ELIZABETH RIVER AND SOUTHERN BRANCH NAVIGATION IMPROVEMENTS

Draft General Reevaluation Report and Environmental Assessment

US Army Corps of Engineers ®
Norfolk District
803 Front Street
Norfolk, VA 23510

12 December 2017

THE PORT OF VIRGINIA®
Virginia Port Authority
600 World Trade Center
Norfolk, VA 23510

Cooperating agencies: U.S. Environmental Protection Agency, National Oceanographic and Atmospheric Administration/National Marine Fisheries Service, U.S. Department of the Navy

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COVER SHEET

Elizabeth River and Southern Branch Navigation Improvements, Virginia

Draft General Reevaluation Report and Environmental Assessment

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

NONFEDERAL SPONSOR: Virginia Port Authority, agent of the Commonwealth of Virginia

COOPERATING AGENCIES: U.S. Environmental Protection Agency, Region 3
National Oceanographic and Atmospheric Administration/National Marine Fisheries Service,
U.S Department of the Navy

ABSTRACT:

The Elizabeth River and Southern Branch Navigation Improvements study area encompasses the Federally improved channel from Lamberts Bend to the Chesapeake Extension in the Elizabeth River, Virginia. The need for this study arises from transportation inefficiencies currently experienced by commercial vessels in the Elizabeth River and Southern Branch of the Elizabeth River. These inefficiencies are projected to continue in the future.

Deepening the existing channel to various depths was evaluated and two Action Project Alternatives (a National Economic Development Plan and a Locally Preferred Plan) were evaluated in detail as well as the No Action/Future Without-Project Alternative. Nonstructural measures such as reducing vessel speed in the channel were also considered.

The Recommended Plan or Preferred Alternative is the Locally Preferred Alternative, which includes the following features:

- Deepening the channel from Lamberts Bend to Perdue Farms (Segment 1a) from a required depth of 40 feet to 45 feet deep in Segment 1a, and deepening the channel from Perdue Farms to the Norfolk Southern Lift Bridge (Segment 1b) from a required depth of 40 feet to 42 feet.
- Deepening the channel from the Norfolk Southern Lift Bridge to the Gilmerton Bridge (Segment 2), from a required depth of 35 feet to 39 feet deep; and
- Continuing to maintain the channel from the Gilmerton Bridge to the Chesapeake Extension to a required depth of 35 feet (Segment 3).

All comments concerning this Environmental Assessment are required to be submitted by January 15, 2018. For further information and to submit comments, please contact the U.S. Army Corps of Engineers, Norfolk District:

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EXECUTIVE SUMMARY

The results of engineering, economic, environmental, and real estate investigations performed for this Feasibility Study are being used to determine if there is continued Federal interest in the implementation of authorized navigation improvements on the Norfolk Harbor and Channels Project from the Lamberts Bend to the Chesapeake Extension (Hereafter referred to as the Elizabeth River and Southern Branch Navigation Improvements (ERSB)) (Figure 1). The Virginia Port Authority (VPA) requested the re-evaluation of a portion of the project which was authorized under Section 201 of the Water Resources Development Act (WRDA) of 1986 (Public Law 99-662) for the construction of the Norfolk Harbor and Channels, Virginia, Project, as described in House Document 99-85, dated 18 July 1985, entitled "Norfolk Harbor and Channels, Virginia." The original authorization included channel deepening from 45 to 55 feet within the Thimble Shoal Channel and the Norfolk Harbor Channel (northern portion of the Main Branch of the Elizabeth River) and 57 feet within the Atlantic Ocean Channel. It also included channel deepening from 40 to 45 feet in the Main Branch of the Elizabeth River and the upper portion of the Elizabeth River Southern Branch and 35 to 40 feet in the Elizabeth River Southern Branch (ERSB). Since being authorized, the Thimble Shoal and Norfolk Harbor Channels were deepened to 50 feet and the Atlantic Ocean Channel to 52 feet. There have been no authorized channel improvements to the ERSB channel segments; however, the Department of the Navy did deepen a portion of the existing 40-foot channel to a depth of 47 feet for national defense purposes. This study is being conducted under Section 216 of the Flood Control Act of 1970 (Public Law 91-611), which authorizes the review of completed projects in the interest of navigation and related purposes to determine the feasibility of further port deepening.

DESCRIPTION OF REPORT

This Draft Integrated General Reevaluation Report and Environmental Assessment documents the study process and presents the results of investigations and analyses conducted to evaluate modifications to the existing Federal navigation system within ERSB to improve its ability 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) an evaluation of related problems and opportunities; (3) development of potential alternatives; (4) a comparison of costs, benefits, adverse impacts, and feasibility of those alternatives; and (5) identification of a National Economic Development (NED) Plan and the Draft Recommended Plan.

PURPOSE AND NEED

The commodities passing through the ERSB between 2009 and 2015 averaged 8.4 million tons annually. The major commodity exports consisted of dry-bulk grains; barge petroleum; dry-bulk fertilizers; scrap iron; general cargo; liquid-bulk chemicals; lards, fats, and oils; and wood pellets. The major commodity imports consisted of barge aggregates; barge petroleum; dry-bulk fertilizers; liquid-bulk fertilizers; liquid-bulk petroleum; dry-bulk chemicals; dry-bulk aggregates; general cargo; liquid-bulk chemicals; and ores and minerals.

The current vessel fleet moving the commodities through the waterway consists of bulkers, general cargo vessels, dry cargo barges, tankers, gas carriers, and tank barges. The largest vessels are 100K DWT bulkers and 200K DWT tankers. Many vessels in the current fleet have drafts greater than the currents depths of the waterway and are underutilized and inefficiently operated, thereby foregoing potential transportation cost savings available from the economies of scale associated with more complete vessel loading. It is not anticipated that a fleet transition will occur for ERSB with the implementation of navigation improvements. Instead, as the channel gets deeper, the utilization of the channel will increase with the transfer of cargo from

smaller to larger vessels in the existing fleet. In this way, calls by smaller vessels are eliminated and larger vessels are able to utilize capacity that cannot currently be used given the existing channel depth.

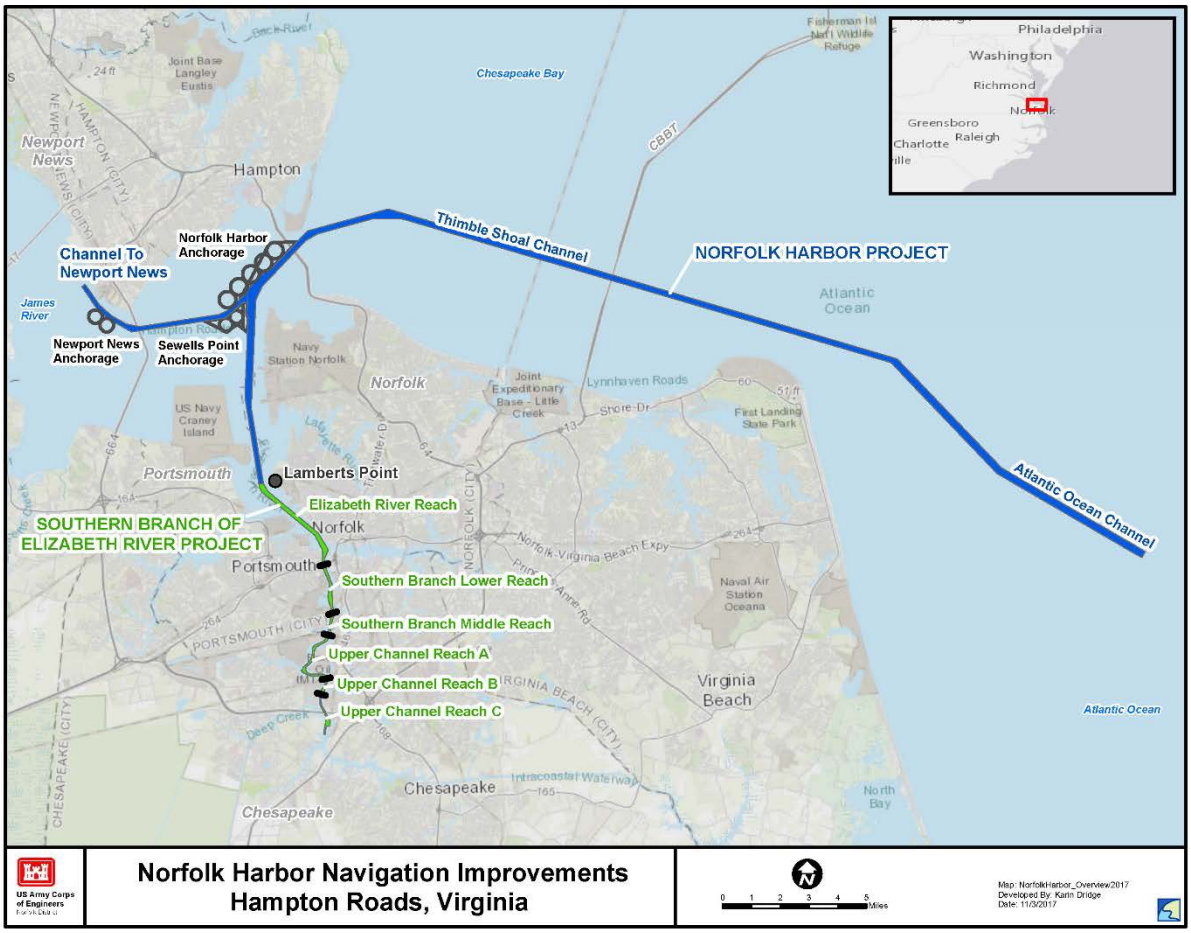

Figure 1. Norfolk Harbor and Channels. Green portion indicates ERSB study location.

ALTERNATIVES AND DRAFT RECOMMENDED PLAN

Utilizing the Corps' Planning Process as specified in ER 1105-2-100, plan formulation was conducted with a focus on achieving the Federal objective of water and related land resources project planning, which is to contribute to National Economic Development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Plan formulation also considers all effects, beneficial or adverse, to each of the four evaluation accounts identified in the Principles and Guidelines (1983), which are National Economic Development, Environmental Quality, Regional Economic Development, and Other Social Effects.

Alternative plans combining multiple structural and nonstructural measures to improve the safety and efficiency of the navigation system were considered. To determine whether the Federal government should participate in implementing navigation improvements, the expected returns to the national economy (National Economic Development (NED) benefits) are calculated. NED benefits are generated by addressing inefficiencies in the existing transportation system to lower transportation costs. Net benefits are calculated by subtracting the total cost to construct and maintain the improvements over a 50-year study period from the

total transportation cost savings that would be generated by the proposed improvements over that period. The NED Plan is the alternative that reasonably maximizes net NED benefits while remaining consistent with the Federal objective of protecting the nation's environment. Where two cost-effective plans produce similar net benefits, the less costly plan is identified as the NED plan, even though the level of outputs may be less. The NED Plan is normally recommended for implementation. However, if the non-Federal sponsor prefers a more costly plan and is willing to pay the additional costs, a Locally Preferred Plan (LPP) can be recommended if the outputs are similar in kind, and equal to or greater than the outputs of the NED Plan.

Alternative plans combining multiple structural and nonstructural measures to improve the safety and efficiency of the navigation system were considered to determine whether the Federal government should participate in implementing navigation improvements. The expected returns to the national economy (NED benefits) are calculated. NED benefits are generated by addressing inefficiencies in the existing transportation system to lower transportation costs. Net benefits are calculated by subtracting the total cost to construct and maintain the improvements over a 50-year study period from the total transportation cost savings that would be generated by the proposed improvements over that period. The NED Plan is the alternative that reasonably maximizes net NED benefits while remaining consistent with the Federal objective of protecting the nation's environment.

Based on an evaluation of alternative plan economic costs and benefits, the NED plan includes a deepening of the channel. The benefit-to-cost ratio (BCR) for the NED plan is 2.4. The non-Federal sponsor, the Virginia Port Authority (VPA), subsequently requested a locally preferred plan (LPP) which includes:

- Deepening the channel from Lamberts Bend to Perdue Farms (Segment 1a) from a required depth of 40 feet to 45 feet deep in Segment 1a, and deepening the channel from Perdue Farms to the Norfolk Southern Lift Bridge (Segment 1b) from a required depth of 40 feet to 42 feet.
- Deepening the channel from the Norfolk Southern Lift Bridge to the Gilmerton Bridge (Segment 2), from a required depth of 35 feet to 39 feet deep; and
- Continuing to maintain the channel from the Gilmerton Bridge to the Chesapeake Extension to a required depth of 35 feet (Segment 3).

The LPP has positive net benefits and is economically justified (BCR is 2.4). A comparison of the annualized benefits and costs for the NED and LPP is located in Table 1. In accordance with USACE policy, the LPP is required to be submitted for consideration to the Assistant Secretary of the Army for Civil Works (ASA-CW) and approved for consideration as the recommended plan on finalization of this draft study.

