Species Act Biological Opinion. Construction and Maintenance of Chesapeake Bay Entrance Channels and use of Sand Borrow Areas for Beach Nourishment. F/NER/2018/14816. Submitted to the Army Corps of Engineers (USACE), Norfolk District (lead), USACE Baltimore District, Bureau of Ocean Energy Management, U.S. Environmental Protection Agency, U.S. Navy.

Overstreet, R. M., and R. W. Heard. 1978a. Food of the red drum, Sciaenops ocellata, from Mississippi Sound. Gulf Research Report 6: 131–135.

Parr, W., Clarke, S.J., Van Dijk, P. and Morgan, N., 1998. Turbidity in English and Welsh Tidal Waters. WRC Report No. CO 4301, Report for English Nature. WRC Medmenham, Bucks.

Pennekamp, J. G. S., R. J. C. Eskamp, W. F. Rosenbrand, A. Mullie, G. L. Wessel, T. Arts, and I. K. Decibel. 1996. *Turbidity caused by dredging; viewed in perspective*. Terra et Aqua, 64.

Priest, W., 1981. A Study of Dredging Effects in Hampton Roads, Virginia. Special report No.247 in Applied Marine Science and Ocean Engineering. Virginia Institute of Marine Science, School of Marine Science, College of William and Mary, Gloucester Point, Virginia.

Pyle, R., and E. Cronin. 1950. The general anatomy of the blue crab Callinectes sapidus Rathbun. Chesapeake Biological Laboratory Publication 87, 40 p.

Rudloe, A. 1981. Aspects of the biology or juvenile horseshoe crabs, Limulus Polyphemus. Bulleting on Marine Science 31: 125-133.

Sallenger, A. H., K.S. Doran, and P.A. Howd. 2012. Hotspot of Accelerated Sea-Level Rise on the Atlantic Coast of North America. Nature Climate Change. 884-888. Abstract online at: http://www.nature.com/nclimate/journal/v2/n12/full/nclimate1597.html.

Sandoz, M., and R. Rogers. 1944. The effect of environmental factors on hatching, moulting, and survival of zoea larvae of the blue crab Callinectes sapidus Rathbun. Ecology 25: 216–228.

Schaffner, L. C., and R. J. Diaz. 1988. Distribution and abundance of overwintering blue crabs, Callinectes sapidus, in the lower Chesapeake Bay. Estuaries 11: 68–72.

Scharf, F. S., and K. K. Schlicht. 2000. Feeding habits of red drum (Sciaenops ocellatus) in Galveston Bay, Texas: Seasonal diet variation and predator-prey size relationships. Estuaries 23: 128–139.

Schulte, D. M., Dridge, K. M., and Hudgins, M. H. 2015. Climate Change and the Evolution and Fate of the Tangier Islands of Chesapeake Bay, USA. Nature Scientific Reports 5, 17890. Retrieved from http://www.nature.com/articles/srep17890.

Schulte, D.M. 2017. History of the Virginia oyster fishery, Chesapeake Bay, USA. Frontiers in Marine Science, 4, 127.

Setzler-Hamilton, E.M., 1991a. White Perch. IN: S.L. Funderburk, S.J. Jordan, J.A. Mihursky, and D. Riley, eds., Habitat Requirements for Chesapeake Bay Living Resources, Second Edition. Habitat Objectives Workgrou, Living Resources Subcommittee, Chesapeake Research Consortium, Inc. Solomons, Maryland.

Setzler-Hamilton, E.M., 1991b. Striped Bass. IN: S.L. Funderburk, S.J. Jordan, J.A. Mihursky, and D. Riley, eds., Habitat Requirements for Chesapeake Bay Living Resources, Second Edition. Habitat Objectives Workgrou, Living Resources Subcommittee.

Shomette, Donald G., 2007, Shipwrecks, Sea Raiders, and Maritime Disasters along the Delmarva Coast, 1632-2004, Johns Hopkins University Press, Baltimore.

Swingle, W.M., Barco, S.G., Costidis, A.M., Bates, E.B., Mallette, S.D., Phillips, K.M., Rose, S.A., Williams, K.M. 2017. Virginia Sea Turtle and Marine Mammal Stranding Network 2016 Grant Report: VAQF Scientific Report (Vol 2017 No. 1). Retrieved from: http://www.deq.virginia.gov/Portals/0/DEQ/CoastalZoneManagement/FundsInitiativesProjects/task49-15.pdf?ver=2017-05-16-074848-097.