Table 1. Equivalent Annual Benefits and Costs

Equivalent Annual Benefits and Costs FY2017 Price Levels 50-Year Period of Analysis / 2.75 % Discount Rate	NED	LPP
Project Costs	$152,920,000	$163,198,000
Interest During Construction	$2,238,000	$2,343,000
Total Economic Investment	$155,158,000	$165,541,000
AAEQ Costs		
Economic Investment	$5,747,000	$6,132,000
Increased O&M Costs	$304,500	$329,800
Total AAEQ Costs	$6,052,000	$6,462,000
AAEQ Benefits		
Transportation Cost Savings	$14,919,000	$15,443,000
Total AAEQ benefits	$14,919,000	$15,443,000
Net AAEQ Benefits	$8,867,000	$8,981,000
Benefit-Cost Ratio (at 2.75%)	2.47	2.39

COSTS AND BENEFITS

The USACE employed the traditional providers of traffic and fleet projections to study ERSB. Based on existing and projected future vessel traffic, vessel fleet mix, trade route allocations, and liner services currently associated with the waterway, one design vessels was selected. The vessel mix was allocated over time to provide benefit calculations using the USACE HarborSym economic analysis model. The characteristics of the design vessel was used to develop channel dimension and alignment needs. Further refinement of the dimensions and alignment is expected through application of ship simulations prior to developing final designs. The dimensions of the design vessel is as follows: no larger than a current Panamax-Class 83,000 DWT bulk carrier with an overall length of approximately 750 feet, a beam of 106 feet, and a design depth of 47.6 feet.

The projected traffic allocated between the time-modified mix of containerships and bulkers has provided average annual net benefits of $8.9 million for the DRP (the LPP). The DRP maximizes annual net benefits and maintained a robust BCR of 2.4. The estimated project costs are $163 million and economic investment costs are $165.5million. The entire project is economically justified. Table 2 provides a summary of the Federal and non-Federal costs and the benefits are attributable to transportation cost savings through the use of existing ships with a deeper draft, the use of larger vessels, and delay reductions.

Table 2. Federal and Non-Federal Cost Shares for DRP

	Total Cost	Federal	Non-Federal
Mob and Demobilization	$4,503,000	$3,377,000	$1,126,000
Dredging Cost (Including Mob / Demob)	$99,013,000	$69,191,000	$29,822,000
Environmental Mitigation	$0	$0	$0
Monitoring	$0	$0	$0
Construction Management	$758,000	$569,000	$190,000
PED	$7,945,000	$5,959,000	$1,986,000
Contingency (14.81%)	$16,620,000	$11,714,000	$4,906,000
Total Construction of GNF	$128,839,000	$90,810,000	$38,029,000
LERR	$0	$0	$0
Total Project First Costs	$128,839,000	$90,810,000	$38,029,000
Non-Federal Berth Dredging Costs	$34,373,000	$-	$34,373,000
Relocating Aids to Navigation	$0	$0	$0
10% GNF Non-Federal	$0	$(12,108,000)	$12,108,000
Total Cost	$163,213,000	$78,702,000	$84,510,000

ENVIRONMENTAL IMPACTS AND MITIGATION

The potential consequences of implementation of the Preferred Alternative were considered in terms of probable environmental impact, social well-being, and economic factors. There are no significant economic, recreation, aesthetic, or social well-being impacts with implementation of the Preferred Alternative. This project is expected to have a positive impact on the economy of Hampton Roads and the Commonwealth of Virginia.

A Programmatic Agreement was coordinated and signed by USACE, Virginia Port Authority and the Virginia State Historic Preservation Office in June 2017 to address any potential cultural

resource impacts anticipated during project implementation. Endangered Species Act, Section 7 consultation is ongoing with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. Marine Mammal Protection Act and Essential Fish Habitat consultation as required per the Magnuson-Stevens Fishery and Conservation Management Act with the NMFS is ongoing. Potential impacts to protected species and any designated Critical habitat are not anticipated to be "significant," as defined by the significance thresholds in National Environmental Policy Act guidelines (40 CFR Parts 1500-1508).

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 (BMPs) have been incorporated in order to protect the environment and avoid and minimize impacts during construction, and operation and maintenance cycles. Best Management Practices and standard USACE protocols will be implemented for the protection of listed turtle and whale species, Atlantic Sturgeon, as well as other listed species that could be found in the area as well as those protected by the Marine Mammal Protection Act to reduce any potential negative impacts of the project. For all Threatened and Endangered Species, our findings are either "No Affect" or "May Affect, Not Likely to Adversely Affect", depending on the listed species.

There are no significant impacts anticipated to benthic resources, wetlands, and water quality. Adverse impacts would not exceed a minor level of impact. Total Suspended Solids and turbidity in the water column resulting from dredging and material placement/disposal will quickly return to ambient conditions after construction is complete. Water quality monitoring indicated minor, though permanent, changes to local salinity in the Elizabeth River resulting from the proposed dredging.

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 that exceeds limits of contaminants for disposal in CIDMMA will be disposed of at approved upland sites in the region able to process and properly dispose of contaminated sediments.

Dredged material placement actions at CIDMMA will comply with Clean Water Act and CIDMMA acceptance criteria. Commander's Policy WRD-01 is an NAO 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

ADCIRC – Advanced Circulation Model

BCR – Benefit-to-cost ratio

BFE – Base Flood Elevation

CAA – Clean Air Act

CERCLA – Comprehensive Environmental Response, Compensation and Liability Information System

CSRM – Coastal Storm Risk Management

CWA - Clean Water Act

CZMA - Coastal Zone Management Act

DO - Dissolved Oxygen

EA - Environmental Assessment

EFH - Essential Fish Habitat

EO – Executive Order

ESA - Endangered Species Act

ESI - Environmental Sensitivity Index

FA – Focus Area

FONSI - Finding of No Significant Impact

FCSA – Federal Cost Share Agreement

GIS – Geographic Information System

H & H – Hydrology and Hydraulics

LERRD - Lands, Easements, Rights-of-Way, Relocations, and Disposal

MSFCMA - Magnuson-Stevens Fishery Conservation and Management Act

MSL – Mean Sea Level

NAAQS - National Ambient Air Quality Standards

NACCS – North Atlantic Coast Comprehensive Study

NAD – North Atlantic Division

NAVD - North American Vertical Datum

NED – Net Economic Plan

NEPA - National Environmental Policy Act

NHPA - National Historic Preservation Act

NMFS - National Marine Fisheries Service

NOAA – National Oceanographic and Atmospheric Administration

NNBF – Natural and Nature Based Features

NRHP - National Register of Historic Places

NWI - National Wetlands Inventory Project

PCB - Polychlorinated Biphenyls

PDT – Project Delivery Team

ROI – Region of Influence

RSLR – Relative Sea Level Rise

SAV - Submerged Aquatic Vegetation

TMDL – Total Maximum Daily Load

TSP – Tentatively Selected Plan

TSS - Total Suspended Solids

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

VCRIS - Virginia Cultural Resource Information System

VDEQ - Virginia Department of Environmental Quality

VDCR – Virginia Department of Conservation and Recreation

VDHR - Virginia Department of Historic Resources

VDGIF - Virginia Department of Game and Inland Fisheries

VDH - Virginia Department of Health

VIMS - Virginia Institute of Marine Science

VMRC – Virginia Marine Resources Commission

WRDA - Water Resources Development Act

1 STUDY INFORMATION

1.1 INTRODUCTION

The main branch of the Elizabeth River and southern branch of the Elizabeth River (Southern Branch) Navigation Improvements project is a single purpose deep draft navigation project located in Hampton Roads, a 25 square mile natural harbor serving port facilities in the cities of Norfolk, Newport News, Portsmouth, Chesapeake, and Hampton in southeastern Virginia. The major port facilities served by the project include bulk and liquid bulk terminals, which are a nationally significant import and export gateway, and Naval Station Norfolk, which is the largest naval complex in the world.

The Elizabeth River and Southern Branch of the Elizabeth River Navigation Improvements project (ERSB) consists of a network of Federally improved channels extending from Lamberts Bend on the Main Branch of the Elizabeth River to the Chesapeake Extension upstream of the Gilmerton Bridge on the Southern Branch of the Elizabeth River (Figure 1-1). The project is a separable element of the congressionally authorized Norfolk Harbor and Channels project and includes a system of channels with depths ranging from 35 to 45 feet. Since its authorization in 1986 the authorized project has been and continues to be constructed in usable increments or elements in accordance with Section 207 of Public Law 99-662 based on the needs of the port community and the financial capability of the non-Federal sponsor. Section 207, which is entitled "Construction in Usable Increments," states *"Any navigation project for a harbor or inland harbor authorized by this title or any other provision of law enacted before, on, or after the date of enactment of this title may be constructed in usable increments. "* The Southern Branch project has not been constructed, nor is it maintained, to its full authorized depths.

This integrated Draft General Reevaluation Report and Environmental Assessment (GRR/EA) documents the USACE feasibility study planning process for channel improvements at the Southern Branch project and documents implementation of the National Environmental Policy Act (NEPA) in the planning process.

1.2 STUDY AUTHORITY

Section 201 of the Water Resources Development Act (WRDA) of 1986 (Public Law 99-662) authorized the construction of the Norfolk Harbor and Channels, Virginia, Project, as described in House Document 99-85, dated July 18, 1985, entitled "Norfolk Harbor and Channels, Virginia." The authority states, as follows:

> *"The project for navigation, Norfolk Harbor and Channels, Virginia: Report of the Chief of Engineers, dated November 20, 1981, at a total cost of $551,000,000, with an estimated first Federal cost of $256,000,000 and an estimated first non-Federal cost of $295,000,000, including such modifications as the Secretary determines to be necessary and appropriate for mitigation of any damage to fish and wildlife resources resulting from construction, operation, and maintenance of each segment of the proposed project. The Secretary, in conjunction with appropriate Federal, State, and local agencies, shall study the effects that construction, operation, and maintenance of each segment of the proposed project will have on fish and wildlife resources and the need for mitigation of any damage to such resources resulting from such construction, operation, and maintenance."*

This study is authorized under Section 216 of the Flood Control Act of 1970 (Public Law 91-611), which authorizes the review of completed projects in the interest of navigation and related purposes to determine the feasibility of further port deepening.

The major components of the ERSB project portion of the Norfolk Harbor and Channels authorized project include:

(1) Increasing the depth of the Elizabeth River and the Southern Branch of the Elizabeth River between Lamberts Point (river mile 9) and the Norfolk and Western Railway Bridge (river mile 15) from 40 feet to 45 feet over its existing 375 to 750-foot width.

(2) Increasing the depth of the Southern Branch of the Elizabeth River between the Norfolk and Western Railway Bridge (river mile 15) and the US Routes 460 and 13 highway crossing (river mile 17.5) from 35 feet to 40 feet over its existing 250 to 500-foot width, and providing a new 800-foot turning basin at the terminus of the channel improvement.

(3) Placing suitable dredged material in the Craney Island Dredged Material Management Area (CIDMMA) site and unsuitable material in an upland disposal site(s).

1.3 FEDERAL POLICY AND PROCEDURES

The lead Federal agency is the 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 sharing agreement with USACE on June 15, 2015.

Identification of project-specific planning criteria used in USACE project planning is guided by the Principles and Guidelines (1983), the Planning Guidance Notebook, ER 1105-2-100 (22 Apr 2000), and The National Environmental Policy Act (NEPA) of 1969, and Procedures for Implementing NEPA, ER 200-2-2 (4 Mar 1988).

USACE project planning follows the six-step process first described in the Principles and Guidelines (1983) and further elaborated in the Planning Guidance Notebook, ER 1105-2-100 (April 2000). Although presented in series, these steps are applied in an iterative plan formulation process, which focuses on succeeding steps, as follows:

1. The specific problems and opportunities to be addressed in the study are identified, and the causes of the problems are discussed and documented. Planning goals are set, objectives are established, and constraints are identified.

2. Existing and future Without Project conditions are identified, analyzed and forecast. The existing condition resources, problems, and opportunities critical to plan formulation, impact assessment, and evaluation are characterized and documented.

3. The study team formulates alternative plans that address the planning objectives. A range of alternative plans are identified at the beginning of the planning process and screened and refined in subsequent iterations throughout the planning process.

4. Alternative project plans are evaluated for effectiveness, efficiency, completeness, and acceptability. The impacts of alternative plans will be evaluated using the system of accounts framework [National Economic Development (NED), Environmental Quality (EQ), Regional Economic Development (RED), Other Significant Effects (OSE)] specified in the Principles and Guidelines and ER 1105-2-100.

5. Alternative plans will be compared and contributions to National Economic Development (NED) will be used to prioritize and rank alternatives. The public involvement program will be used to obtain public input to the alternative identification and evaluation process.

6. A plan will be selected for recommendation, and a justification for plan selection will be prepared.

1.4 PURPOSE AND NEED FOR USACE ACTION

The purpose of this investigation is to identify whether the authorized plan is still in the Federal interest and to evaluate measures which would improve the operational efficiency of commercial vessels currently using the Southern Branch project and commercial vessels projected to use the waterway in the future.

The need for this investigation arises from inefficiencies currently experienced by commercial vessels on the Southern Branch. These inefficiencies are projected to continue in the future as size of vessels navigating the channel is expected to increase.

1.5 OBJECTIVES

The primary planning objective of this study is to reasonably maximize the ERSB's contribution to national economic development (NED), consistent with protecting the Nation's environment, by addressing the physical constraints and inefficiencies in the existing navigation system's ability to safely and efficiently serve the forecasted vessel fleet and process the forecasted cargo volumes. The specific objective for this study is to reduce transportation costs for the existing and future fleet of cargo vessels over the period of analysis on the Southern Branch.

1.6 LOCATION AND DESCRIPTION OF THE STUDY AREA

The Elizabeth River is approximately 20 miles long and is situated within Norfolk Harbor along the Cities of Chesapeake, Norfolk, and Portsmouth. Norfolk Harbor is located in the southeastern part of the Commonwealth of Virginia at the southern end of Chesapeake Bay, midway on the Atlantic Seaboard, approximately 170 miles south of Baltimore, Maryland, and 220 miles north of Wilmington, North Carolina. The harbor is formed by the confluence of the James, Nansemond, and Elizabeth Rivers.

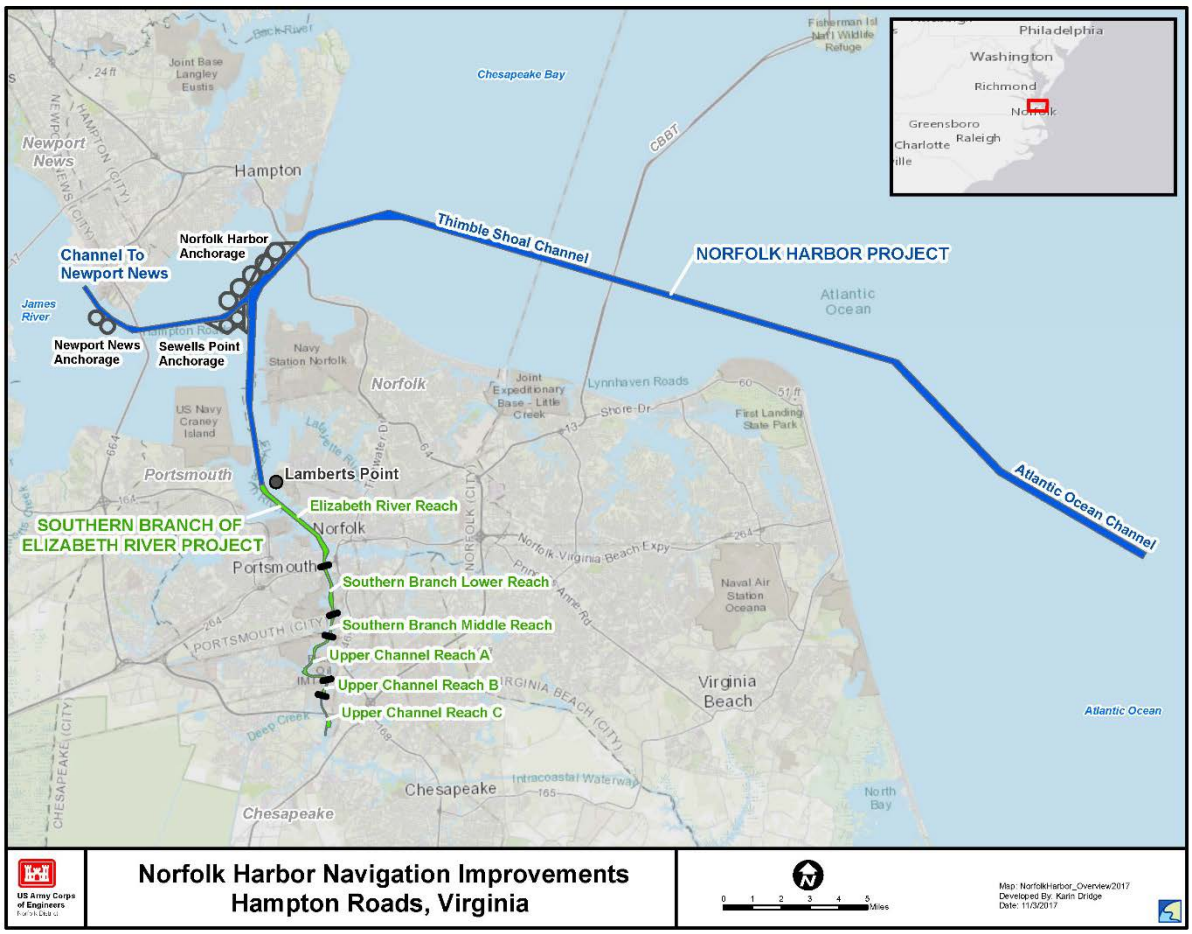


Figure 1-1. Elizabeth River and Southern Branch of the Elizabeth River Reaches

1.7 EXISTING SOUTHERN BRANCH PROJECT

The ERSB component of the Norfolk Harbor Federal Navigation Channel extends from Lamberts Point on the main branch of the Elizabeth River to a point 0.8 mile upstream (south) of the Interstate 64 highway bridge on the Southern Branch of the Elizabeth River, ending at the Chesapeake Extension, a total length of 10.5 miles. There are three authorized project depths within this length: (1) the 45-foot project depth, (2) the 40-foot project depth, and (3) the 35-foot project depth. In 2011, the U.S. Navy deepened the channel to a depth of 50 feet and a width of 600 feet from the Craney Island Reach of the Norfolk Harbor and Channels project through Lamberts Bend and a depth of 47 feet and a width of 600 feet from Lamberts Bend to the Norfolk Naval Shipyard to meet naval operational needs. The Elizabeth River and Southern Branch channels are shown in Figure 1-2.

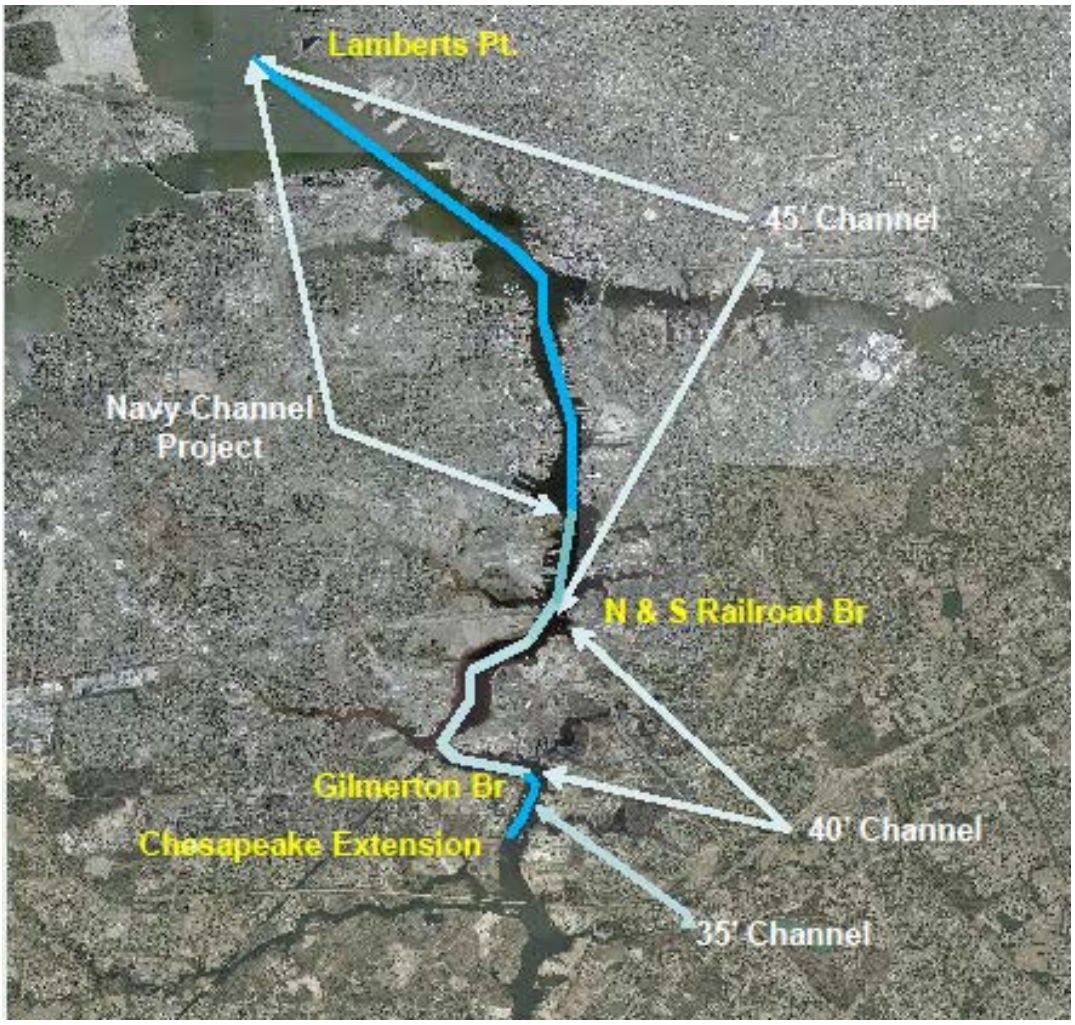


Figure 1-2. Southern Branch Channels

The following table presents the authorized and constructed dimensions of the ERSB component of the Norfolk Harbor and Channels project by channel reaches that were established for purposes of surveying, operating, and maintaining the project.

Table 1-1. Southern Branch Authorized and Constructed Channel Dimensions

Channel Reach	Channel Depth Authorized/ Constructed (feet)	Channel Width Authorized/ Constructed (feet)	Channel Length (miles)
Elizabeth River Reach	45/40	750/750	3.0
Southern Branch Lower Reach	45/40	750/450	2.0
Southern Branch Middle Reach	45/40	375/375	1.0
Upper Channel Reach A	40/35	250-500/250-500	2.4
Upper Channel Reach B	35/35	300/300	0.6
Upper Channel Reach C	35/35*	250/250*	1.5

Note: All depths are Mean Lower Low Water (MLLW);* not maintained.

1.8 PRIOR REPORTS AND STUDIES

The following is a brief description of the pertinent reports that document studies conducted on the Norfolk Harbor and Channels Project, including the Southern Branch component:

- 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). The report recommended deepening the major channels in Hampton Roads to a depth of 55 feet, as well as lesser improvements on the Elizabeth River and its Southern Branch. It also recommended construction of the 6,000-acre Suffolk site to replace the Craney Island Disposal Area (now known as Craney Island Dredged Material Area). However, the Board of Engineers for Rivers and Harbors recommended ocean placement for all suitable material from the deepening and Craney Island for all material unsuitable for ocean placement. However, all material dredged from the inner harbor for the 50-foot deepening project was placed in Craney Island. In addition, the Board recommended that an investigation be conducted to develop a long-term placement plan. As stated earlier, this project has been implemented in separable elements. The 50-foot Outbound Channel Element was completed in 1989, the 50-foot Anchorage in 1999, and the 50-goot Inbound Channel Element in 2007.

- 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. This report addressed modifications to the proposed placement plan for the Norfolk Harbor and Channels project not discussed in previous project documents. Specifically, it identified an expansion of the existing Dam Neck Disposal Site (now known as Dam Neck DMA) as an additional alternative site for placement of dredged material. These proposed modifications have been implemented.

- Norfolk Harbor and Channels, General Design Memorandum 1, June 1986. The GDM affirmed and modified the July 1980 feasibility report recommended plan. It provided for the placement of all inner harbor dredged material in Craney Island and all outer harbor dredged

material in the Dam Neck Dredged Material Area (DMA) except for material used for beneficial purposes. The modified placement plan has been adopted.

- Final Report, Norfolk Harbor and Channels, Virginia, Evaluation and Sediment Test Results for the Southern Branch, August 1998. The report provided a description of the data collection and analysis and an overview of the methodology that was used to assess and evaluate the potential contaminants of concern in the Southern Branch. It also provided a detailed description of those contaminants including information on toxicity, chemical fate, and potential sources.

- Navigation Management Plan for the Port of Hampton Roads, Virginia, February 2000. This report prioritizes the problems, needs, concerns, and opportunities associated with the use and development of the Port of Hampton Roads, as identified by port users and interests. The report provides a comprehensive integrated plan for the port and documents existing corporate knowledge regarding the Port of Hampton Roads. The update to the February 2000 Navigation Management Plan was initiated in 2012.

- Elizabeth River Basin, Virginia, Environmental Restoration, Interim Final Feasibility Study and Environmental Assessment, June 2001. This report recommends implementation of a combination of both sediment restoration at Scuffletown Creek, a tributary to the Southern Branch of the Elizabeth River, and wetland restoration at eight different sites throughout the river system. To date, two of the wetland restoration projects identified in this document have been constructed. The sediment remediation project has been incorporated in the mitigation plan for the Craney Island Eastward Expansion Project.

- Norfolk Harbor and Channels, Virginia, 50-foot Channel Project, 50-foot Inbound Element, Final Limited Reevaluation Report, October 2002. This report recommends the implementation of the 50-foot Inbound Element of the Norfolk Harbor and Channels Project. This consists of deepening the inbound land of the Norfolk Harbor and Channels project to a depth of 50 feet in the Norfolk Harbor Channel and the Thimble Shoal Channel and 52 feet in the Atlantic Ocean Channel. The 50-foot Inbound Element was completed in 2007.

- Craney Island Eastward Expansion, Norfolk Harbor and Channels, Hampton Roads, Virginia, Final Feasibility Report and Environmental Impact Statement, January 2006. This report recommends implementation of a Locally Preferred Plan, consisting of a 580-acre eastward expansion to an elevation of +18 (MLLW), which would provide additional dredged material capacity and a suitable platform to construct a container handling terminal. Various aspects of this project are currently under construction by the Virginia Port Authority in partnership with the Norfolk District.