Swingle, W.M., Barco, S.G., Bates, E.B., Lockhart, G.G., Phillips, K.M., Rodrique, K.R., Rose, S.A., Williams, K.M. 2016. Virginia Sea Turtle and Marine Mammal Stranding Network 2015 Grant Report: VAQF Scientific Report (Volume 2016 No. 01). Retrieved from: http://www.deq.virginia.gov/Portals/0/DEQ/CoastalZoneManagement/FundsInitiativesProjects/task49-14.pdf.

Swingle, W.M., Lynott, M.C., Bates, E.B., Lockhart, G.G., Phillips, K.M., Rodrique, K.R., Rose, S.A., Williams, K.M. 2015. Virginia Sea Turtle and Marine Mammal Stranding Network 2014 Grant Report: VAQF Scientific Report (Volume 2015 No. 01). Retrieved from: http://www.deq.virginia.gov/Portals/0/DEQ/CoastalZoneManagement/FundsInitiativesProjects/task49-13.pdf.

Swingle, W.M., Lynott, M.C., Bates, E.B., D'Eri, L.R., Lockhart, G.G., Phillips, K.M., Thomas, M.D. 2014. Virginia Sea Turtle and Marine Mammal Stranding Network 2013 Grant Report: VAQF Scientific Report (Volume 2014 No. 02). Retrieved from: http://www.deq.virginia.gov/Portals/0/DEQ/CoastalZoneManagement/FundsInitiativesProjects/task49-12.pdf.

Swingle, W.M., Trapani, C.M., D'Eri, L.R., Lynott, M.C. 2013. Marine Mammal and Sea Turtle Stranding Response 2012 Grant Report: VAQF Scientific Report (Volume 2013 No. 01). Retrieved from: https://www.virginiaaquarium.com/conserve/Documents/2012-Stranding-Network-Report.pdf.

Swingle, W.M., Trapani, C.M., D'Eri, L.R., Lynott, M.C. 2012. Marine Mammal and Sea Turtle Stranding Response 2011 Grant Report: VAQF Scientific Report (Volume 2012 No. 02). Retrieved from: http://www.deq.virginia.gov/Portals/0/DEQ/CoastalZoneManagement/FundsInitiativesProjects/task49-10.pdf.

Swingle, W.M., Trapani, C.M., Cook, M.L. 2011. Marine Mammal and Sea Turtle Stranding Response 2010 Grant Report: VAQF Scientific Report (Volume 2011 No. 01). Retrieved from: http://www.deq.virginia.gov/Portals/0/DEQ/CoastalZoneManagement/task49-09.pdf.

Swingle, W.M., Trapani, C.M., Cook, M.L. 2010. Marine Mammal and Sea Turtle Stranding Response 2009 Grant Report: VAQF Scientific Report (Volume 2010 No. 01). Retrieved from: http://www.deq.virginia.gov/Portals/0/DEQ/CoastalZoneManagement/task49-08.pdf.

Tagatz, M. E. 1971. Osmoregulatory ability of blue crabs in different temperature-salinity combinations. Chesapeake Science 12: 14–17.

Tan, E., and W. A. Van Engel. 1966. Osmoregulation in the adult blue crab, Callinectes sapidus Rathbun. Chesapeake Science 7: 30–35.

The Center of Biology Conservation. CCB Mapping Portal. VA Eagle Nest Locator. Retrieved from https://ccbbirds.org/what-we-do/research/species-of-concern/species-of-concern-projects/national-eagle-roost-registry. Retrieved 15 October 2021.

Thompson, M. 1998. Assessments of the population biology and critical habitat for the horseshoe crab, Limulus polyphemus, in the South Atlantic Bight. M.S. Thesis. University of Charleston, Charleston, South Carolina.

Todd, Victoria L.G., I.B. Todd, J.C. Gardiner, E.C. N. Morrin, N.A. MacPherson, N.A. DiMarzio, and F. Thomsen. 2014. A Review of Impacts of Marine Dredging Activities on Marine Mammals. ICES Journal of Marine Science. Retrieved from http://www.osc.co.uk/wp-content/uploads/2015/01/Todd_2015_DredgingReview.pdf.