- Final Environmental Impact Statement for the Proposed Dredging of Norfolk Harbor Channel, Norfolk and Portsmouth, Virginia, July 2009. This report, led by the U.S. Department of the Navy, presents the environmental consequences associated with deepening approximately five miles of Norfolk Harbor Channel within the existing Federal navigation channel from Lamberts Bend through the Port Norfolk Reach, Town Point Reach, and Lower Reach to the NNSY in the Southern Branch of the Elizabeth River. This project would range in depths from 47 feet mean lower low water (MLLW) to 50 feet below MLLW, depending on location. This project, referenced as the Navy Channel Project, was

constructed in 2011, the specifics of which are presented in the Existing and Future Conditions section of this report.

1.9 OVERVIEW OF GENERAL REEVALUATION REPORT AND ENVIRONMENTAL ASSESSMENT

This document integrates the General Reevaluation Report (GRR) and the Environmental Assessment (EA). The purpose of the Integrated GRR/EA is to:

- Identify the plan that reasonably maximizes national economic development benefits while being technically feasible and environmentally sustainable; and
- Recommend a plan for future action.

The purpose of the environmental assessment is to:

- Identify and analyze the environmental effects of the alternatives;
- Incorporate environmental concerns into the decision making process; and
- Determine whether projected environmental impacts warrant the preparation of an Environmental Impact Statement.

1.9.1 Planning Segments Utilized for the Study

The Elizabeth River and Southern Branch of the Elizabeth River channels are grouped into three planning segments (Table 1-1). Segment 1 includes the Elizabeth River Reach, the Southern Branch of the Elizabeth River Lower Reach, and the Southern Branch of the Elizabeth River Middle Reach (Figure 1-3). This segment is identified as “Lamberts Bend to Norfolk Southern Lift Bridge.”

Segment 2 includes the Southern Branch of the Elizabeth River Upper Channel Reach A (Figure 1-4). This segment is identified as “Norfolk Southern Lift Bridge to Gilmerton Bridge.”

Segment 3 includes the Elizabeth River Upper Channel Reach B and Reach C (Figure 1-5). This planning segment is identified as the “Gilmerton Bridge to the Chesapeake Extension.”

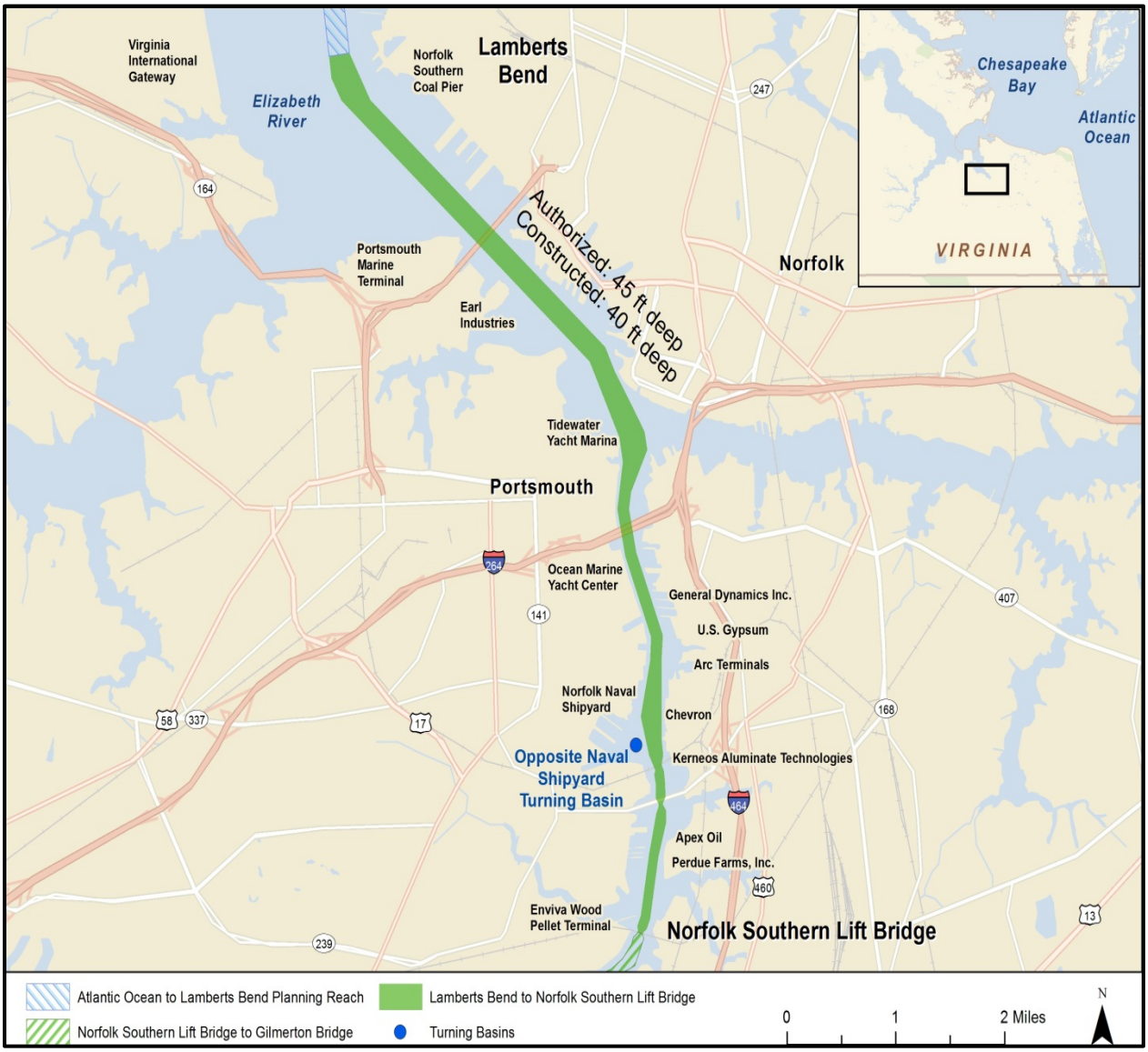


Figure 1-3. Segment 1, Lamberts Bend to Norfolk Southern Lift Bridge

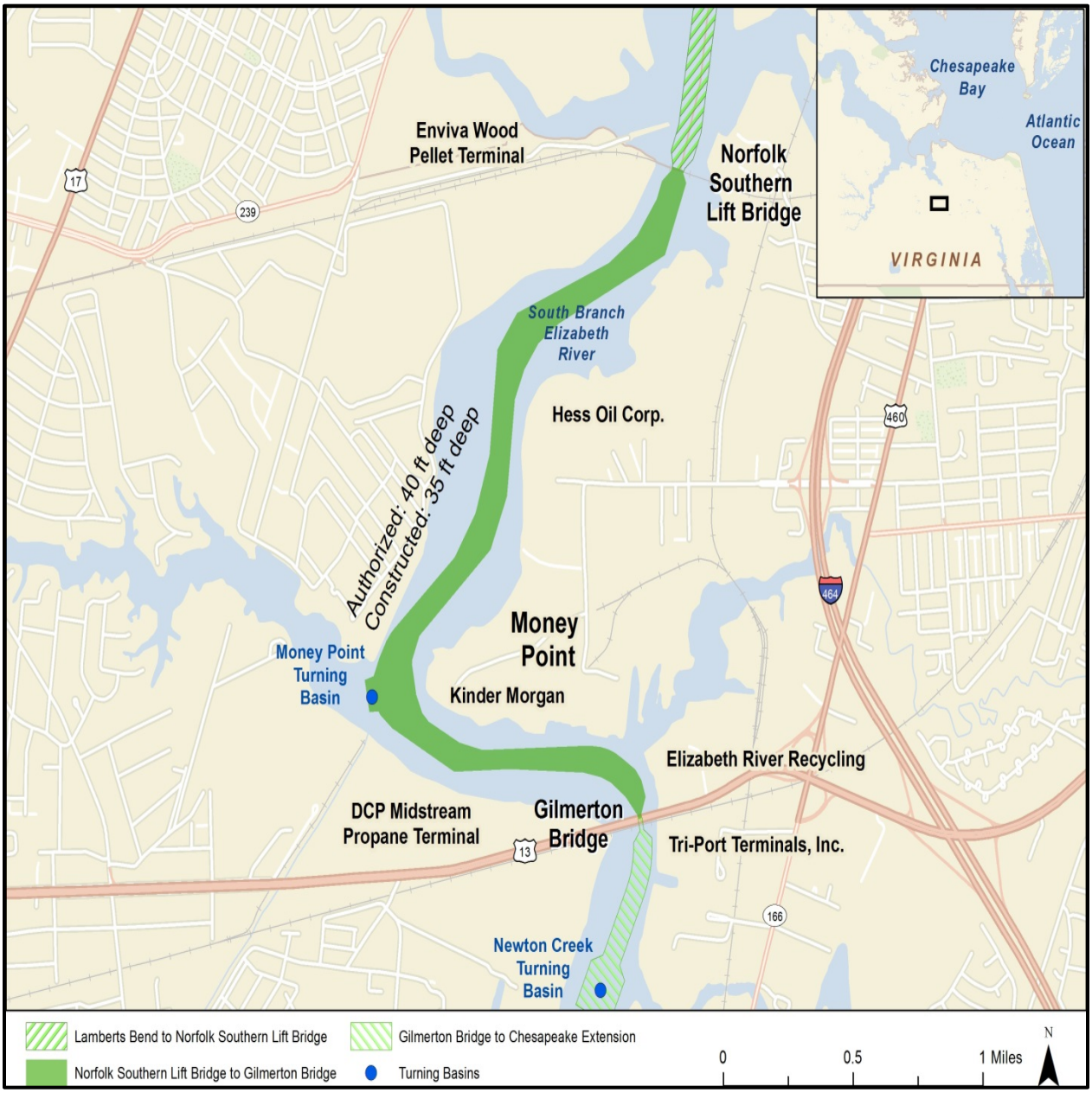


Figure 1-4. Segment 2, Norfolk Southern Lift Bridge to Gilmerton Bridge

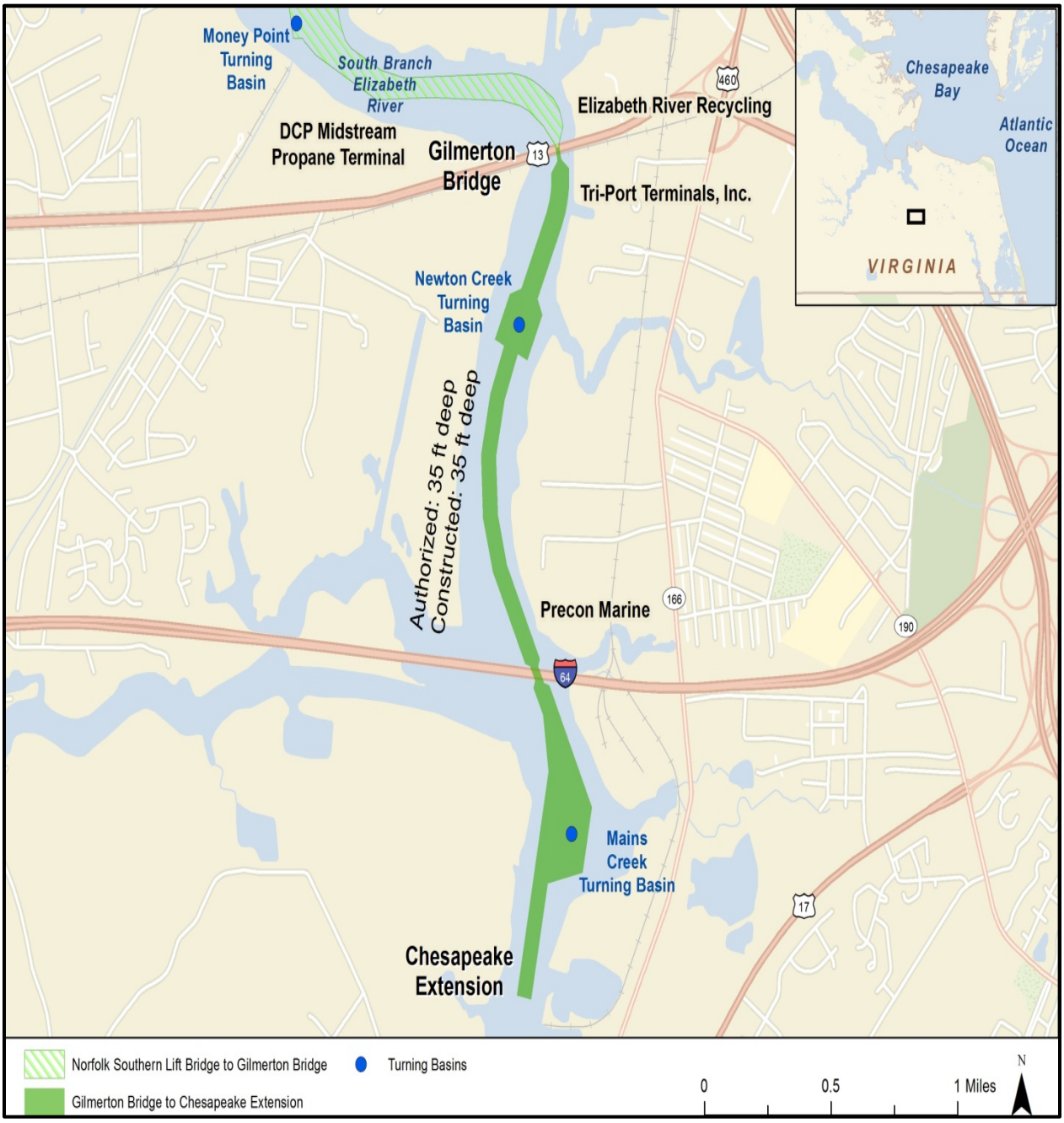


Figure 1-5. Segment 3, Gilmerton Bridge to Chesapeake Extension

1.9.2 Public Involvement in Scoping Process for the Environmental Assessment

Extensive coordination with both the public and Federal and state agencies as well as local non-profit environmental nongovernmental organizations has been completed and is ongoing. In 2015, initial coordination with the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) was conducted at the USACE/USFWS quarterly coordination meetings to orient them to the project and also discuss consultation questions. Resource agency coordination was formerly initiated with a NEPA scoping session that was conducted as part of the Norfolk Harbor and Channels and Elizabeth River and Southern Branch of the Elizabeth River Problems, Opportunities, and

Constraints Workshop on July 21, 2015. Coordination with pertinent Federal and state agencies, including but not limited to the Virginia Department of Conservation and Recreation (DCR), USFWS, NMFS, Virginia Department of Game and Inland Fisheries (VDGIF), Virginia Marine Resources Commission (VMRC), Virginia Department of Environmental Quality (VDEQ), as well as local non-profits such as the Chesapeake Bay Foundation and the Elizabeth River Project occurred during the workshop.

- On July 15, 2015 a coordination meeting was held with VDEQ to discuss water quality impacts associated with the project and discuss the scope of work and goals of the proposed hydrologic and water quality modeling.
- On September 22, 2015, a Notice of Intent to publish an Environmental Assessment was published, along with information on a NEPA public scoping meeting on September 25, 2015 open to the public. A Federal Register Notice was also published to announce the initiation of the feasibility study and also the public NEPA scoping meeting.
- An open house NEPA scoping meeting was held on September 25, 2015; no public comments were submitted at the meeting.
- A coordination meeting with the Virginia State Historic Preservation Officer (SHPO) was held on May 9, 2016 to discuss the proposed Section 106 consultation and the feasibility of preparing a Programmatic Agreement.
- On August 8, 2016 the USACE invited the Catawba Nation, the Delaware Nation, the Delaware Tribe, Narragansett Indian Tribe, the Pamunkey Tribe, and the Shinnecock Indian Nation to consult on cultural resources and the development of a Programmatic Agreement as concurring parties. The Catawba Nation and Delaware tribe responded that they were not interested in consulting on this project, and the other tribes did not respond.
- The cities of Chesapeake, Norfolk, and Portsmouth were invited to consult on Section 106 compliance and in the development of a Programmatic Agreement and either declined or did not respond.
- On August 16, 2016 a coordination meeting was conducted with the VMRC. The USACE provided an overview of the harbor deepening project, anticipated impacts to benthic resources, and the permitting pathway with the VDEQ. The USACE noted during the meeting that environmental mitigation for impacts to benthic resources is not anticipated.
- On August 22, 2016 an Endangered Species Act, Section 7 coordination meeting was conducted with the USFWS and NMFS. The USACE provided an overview of the harbor deepening project, anticipated impacts to Federally listed species and the USFWS and NMFS concurred with the species lists, draft affect determinations, and proposed consultation pathway (formal consultation will be conducted).
- Cooperating agency invitations were sent on May 22, 2017 to the U.S. Environmental Protection Agency, the U.S. Navy, the U.S. Fish and Wildlife Service, the U.S. Coast Guard, National Oceanic and Atmospheric Administration. The U.S. EPA and the NOAA accepted to be cooperating agencies.
- A Programmatic Agreement between the USACE and the SHPO was signed in 2017. The Virginia Port Authority (VPA) also signed the Programmatic Agreement as an Invited Signatory and the Naval History and Heritage Command also signed the Programmatic Agreement as a Concurring Party.

- The USACE has requested the USFWS to prepare a Fish and Wildlife Coordination Act in 2017. Preparation of the report is underway by the USFWS.
- In accordance with Section 7 of the Endangered Species Act, the USACE has prepared a Biological Assessment that has been submitted to the NMFS and the USFWS to ensure their concurrence with our affect determinations. Consultation with the USFWS and the NMFS is still ongoing.
- In accordance with the Magnuson-Stevens Fishery Conservation and Management Act, the USACE has prepared an Essential Fish Habitat Assessment and coordination with the NMFS ongoing.

1.10 REPORT ORGANIZATION

This integrated GRR/EA serves as the USACE decision support document for the recommended navigation improvements and as the EA to meet NEPA requirements for the proposed action. It is also formatted to facilitate review and processing by the Assistant Secretary of the Army for Civil Works [ASA(CW)] to provide a report with recommendations to Congress. The remainder of the report is organized as follows.

Section 2: Existing Navigation Features and Economic and Environmental Conditions

Section 3: Future Without Project Economic and Navigation Feature Conditions

Section 4: Plan Formulation

Section 5: Draft Recommended Plan/Proposed Action

Section 6: Affected Environment and Environmental Consequences

Section 7: Summary of Proposed Management Actions

Section 8: Environmental Compliance

Section 9: List of Agencies and Persons Consulted

Section 10: Recommendations

Section 11: Draft Finding of No Significant Impact

Section 12: References

Appendices

2 EXISTING NAVIGATION FEATURES AND ECONOMIC AND ENVIRONMENTAL CONDITIONS

This section presents the existing navigation features, economic conditions, and the physical and natural environment of the Southern Branch waterway, all of which are consistent with the National Environmental Policy Act (NEPA) regulations.

2.1 GENERAL SETTING

The parts of the Elizabeth River and Southern Branch that are being considered for deepening are located within or adjacent to the cities of Norfolk, Portsmouth, and Chesapeake. These cities had a combined population of 560,547 as of 2009 (U.S. Census, 2010), which is a 5 percent increase since 2000. Most of the increase has occurred in the City of Chesapeake with a small increase in Norfolk and a small decline in Portsmouth.

The three major basic industries in the Hampton Roads economy are the military, the port facilities, and tourism. The military employs about 10 percent of the region's workers with the majority of these working for or serving in the U.S. Navy (Hampton Roads Planning District Commission). Because of the large Navy presence, there is a significant shipbuilding and repair industry in the region, with several facilities located along the Elizabeth River. The Hampton Roads harbor, which is naturally deep and large, is one of the major container cargo harbors on the east coast. Employment in the tourism industry, which is centered in Virginia Beach, has slowed since 2007 because of the downturn in the overall economy and increasing fuel prices.

Land use along the Southern Branch is primarily industrial and military with facilities located along the river that support shipping, waterborne commerce, and defense. There are various shipyards, which repair both private and military vessels, with the Norfolk Naval Shipyard being one of the largest. Other facilities located along the river are associated with shipping commodities such as soy beans, wheat, barley, fertilizer, Portland cement, petroleum gas, scrap metal, limestone, fuels, wood pellets and gypsum. In 2015, 8.1 million tons of cargo, foreign and domestic, moved through the Southern Branch. Along the shore of the Elizabeth River in downtown Norfolk and Portsmouth are hotels, marinas, and corporate offices.

The Southern Branch has had a long history of maritime activity, based on historical records (Tidewater Atlantic Research, 2009). There were settlements along the river since the seventeenth century. The first wave of growth was stimulated by the tobacco industry, which was followed by the development of port and shipbuilding facilities in Norfolk and Portsmouth. The Elizabeth River's commercial potential expanded during the nineteenth century with the development of Norfolk Naval Shipyard (in Portsmouth), Dismal Swamp Canal, steamships, and numerous railroads connecting the area with central and western parts of the state. Because of the river's long history of settlement and use, there is a potential for archaeological resources along the banks and in the river itself.

2.2 EXISTING NAVIGATION FEATURES

2.2.1 Bridges and Tunnels

There are numerous bridges that cross the study area. Some of these bridges are owned and operated by the city of Chesapeake and others by Norfolk Southern Railroad. The majority of

the bridges open on demand, except during high vehicle traffic time periods. Two bridges in the Middle Reach include the Norfolk and Portsmouth Railroad Bridge and the Jordan Bridge. The Norfolk and Portsmouth Railroad Bridge has a navigation elevation of 142 feet and a width of 300 feet, while the Jordan Bridge, replaced in 2012, has a navigation elevation of 145 feet and a width of 225 feet. The bridge located at the beginning of Upper Reach A is the Norfolk Southern Railroad Bridge at Paradise Creek (navigation elevation 135 feet and width of 220 feet). Two bridges located in Upper Reach B include the Gilmerton Bridge (navigation elevation of 136.9 feet and width of 220 feet) and the Norfolk Southern Railroad Bridge at Military Highway (unlimited navigational elevation and width of 125 feet). The High Rise Bridge at Interstate 64 is located in Upper Reach C.

There are two vehicular-traffic tunnels that pass under the Elizabeth River within the study area. Both tunnels connect the Cities of Norfolk and Portsmouth. The Downtown Tunnel passes under the Southern Branch of the Elizabeth River in conjunction with Interstate Highway 264. The two-lane tunnel was completed in 1952 and a second, parallel two-lane tunnel was completed in 1987. The Midtown Tunnel passes under the Main Branch of the Elizabeth River in conjunction with U.S. Highway 58. The two-lane tunnel was completed in 1962 and a second, parallel two-lane tunnel was completed in 1989. The depths to which the Downtown and Midtown Tunnels were constructed would not likely be a factor in any possible future deepening of the Federal navigation channel.

2.2.2 Channels and Turning Basins

The existing channel reaches for the Southern Branch Project were presented in Section 1.7--Existing Southern Branch Project. The existing turning basins are: (1) the turning basin opposite the Naval Shipyard; (2) the Money Point Turning Basin; (3) the Newton Creek Turning Basin; and (4) the Mains Creek Turning Basin.

2.3 Terminal Facilities

The channel reaches for the Southern Branch Project are heavily industrialized, providing marine access to numerous industrial facilities and Norfolk Naval Shipyard (NNSY). The following lists the active terminals and maritime facilities located on the channel reaches. Note that there are no currently active terminals along Upper Channel Reaches B, although the reach does include the site of a former coal fired Dominion Generation Corporation power generation facility.

Port Facilities/Terminal Operators adjacent to the Southern Branch of the Elizabeth River Lower Reach include:

- Tidewater yacht marine: marina and boatyard;
- Ocean Marine Yacht Center: Marina and boatyard;
- BAE Systems – Norfolk Ship Repair: Naval shipyard;
- General Dynamics: Naval shipyard;
- U.S. Gypsum: Aggregates, sand, stone;
- Arc Terminal: Petroleum products;
- Kerneos Aluminate Technologies: high alumina cement production; and
- Norfolk Naval Shipyard: Naval shipyard and Navy Base.
- Apex Oil Terminal: Petroleum products;

- Perdue Farms: Grains, Liquid bulk food products;
- Enviva Wood Pellet Terminal: Wood pellets;
- Hess Oil: Petroleum products;
- Kinder Morgan Money Point Terminal: Aggregates, sand, stone;
- DCP Midstream Propane Terminal: Propane and other natural gas liquids;
- Elizabeth River Recycling: Scrap metal;
- Precon Marine: Heavy marine construction and waterfront construction contractor; and
- Tri-port Fuel Pier.

Analysis of the data returned over 80 different terminal locations (some active, some inactive). These were aggregated into the 27 terminals shown in the following table (Table 2-1).

Table 2-1. Dock Aggregation

Dock	Channel	Planning Segment	Commodities
LAMBERT POINT DOCKS	Lambert Bend to Pinner Point	ERSB-Segment-1	Dry-Bulk Grains, Barge Aggregates, Dry-Bulk Fertilizers, Ores & Minerals, Wood Pellets, Lards Fats & Oils, Liquid Bulk Chemicals, Petroleum, General Cargo, Passenger Cruises
PINNERS POINT DOCKS	Pinners Point to Town Point Reach		
CRUISE TERMINAL	Town Point Reach		
TOWN POINT REACH DOCKS			
EAST BRANCH DOCKS			
US GYPSUM	Southern Branch - Lower Reach		
BERKLEY DOCKS			
ELMSLEY DOCKS			
TRANSMONTAIGNE			
ARC TERMINALS			
JORDAN BRIDGE DOCKS	Southern Branch - Middle Reach		
PERDUE FARMS TERMINAL			
APEX TERMINAL			
PARADISE POINT DOCKS			
ENVIVA TERMINAL			
KINDER MORGAN SOUTH HILL TERMINAL	N&W Railway Lift Bridge Reach	ERSB-Segment-2	Liquid Bulk Petroleum Products, Dry & Liquid Bulk Chemicals, Ores & Minerals, Liquid Bulk Fertilizers, LPG,
BUCKEYE-HESS TERMINAL	Gilmerton Bridge Reach		
KINDER MORGAN SOUTHEAST TERMINAL			

Dock	Channel	Planning Segment	Commodities
MONEY POINT DOCKS			Aggregates, General Cargo, Scrap Iron
SOUTHERN AGGREGATES			
MILLDAM CREEK DOCKS			
KINDER MORGAN ELIZABETH RIVER TERMINAL			
SOUTHERN STATES			
RECYCLING TERMINAL			
TRIPORT TERMINAL	Gilmerton Bridge Reach to End of Newton Creek Turning Basin	ERSB-Segment-3	Petroleum, Fertilizers, Chemicals, Aggregates
NEWTON CREEK DOCKS	End of Newton Creek Turning Basin to Upstream Limit		
TERMINUS DOCKS			

2.4 EXISTING ECONOMIC CONDITIONS

The immediate area surrounding the ERSB and Norfolk Harbor includes the U.S. Census Bureau's Virginia Beach-Norfolk-Newport News, VA-NC Metropolitan Statistical Area (MSA) (Figure 2-1). The MSA is made up of the cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach and Williamsburg; the Virginia Counties of Gloucester, Isle of Wight, James City, Southampton, and York; and the North Carolina Counties of Currituck and Gates[1]. The U.S. Census Bureau's 2010 Census reported that the population of the Virginia Beach-Norfolk-Newport News, VA-NC MSA was 1,671,6832.