University of Maryland Center for Environmental Science (UMCES). Integration and Application Network: Ecocheck. 2013. Chesapeake Bay Benthic Index of Biotic Integrity data: Retrieved from http://ian.umces.edu/ecocheck/reportcards/chesapeakebay/2013/indicators/benthic_index/.

U.S. Army Corps of Engineers (USACE), Norfolk District, 2018. Norfolk Harbor General Reevaluation Report/Environmental Assessment, 323 pp. w/o Appendices.

U.S. Army Corps of Engineers (USACE). 2013. Incorporating Sea Level Change in Civil Works Programs. Regulation No. 1100-2-8162. Retrieved from: http://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1100-2-8162.pdf.

U.S. Army Corps of Engineers (USACE). 2014. Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation. Technical Letter No. 1100-2-1. Retrieved from: http://www.publications.usace.army.mil/Portals/76/Publications/EngineerTechnicalLetters/ETL_1100-2-1.pdf.

U.S. Army Corps of Engineers (USACE). n.d. Craney Island Dredged Material Management Area. Brochure. Office, Craney Island Project, Portsmouth, VA.

U.S. Army Corps of Engineers, 1983. Dredging and Dredged Material Disposal. Engineer Manual 1110-2-5025, Office, Chief of Engineers, Washington, D.C.

U.S. Army Corps of Engineers (USACE). 2002. Final Limited Reevaluation Report. Norfolk Harbor and Channels. 50-foot Channel Project, 50-foot Inbound Element. Norfolk District. Norfolk, VA.

U.S. Army Corps of Engineers (USACE). 2005. Craney Island Eastward Expansion Draft Feasibility Report. Norfolk District. Norfolk, VA.

U.S. Army Corps of Engineers (USACE). 2006. Craney Island Easterward Expansion Final Environmental Impact Statement, Norfolk Harbor and Channels, Virginia. Norfolk District. Norfolk, VA.

U.S. Army Corps of Engineers (USACE). 2009(a) Site Management Plan for the Dam Neck Ocean Dredged Material Disposal Site. Norfolk District. Norfolk, VA.

U.S. Army Corps of Engineers. 2009(b) Site Management Plan for the Norfolk Ocean Dredged Material Disposal Site. Norfolk District. Norfolk, VA.

U.S. Army Corps of Engineers. 1983. Dredging and Dredged Material Disposal. Engineer Manual 1110-2-5025, Office, Chief of Engineers, Washington, DC.

U.S. Army Corps of Engineers. 2003. Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities — Testing Manual, Environmental Testing Laboratory, ERDC/EL TR-03-1.

U.S. Fish and Wildlife Service. 2002. Craney Island Expansion Study Planning Aid Report: Baseline Biological Conditions and Impacts of the Eastward Expansion. Prepared for the U.S. Army Corps of Engineers.

U.S. Fish and Wildlife Service. 2013. Fishes of the Chesapeake Bay. July 2. Retrieved from https://www.fws.gov/chesapeakebay/fishpage.html.

U.S. Fish and Wildlife Service. 2021a. Information for Planning and Conservation Database. Retrieved from http://www.fws.gov/northeast/virginiafield/endangered/projectreviews_step2.html. Date Retrieved 15 October 2021.

U.S. Fish and Wildlife Service. 2021b. Critical Habitat Map Tool. Retrieved from https://fws.maps.arcgis.com/apps/Viewer/index.html?appid=f6e84e675ba1461b8ae6a351adea1429. Date Retrieved 15 October 2021.

U.S. Fish and Wildlife Service. 2021c. NLEB Winter Habitat and Roost Tree Map. Retrieved from https://dgif-virginia.maps.arcgis.com/apps/webappviewer/index.html?id=32ea4ee4935942c092e41ddcd19e5ec5. Date Retrieved 15 October 2021.

U.S. National Climate Assessment. 2012. Global Sea Level Rise Scenarios for the United States National Climate Assessment. Retrieved from: http://scenarios.globalchange.gov/sites/default/files/NOAA_SLR_r3_0.pdf.

Valle-Levinson, A., Wong, K. C., & Bosley, K. T. 2002. Response of the lower Chesapeake Bay to forcing from Hurricane Floyd. Continental Shelf Research, *22*(11), 1715-1729.