[1] Hampton Roads Planning District Commission (HRPDC). 2013. Hampton Roads MSA: Analysis of Recent Delineation. Retrieved from: http://www.hrpdcva.gov/news/article/march/25/2013/hampton-roads-msa-:-analysis-of-recent-delineation/.
[2] U.S. Census Bureau. 2010. 2010 Census Data. Retrieved from: http://www.census.gov/2010census/data/

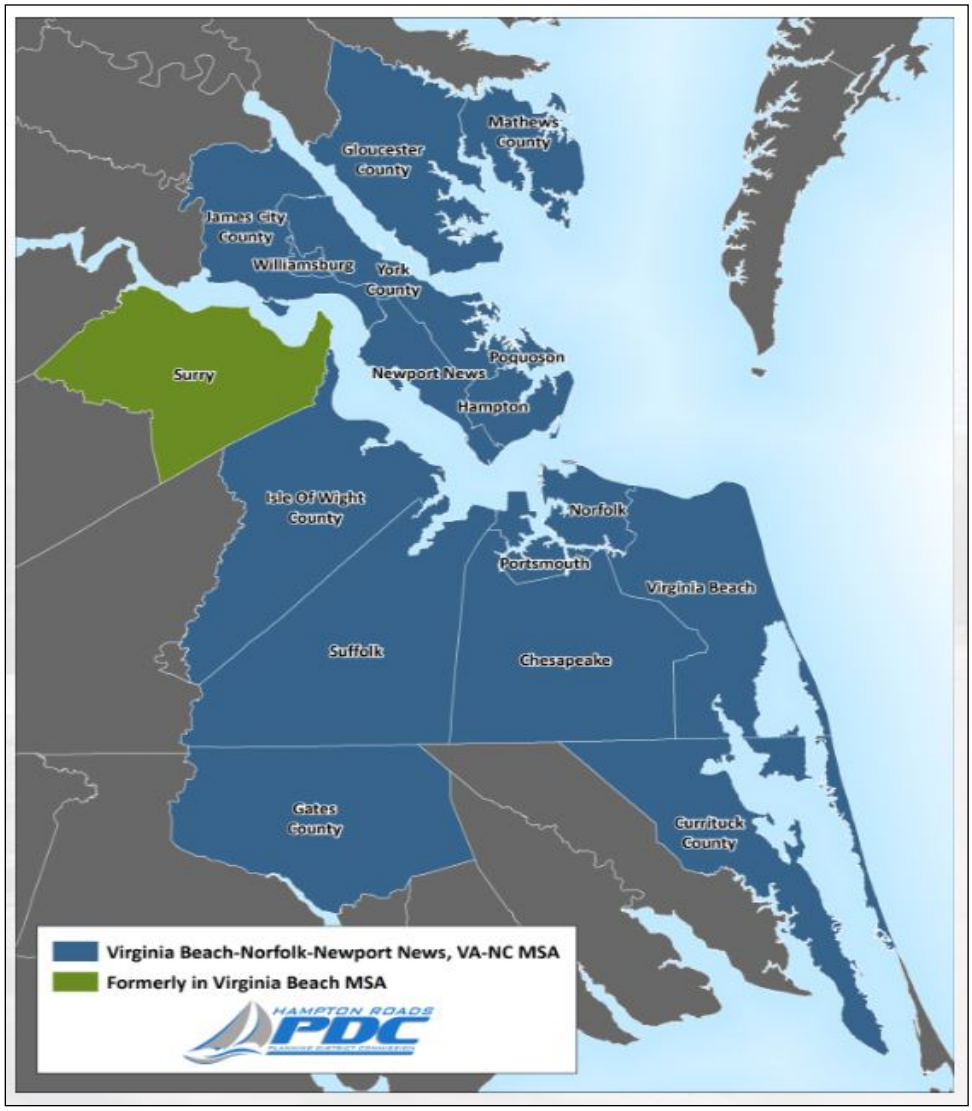


Figure 2-1. Virginia Beach-Norfolk-Newport News, VA-NC MSA

The following table (Table 2-2) compares the population data from the 2000 and 2010 census and calculates the percent change for each of the municipal boundaries that were within the Hampton Roads MSA at the time the respective census was taken.

Table 2-2. Virginia Beach-Norfolk-Newport News, VA-NC MSA Population

MSA Component	2000 Census	2010 Census	Percent Change
Virginia Cities			
Chesapeake	199,184	222,209	11.6
Hampton	138,437	137,436	-0.7
Newport News	180,150	180,719	0.3
Norfolk	234,403	242,803	3.6
Poquoson	11,566	12,150	5.1

MSA Component	2000 Census	2010 Census	Percent Change
Portsmouth	100,565	95,535	-5.0
Suffolk	63,677	84,585	32.8
Virginia Beach	425,257	437,994	3
Williamsburg	11,998	14,068	17.3
Counties			
Currituck Co., NC	18,190	23,547	29.5
Gates Co., NC	10,516	12,197	16
Gloucester Co., VA	34,780	36,858	6
Isle of Wight Co., VA	29,728	35,270	18.6
James City Co., VA	48,102	67,009	39.3
Surry Co., VA	6,829	7,058	3.4
York Co., VA	56,297	65,464	16.3
Total MSA Population	**1,569,679**	**1,674,902**	**6.7**

The Norfolk Harbor Channels Project supports transport of goods to/from the Mid-Atlantic, Appalachian, and Midwest regions of the United States. For example, grains, a major export from the ERSB, come primarily from the Midwest. The marine terminals at Norfolk Harbor are well served by a network of highways and rail that connect the terminals to their hinterland. Interstate Highway 64 and U.S. Highway 58 are the main highways in the harbor area, with branch routes in all directions via Interstate Highways 264, 464, 564, and 664. State Highway 58 connects directly with Interstate Highways 95 and 85 providing north-south corridor access. The Norfolk and Portsmouth Belt Line Rail Road (NPBLRR) services terminals along the ERSB, including Kinder Morgan's Elizabeth River, VA terminal.3 NPBLRR has connections to Norfolk Southern and CSX rail lines for broader access geographically. Norfolk Southern and CSX service extends from the Norfolk area to the southeastern, Midwestern, and northeastern U.S.

2.5 Port Operations

The Elizabeth River 45-foot and the Southern Branch of the Elizabeth River 40-foot Channel Project is the Norfolk Harbor and Channels authorized project separable project element under consideration and is one of five port priorities identified at the Virginia Maritime Association's Annual Navigation Summit. The Elizabeth River Channel, which is authorized to a depth of 45 feet, extends from Lamberts Point on the main branch of the Elizabeth River to the Norfolk and Southern Railroad Bridge on the Southern Branch of the Elizabeth River, a distance of 6 miles. This Federal navigation channel is currently maintained at a depth of 40 feet over channel widths of 750, 450, and 375 feet. The reach of the Southern Branch of the Elizabeth River Channel, which is authorized to a depth of 40 feet, extends from the Norfolk and Southern Railroad Bridge to the Gilmerton Bridge, a distance of 2.4 miles. This Federal navigation channel is currently maintained at a depth of 35 feet over channel widths of 250 to 500 feet.

[3] Kinder Morgan Terminals, Elizabeth River, VA Terminal. Retrieved from: https://www.kindermorgan.com/content/docs/terminalbrochures/ma_elizabethriver.pdf; http://www.npblrr.com/wp-content/uploads/2013/11/map.jpg.

The reach of the Southern Branch of the Elizabeth River Channel extending from the Gilmerton Bridge to the Chesapeake Extension is authorized to a depth of 35 feet for a length of 2.1 miles. The current depth of this reach is 35 feet.

2.5.1 Southern Branch Historical Cargo Volumes

The following table lists the commodities and associated tonnages passing through the ERSB on an annual basis from 2009 through 2013 (Table 2-3). The historical data was then used to derive representative 2015 tonnages by commodity type. Table 2-4 shows the breakdown of commodities by percentage export versus percentage import tonnage. The commodity category with the most estimated throughput in 2015 is Dry-Bulk Grains, which makes up around 34% of the total baseline (2015) tonnage passing through the ERSB docks. The majority of the Dry-Bulk Grains tonnage is attributable to exports.

Table 2-3. Existing Condition Commodity Throughput

Commodity Name	2009	2010	2011	2012	2013	2015*
Dry-Bulk Grains	2,546,536	2,563,175	3,096,279	3,005,957	2,710,364	2,788,735
Dry-Bulk Fertilizers	855,154	674,613	621,192	553,571	611,137	642,163
Dry-Bulk Aggregates	161,202	223,382	180,086	128,401	180,101	177,360
Barge Aggregates	1,325,588	1,086,394	1,018,500	1,081,005	1,288,525	1,123,198
Dry-Bulk Chemicals	58,967	317,080	216,441	265,239	186,886	212,682
Ores & Minerals	102,634	106,255	77,167	111,286	54,606	96,512
Lards Fats & Oils	159,002	177,896	172,901	160,005	72,344	154,217
Liquid-Bulk Petroleum	240,263	181,542	509,113	160,889	139,321	213,884
Barge Petroleum	1,267,037	1,251,226	1,013,621	724,401	755,108	1,007,950
Liquid-Bulk Fertilizers	218,714	397,538	412,912	412,015	297,682	372,655
Liquid-Bulk Chemicals	159,840	115,734	136,677	202,052	192,256	160,576
LPG/LNG	102,780	106,171	114,130	34,978		137,534
Scrap Iron	214,379	417,211	472,451	435,323	262,896	388,832
Wood Pellets			28,080	231,300	409,934	409,934
General Cargo	199,142	125,718	128,645	268,473	137,596	154,755
Passengers	49,618	51,924	32,702	44,866	50,142	47,734
Coal	1,364,454	1,054,933	1,114,334	32,528		-
Total Units	**9,025,310**	**8,850,792**	**9,345,231**	**7,852,289**	**7,348,898**	**8,088,720**

Coal transits were excluded from the FWOP condition. Based on the data available, coal transits to the Chesapeake Energy Center were discontinued.

Table 2-4. Commodity Imports vs. Exports

Commodity Name	Exports	Imports
Dry-Bulk Grains	69%	31%
Barge Aggregates	4%	96%
Barge Petroleum	50%	50%
Coal	3%	97%
Dry-Bulk Fertilizers	55%	45%
Scrap Iron	99%	1%
Liquid-Bulk Fertilizers	0%	100%
Liquid-Bulk Petroleum	13%	87%
Dry-Bulk Chemicals	4%	96%
Dry-Bulk Aggregates	3%	97%
General Cargo	53%	47%
Liquid-Bulk Chemicals	34%	66%
Lards, Fats, & Oils	100%	0%
Wood Pellets	100%	0%
Ores & Minerals	7%	93%
LPG/LNG	0%	100%

2.5.2 Existing Cargo Traffic Characterization (Vessel Calls)

In addition to serving as the basis for identifying vessel dimensions and for dividing vessels into classes based on these dimensions, historical call data (2009-2014) was used to identify the number of calls by vessel class to ERSB docks (Table 2-5). Data on the number of calls for 2009-2014 for each vessel class was used to come up with a representative number of existing condition calls for 2015. The 2015 number of calls serves as the base condition for calibration of the economic model and thus as the baseline for the economic analysis. Note that nearly 90% of the 2015 calls are by just three vessels classes, 10K DWT Tank Barges, 10K DWT Dry Barges, and Misc. vessels. This is important because it means that the large majority of vessel calls to ERSB contribute to harbor traffic but do not stand to benefit from any potential future channel deepening.

Table 2-5. Existing Condition Vessel Calls

Vessel Class Name	2009	2010	2011	2012	2013	2014	2015*
10K DWT Bulker	8	6	14	10	6	2	8
20K DWT Bulker	20	36	21	9	10	13	18
30K DWT Bulker	48	43	47	51	51	50	49
40K DWT Bulker	21	15	36	10	11	23	19
50K DWT Bulker	10	12	9	12	9	10	10
60K DWT Bulker	4	6	11	18	25	26	15
70K DWT Bulker	7	3	7	5	5	2	5
80K DWT Bulker	1	1	3	5		5	3
90K DWT Bulker			1			1	1
10K DWT Tanker	14	21	17	9	16	12	15
20K DWT Tanker	7	12	15	15	14	25	15
30K DWT Tanker	3	6	11	6	7	2	6
40K DWT Tanker	12	13	9	9	12	7	11
50K DWT Tanker	6	11	15	8	6	11	10
60K DWT Tanker	1		5	8	1	1	2
70K DWT Tanker	16	9	8	4	3	3	7
80K DWT Tanker		1		1			1
100K DWT Tanker		1					1
200K DWT Tanker					1		1
10K DWT Gas Carrier						3	3
20K DWT Gas Carrier				1	1		1
40K DWT Gas Carrier	5	3	5	2			4
60K DWT Gas Carrier		1					1
80K DWT Gas Carrier						1	1
10K DWT Tank Barge	1013	994	956	968	953	977	975
20K DWT Tank Barge	17	16	14	6	17	14	15
30K DWT Tank Barge			3	1	1	2	2
40K DWT Tank Barge	16	7	9	2	1	7	7
10K DWT Dry Barge	1101	1204	1055	968	1303	1101	1112
20K DWT Dry Barge	34	38	37	42	27	37	37
10K DWT Gen Cargo	84	75	89	80	47	50	75
20K DWT Gen Cargo	7	15	12	14	13	8	13
30K DWT Gen Cargo		6	2	11	13	8	8

Vessel Class Name	2009	2010	2011	2012	2013	2014	2015*
40K DWT Gen Cargo	3	1	7	1	2	1	3
50K DWT Gen Cargo	1				1		1
1K Passenger	4	6	5	3	7	5	5
2K Passenger	8	9		3	1		6
3K Passenger	1	1	2	3	1	4	2
4K Passenger	7	7	7	8	12		8
Navy Ships	12	5	10	7	6	1	7
Misc.	1342	1213	1391	1470	1246	1342	1338
Total	**3833**	**3797**	**3833**	**3770**	**3829**	**3754**	**3821**

2.5.3 Existing Cargo Fleet

Vessel Types were defined by the type of cargo moved and the overall vessel structure. Vessel Type and Class were identified for each unique vessel calling ERSB over the period from 2009 through 2013.

Vessel Types defined in the study include those displayed in the following table (Table 2-6). The "Classification" column states the vessel characteristic used to classify ships of a given type into different Vessel Classes in HarborSym. See Economics Appendix B ("Vessels" section) for more details on vessels dimensions.

Table 2-6. Vessel Types

Vessel Type	Classification
10K-30K DWT Bulker	Capacity
40K-70K DWT Bulker	Capacity
Capesize Bulker	Capacity
Tanker	Capacity
Gas Carrier	Capacity
General Cargo Ship	Capacity
Cruise Ship	Capacity
Tanker Barge	Capacity
Dry Cargo Barge	Capacity
Navy Vessel	Beam

The economic model incorporates those vessels that are currently calling at the ERSB. It is not anticipated that a fleet transition will occur for the Elizabeth River Southern Branch. Instead, as the channel gets deeper, the utilization of the channel will increase with the transfer of cargo from smaller to larger vessels in the existing fleet. In this way, calls by smaller vessels are eliminated and larger vessels are able to utilize capacity that cannot currently be used given the existing channel depth. The FWOP and FWP conditions incorporate those vessels currently calling the ERSB channel.

2.6 AFFECTED ENVIRONMENT

This Section 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 National Environmental Policy Act of 1969, as amended (NEPA) and the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations (CFR) 1500-1508), regulations. This section summarizes the existing conditions (baseline) conditions, to provide a sound basis for plan formulation as described in Section 4 and the impact analysis that is provided in Section 6. The existing conditions are used as the baseline to forecast the changes that would be expected to without USACE action to address inefficiencies in the Federal navigation system. The topics in this section are structured to mirror the topics presented in Section 6: Environmental Consequences, where the "future without project" and "future with project" alternatives are evaluated and compared. For both existing and future either with or without implementation of an action alternative, dredged material placement/disposal could occur at the CIDMMA and approved upland disposal facilities (as needed). Any dredged material not meeting CIDMMA placement requirements would be required to be disposed of at an approved, upland disposal facility. Utilities are not discussed in this chapter because there are no anticipated potential effects to utilities and this topic is dismissed from further consideration.

2.6.1 Geology, Physiography, and Topography

The ROI includes areas transited by dredging vessels/equipment and areas of navigation channel dredged, and dredged material placement placement/disposal sites that would include the Craney Island Dredge Material Management Area (CIDMMA) and upland disposal sites.

The ROI is located within the lowland sub-province of the Virginia Coastal Plain Physiographic Province (Figure 2-2). The topography of the Coastal Plain is a terraced landscape that stair-steps down to the coast and to the major rivers. The coastal lowland sub-province is a low-relief region along the major rivers and surrounding the Chesapeake Bay, at topographic elevations between zero and 60 feet above mean sea level.

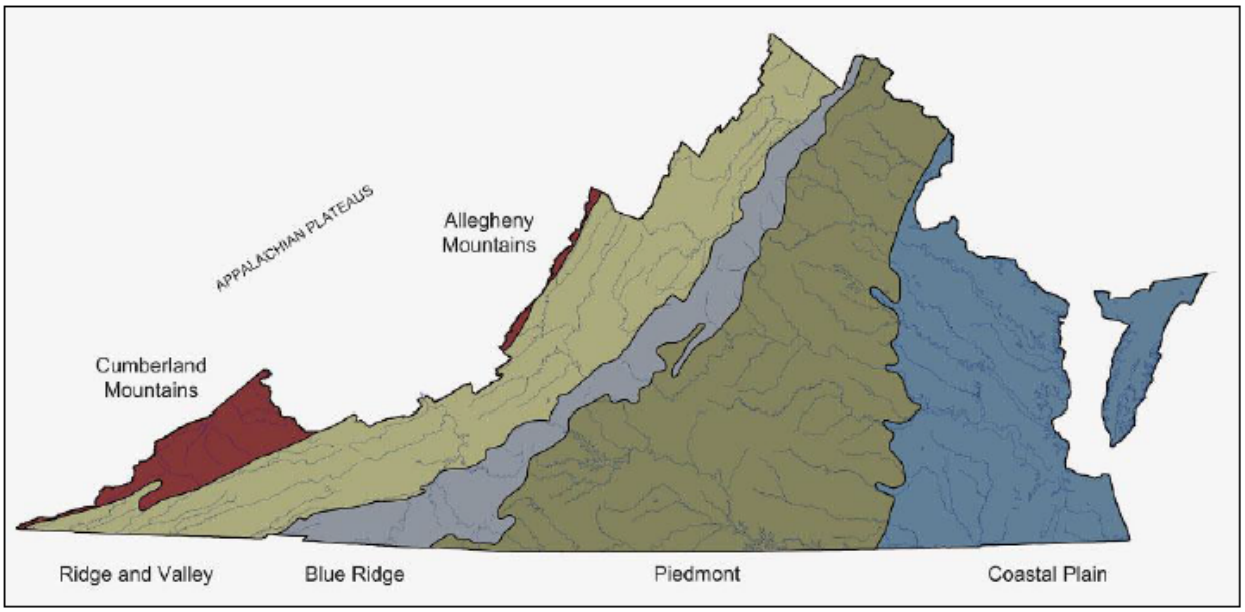


Figure 2-2. Physiographic Map of Virginia (Virginia Department of Conservation and Recreation 2016a)

The Virginia Coastal Plain Physiographic Province extends from the Fall Zone, which passes through Richmond, Virginia, approximately 100 miles eastward to the Atlantic Ocean. The "Fall Line" or "Fall Zone" is the transitional zone where the softer, less consolidated sedimentary rock of the Atlantic Coastal Plain to the east intersects the harder, more resilient metamorphic rock to the west, forming an area of ridges, waterfalls, and rapids (Frye 1986). Large rivers that originate west of the fall line cascade off the resistant igneous and metamorphic rocks of the Piedmont, eastward across the Coastal Plain, to sea level, emptying into the Chesapeake Bay and the Atlantic Ocean. The Chesapeake Bay, Hampton Roads and the Elizabeth River estuaries were created about 5,000-6,000 years ago when melting glaciers caused sea levels to rise approximately 400 feet and inundated the continental shelf. (College of William and Mary 2006).

The Virginia Coastal Plain is underlain by a thick wedge of sediments that increases in thickness from very thin near the Fall Zone, approximately 100 miles to the west, to more than 13,000 feet thick, under the continental shelf in the Atlantic Ocean. This wedge rests on an eroded surface of Precambrian to early Mesozoic rock.

The landforms surrounding the project area are comprised primarily of geologically recent (Pleistocene and Holocene) sediments, primarily fine sands, silts, with small amounts of small gravel (College of William and Mary 2006). The subaqueous terrain of the project area is of similar material, with sand, fine sand, shell, mud, with some pebbles or gravel that were deposited during interglacial periods under conditions similar to those that exist in the modern Chesapeake Bay and its tidal tributaries (College of William and Mary 2006).

Earthquakes of significant magnitude are unlikely occurrences for the Hampton Roads region (Hampton Roads Planning District Commission 2011). The Virginia Department of Emergency Management has identified no significant earthquakes within in the most recent 200 years in eastern Virginia (Commonwealth of Virginia 2013). The risk of seismic events affecting the navigation channels in the project area is sufficiently low; therefore, the U.S. Navy excluded

seismic loading in their analyses of the stability of side slopes as part of the 2009 Final Environmental Impact Statement for the dredging of Norfolk Harbor Channel and the Elizabeth River (U.S. Department of the Navy 2009).

The CIDMMA is located near the northern limits of the project. It was once the natural landform of Craney Island but was transformed into a manmade upland dredge material disposal site. The CIDMMA has been in continuous use since 1957, serving the navigation dredging needs of the Norfolk Harbor. The 2,500-acre area was originally designed for a life span of 20 years, with a capacity of 96 million cubic yards (mcy). However, as a result of modifications that USACE has made to the site, CIDMMA has been able to accept over 268 mcy of material to-date. Frequent placement and subsequent consolidation results in varying topography throughout the site. The existing dikes that contain dredged material have elevations ranging from 36 feet to 40 feet, but based on analysis of dike stability, dikes could be raised to 50 feet (USACE 2005).

Dredged material unsuitable for CIDMMA will likely be dewatered in accordance with Federal and state water quality requirements, and transported to a permitted, upland disposal facility.

2.7 Bathymetry, Hydrology, and Tidal Processes

2.7.1 Surface Water Hydrology

The Elizabeth River is approximately 20 miles long with a drainage basin over 270 square miles within southeastern Virginia including the cities of Chesapeake, Norfolk, Portsmouth, and Virginia Beach (VA State Water Control Board 1988) (See Figures 1-3, 1-4, and 1-5 in Section1.0). The major tributaries of the Elizabeth River are the Lafayette River, the Western, Southern, and Eastern Branches, and the main stem which empties into the confluence of the James River and the Chesapeake Bay (VA State Water Control Board 1988). Because the entire drainage basin for the Elizabeth River lies very close to the Atlantic Ocean and entirely within the Coastal Plain provinces, the topographic relief is slight with a maximum natural elevation of approximately 25 feet above mean sea level (VIMS 1975).

The Elizabeth River and Southern Branch of the Elizabeth River are part of the USACE's Atlantic Intracoastal Waterway system and do not have a defined upland watershed terminus typical of most estuaries due to canals connecting it to other watersheds. At the head of the Southern Branch, the waterway bifurcates--as shown in Figure 2-3--hydrologically connecting the surface water of the Elizabeth River to the Currituck and Albemarle Sounds via two separate inland routes.

Figure 2-3. Atlantic Intracoastal Waterway

The eastern route is through the Albemarle and Chesapeake Canal, down the North Landing River and into Currituck Sound. The locks at Great Bridge control the flow of water and mark the point where the two water bodies meet. Because both halves of the waterway are tidal, there is little to no net flow through the locks and the waterway does not contribute freshwater to the Elizabeth River system (VIMS 1975). However, because water level fluctuations in Currituck Sound are dominated by the wind speed and direction rather than the astronomical tides, it is possible to have a net flow if certain relationships exist between the tidal phases and amplitudes on the two sides of the locks producing a net flow into or out of the Elizabeth River system (VIMS 1975).

The western route follows the Dismal Swamp Canal connecting to the Albemarle Sound near Elizabeth City, North Carolina. From a hydraulic point of view, the Dismal Swamp represents the high point of this region and water flows away from Lake Drummond in nearly every direction. The flow to the Southern Branch of the Elizabeth River is controlled by the locks and spillway at Deep Creek. This flow of water is the only natural source of fresh water into the Elizabeth River (VIMS 1975) other than storm water.

Because the Elizabeth River has topographically low relief, a relatively small drainage area, and large areas of urban land use, groundwater flow into the river is minimal and there are substantial peak freshwater inflows during rainy periods (VIMS 1975). Thus the freshwater input from the tributaries is low during dry periods and has high peaks during wet periods (VIMS 1975).

2.7.2 Tidal Processes

On a flood tide, water from the Chesapeake Bay generally enters Hampton Roads across Hampton Flats and through Newport News Channel into the James River, with a lesser amount flowing into the Elizabeth River. On an ebb tide, water generally flows out of the James River through both the Newport News Channel and the area to the south of the Newport News Middle Ground, joining with the water flowing out of the Elizabeth River along the Norfolk Reach Channel (USACE 2007). The geometry of Hampton Roads results in tidal phasing that sets up circulation cells and a strong frontal system off of Newport News Point (USACE 2007). Salinity is also a major factor in these circulation patterns because higher salinities are found at depth, which sets up strong density gradients (USACE 2007).