Van Engel, W. A. 1958. The blue crab and its fishery in Chesapeake Bay. Part 1-Reproduction, early development, growth, and migration. Commercial Fisheries Review 20: 6–17.

Virginia Department of Environmental Quality (VDEQ). 2015. Air Quality Monitoring Network Assessment. Office of Air Quality Monitoring. Retrieved from: https://www3.epa.gov/ttn/amtic/files/networkplans/VAassess2015.pdf

Virginia Department of Transportation (VDOT). 2016. Hampton Roads Crossing Study SEIS website. Retrieved from: http://hamptonroadscrossingstudy.org/default.asp.

Virginia Institute of Marine Science (VIMS). 1993. Beneficial Uses of Dredged Materials in Hampton Roads, Virginia. House Document No. 16. Commonwealth of Virginia.

Virginia Marine Resources Commission. 2016c. Regulation (4 VAC 20-561-10 et. Seq.) "Pertaining to the Hampton Flats Hard Clam Harvest Area." Retrieved from http://www.mrc.virginia.gov/regulations/fr561.shtm.

Virginia Marine Resources Commission. 2016c. Regulation (4 VAC 20-900-10 et. Seq.) "Pertaining to the Horseshoe Crab." Retrieved from https://mrc.virginia.gov/regulations/fr900.shtm.

Walter, J. F., and H. M. Austin. 2003. Diet composition of large striped bass (Morone saxatilis) in Chesapeake Bay. Fishery Bulletin 101: 414–423.

Walter, J. F., A. S. Overton, K.H. Ferry, and M. E. Mather. 2003. Atlantic coast feeding habits of striped bass: a synthesis supporting a coast-wide understanding of trophic biology. Fisheries Management and Ecology, 10: 349–360.

Wang, H.V., Kim, S.C., Boon, J.D., Kuo, A.Y., Sisson, G.M. Brubaker, J.M. and Maa, J.P-Y. 2001. Three dimensional hydrodynamic modeling study, Craney Island Eastward Expansion, lower James River and Elizabeth River, Virginia. Special Report No. 372 in Applied Marine Science and Ocean Engineering.

Wang, R., Shen, J., Sisson, M. 2017. Incorporation of sea level change scenarios into Norfolk Harbor Channels Deepening Study & Elizabeth River Southern Branch Navigation Improvements Study. Draft Report submitted to the Moffatt and Nickol and the U.S. Army Corps of Engineers. Virginia Institute of Marine Science.

Watts, B.D. 2016. Status and distribution of the eastern black rail along the Atlantic and Gulf Coasts of North America. The Center for Conservation Biology Technical Report Series, CCBTR-16-09. College of William and Mary/Virginia Commonwealth University, Williamsburg, VA, pg 148.

Whale and Dolphin Conservation Society. 2006. Vessel collisions and cetaceans: what happens when they don't miss the boat. Retrieved from: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwj546TqiOfWAhWBLyYKHXryACEQFggoMAA&url=http%3A%2F%2Fuk.whales.org%2Fsites%2Fdefault%2Ffiles%2Fwhales-and-ship-strikes.pdf&usg=AOvVaw1KIM-3ylliuilTv5Q7p3-p.

Wells, H.W. 1957. Abundance of the hard clam *Mercenaria mercenaria* in relation to environmental factors, Ecology, 38(1), 123-128.

Whetstone, Jack M., Leslie N. Sturmer, and Michael J. Oesterling. 2005. Biology and Culture of the Hard Clam (Mercenaria mercenaria), Southern REgioanl Aquaculture Center 433:1-6.

Wilbur D. H. and D.G. Clarke 2001. Biological effects of suspended sediments: A review of suspended sediment impacts on fish and shellfish with relation to dredging activities in esturaries. North American Journal of Fisheries Management 21:4, 855-875.

Wenner, C. A., and J. A. Musick. 1975. Food habits and seasonal abundance of the American eel, Anguilla rostrata, from the lower Chesapeake Bay. Chesapeake Science 16: 62–66.

Yin, J. Schlessinger, M.E., & Stouffer, R.J. 2009. Model projections of rapid sea-level rise on the northeast coast of the United States. Nature Geoscience, 2(4), 262-266.