The typical tidal range in the Elizabeth River and nearby waters of lower Chesapeake Bay is approximately 2.85 feet, 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. Hydrodynamic modeling for the proposed Craney Island Eastward Expansion (CIEE) predicted little change to local salinity and the hydrodynamics of the Elizabeth River (USACE 2007). When completed, the CIEE will result in the infilling of approximately 522 acres of open water near the mouth of the Elizabeth River along the southern shore of the lower James River.

2.7.3 Bathymetry

Where not bulkheaded, the Elizabeth River and Southern Branch of the Elizabeth River have intertidal shallows along the shorelines, but the bathymetry is a substantially modified environment as a result of the maintained navigation channel. The Region of Influence (ROI) for hydrology, bathymetry, and tidal processes for the proposed project is the Elizabeth River as defined, including the Elizabeth River and its confluence with the Lower James River, which matches the VIMS hydrodynamic model grid (Shen et al. 2017; Zhang et al. 2017). Modifications to the channel have the potential to affect the hydrodynamics of the most of the River, including its bathymetry, hydrology and tidal processes, as well as its confluence with the lower James River. The River has a long history of navigation dredging, beginning in the 1870s and continuing to the present, deepening over time as vessels calling on the port have increased in size and draft. Although each increment of dredging was relatively small, with 12 deepening events over time, the cumulative change over 100 years has been significant (Figure 2-4). Channel depth increased 1.8 to 2.4 fold, deeper towards the mouth of the river and more shallow as the channel extends upriver along the Southern Branch of the Elizabeth, channel length increased 2.6 fold, and volume increased 3.7 fold by then late 1980s (Nichols and Howard-Strobel 1991).

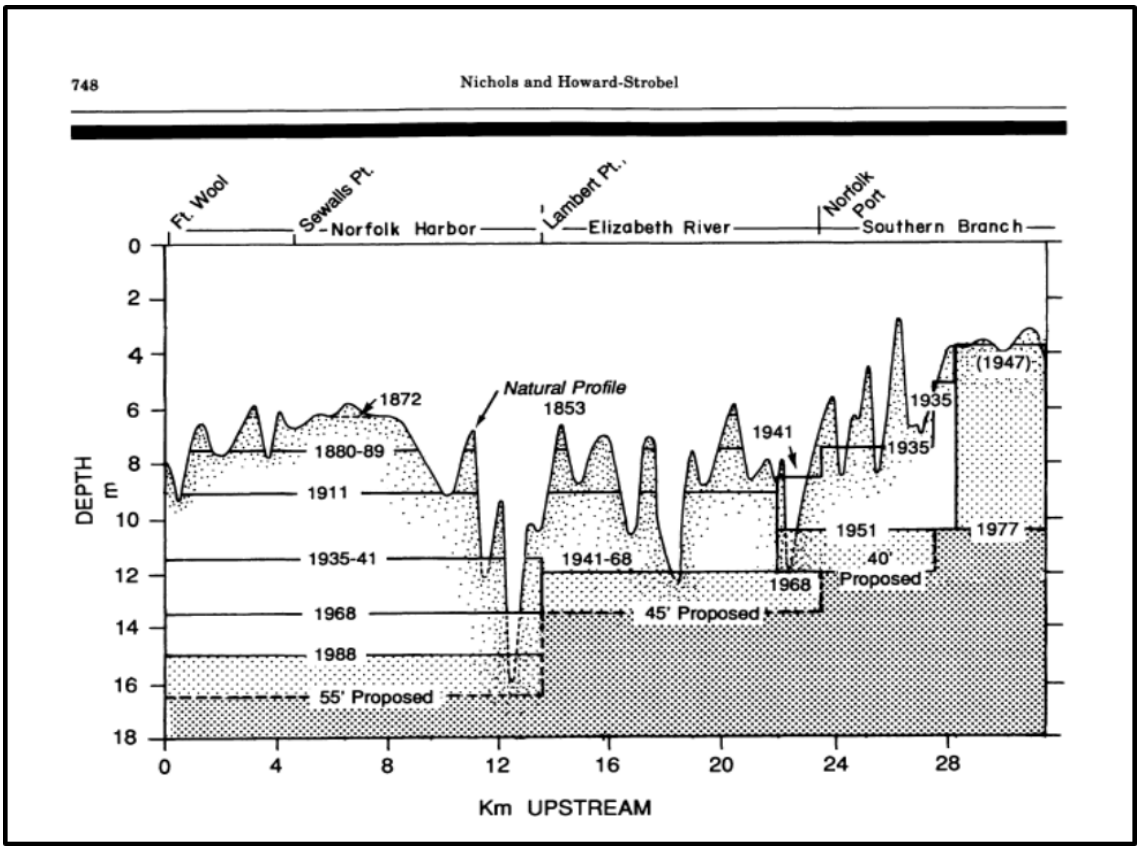


Figure 2-4. Schematic showing dredging history of the Elizabeth River (Nichols and Howard-Strobel 1991)

As shown in Figure 2-4, the Southern Branch component of the Federal navigation channel is contiguous with the Craney Island reach and extends from Lamberts Point on the main branch of the Elizabeth River to a point 0.8 mile upstream (south) of the Interstate 64 highway bridge on the Southern Branch of the Elizabeth River, ending at the Chesapeake Extension, a total length of 10.5 miles. Within these 10.5 miles are three authorized project depths: (1) The authorized 45-foot project depth in Segment 1, the (2) authorized 40-foot project depth in Segment 2, and (3) the authorized 35-foot project depth in Segment 3.

It is important to note that within the same footprint as the Norfolk Harbor and Channels project the U.S. Navy has deepened the channel to a depth of 47 feet from the Craney Island Reach of the Norfolk Harbor and Channels Project through Lamberts Bend and a depth of 47 feet from Lamberts Bend to the Norfolk Naval Shipyard at the southern end of the Southern Branch Lower Reach to meet U.S. Navy operational needs. Both of these reaches are maintained with three feet of overdredge (VIMS 2007) and cover a significant portion of Segment 1. The VIMS evaluation of the environmental consequences of the then-proposed changes in bathymetry for the Navy showed minimal impact on either surface elevation or salinity, and minor impacts on current velocity and sedimentation potential (VIMS 2007).

2.8 Hazardous, Toxic, and Radioactive Waste

The ROI includes the channel bottom sediments that could be affected by the modifications to the channel and any surrounding areas contributing potential contaminants. Dredged material placement as well as upland disposal site(s) are also included in the ROI as well as any potential dewatering sites for handling of contaminated dredged material. The dredged material placement sites would include the CIDMMA as well as potential upland disposal sites(s). Contaminated material that exceeds the acceptance criteria of CIDMMA is required to be disposed of at an approved upland disposal site(s). Potential upland disposal sites for contaminated material may include the following:

- Charles City County Landfill
- CFS, Tri-City Regional Landfill & Recycling Center
- John C. Holland Enterprises Landfill
- Southeastern Public Service Authority (SPSA) Regional Landfill
- Portsmouth City Craney Island Landfill
- Bethel Landfill
- King and Queen Sanitary Landfill

Additionally, the following soil processing services could include the following:

- Port Tobacco/Weanack Land, LLC (also can accept some dredged material)
- Clearfield MMG, Inc. Soil Recycling

The sediments that comprise this area consist mostly of clays and silts with some sand present.

Hazardous and/or toxic wastes, classified by the Resource Conservation and Recovery Act (RCRA), are materials that may pose a potential hazard to human health or the environment due to quantity, concentration, chemical characteristics, or physical characteristics. This applies to discarded or spent materials that are listed in 40 CFR 261.31-.34 and/or that exhibit one of the following characteristics: ignitable, corrosive, reactive, or toxic. Radioactive wastes are materials contaminated with radioactive isotopes from anthropogenic sources (e.g., generated by fission reactions) or naturally occurring radioactive materials (e.g., radon gas, uranium ore). There is no history of radioactive waste being deposited in the Elizabeth River, so our assessment will be focused on chemical constituents only.

A substantive number of geotechnical and environmental sediment sampling studies have been conducted in portions of the Elizabeth River, including the Southern Branch, and provide data on the type and extent of chemical contamination within portions of the sediment profile within the ROI. A report compiled by Fugro Consultants, Inc. (2016) summarized existing subsurface geotechnical and environmental data based on data from the Fugro Consultants, Inc. Hampton Roads Database and a literature search where they collected and synthesized additional bathymetry and geotechnical data. These data are from samples collected within and adjacent to the ROI and include results from both Federal and private investigations (Fugro Consultants, Inc. 2016). The Fugro Consultants, Inc. (2016) Report is provided in Appendix A. Data that was originally presented in the following reports was incorporated into the Fugro Consultants, Inc. (2016) Report:

- Anchor QEA and O'Brien & Gere. 2015. Technical memorandum: Money Point phase 3 sampling summary. Prepared for Elizabeth River project, dated January 2015. Logs dated October 2014.
- CDM Smith. 2012. Amendment 0002 to W91236-14-R-0019 for environmental dredging and dredged material handling at Atlantic Wood Industries Superfund Site, dated May 2012. Logs dated 2005.
- EA Engineering, Science and Technology. 2015. Evaluation of dredged material, Norfolk Harbor Federal Navigation project, Southern Branch of the Elizabeth River. Prepared for USACE, dated March 2015. Logs dated 2014.
- EA Engineering, Science and Technology. 2013. Dredged material sampling and testing – Enviva Terminal, Port of Chesapeake, Chesapeake Virginia. Prepared for Enviva Port of Chesapeake, LLC, dated June 2013.
- EA Engineering, Science and Technology. 2012. Amendment 0002 to W91236-14-R-0019 for environmental dredging and dredged material handling at Atlantic Wood Industries Superfund Site. Prepared for the USACE, dated May 2012. EA vibracore logs presented in this study dated 2008 and 2012.
- EA Engineering, Science and Technology. 2001. Final evaluation of dredged material, Norfolk Harbor Federal Navigation Project: Southern Branch of the Elizabeth River. Prepared for the USACE, dated March 2011. Logs dated 2010.
- Fugro Consultants. 2008. Geotechnical data report, Marine Drilling. In situ testing, and laboratory testing proposed Midtown Second Parallel Tunnel. Prepared for Virginia Department of Transportation, dated June 2008. Logs dated 2008.
- Haley & Aldrich. 2010. South Norfolk Jordan Bridge Site and subsurface exploration plan, dated July 2010. Logs dated 2010.
- Malcolm Pirnie. 2009. Craney Island Design Partners Elizabeth River Remediation Project: Appendix A Republic Site, dated March 2009. Logs dated 2008.
- Science Application International Corporation. 2007. Focused feasibility study for the offshore area at Money Point, Elizabeth River, Virginia, Volume I-Main. Prepared for the Elizabeth River Project, dated April 2007.
- U.S. Army Corps of Engineers, Norfolk District. 2011. Remedial design – Phase 1C offshore sheet pile containment wall, AWI Superfund Site Portsmouth, VA, dated April 2011. Logs dated 2010.
- U.S. Army Corps of Engineers, Norfolk District. 2009. Channel deepening, Norfolk Harbor Channel from Lamberts Bend on the main branch of the Elizabeth River Norfolk Naval Shipyard in the Southern Branch of the Elizabeth River, dated March 2009. Logs dated 2010.
- U.S. Army Corps of Engineers, Norfolk District. 1986. Geology and soils subsurface investigation Norfolk Harbor Channel, Norfolk Harbor Channels, dated May 1986. Logs dated 1983.
- Waterway Surveys & Engineering Ltd. 2015. Sediment sampling and laboratory test results, Seagate Terminals, Chesapeake Virginia. Prepared for Seagate Terminals.
- Waterway Survey & Engineering, Ltd. 1998. Evaluation of sediment test results for the Southern Branch, Norfolk Harbor Federal Navigation Project Norfolk Virginia. Prepared for the USACE, dated June 1998.

From these sources, a total of 352 analyses were identified to occur in the channel or in the vicinity of the channel and incorporated into the Fugro Consultants, Inc. Report (2016). This included 311 vibracores/gravity cores, 38 marine borings, and three cone penetrometer tests (Fugro Consultants, Inc. 2016). The following table summarizes the findings of the report regarding contaminants of concern within portions of the sediment profile in and in the vicinity of the ROI (Table 2-7).

Table 2-7. Summary of Sediment Data by Segment within and Adjacent to the Region of Influence.

Planning Segment	Reach	Measured Range			Exceedance Met[1]
		TPH (ppm) (minimum-maximum) median	PAH (ppm) (minimum-maximum) median	Metals	
Segment 1	Elizabeth River Reach	N/A	(2 – 7) 3	No	No
	Lower Reach	(42 – 448) 309	(1-114) 19	Yes	Yes
	Middle Reach[1]	(16-3,700) 820	(0 – 1,174)	Yes	Yes
Segment 2	Upper Channel Reach A	(25 – 5,907) 230	(0 – 7,707) 49	Yes	Yes
Segment 3	Upper Channel Reach B	(34-93) 68	(1-28) 5	Yes	No
	Upper Channel Reach C	N/A	(2-14) 10	No	No

N/A denotes No Data Available; TPH = Total Petroleum Hydrocarbons;
PAH = Polycyclic Aromatic Hydrocarbons; ppm = parts per million
[1] PAH exceedance value is 45 ppm; TPH exceedance value is 500 ppm.

2.8.1 History and Contaminants of Concern in the Elizabeth River

During the 19th and 20th centuries, the growth of human population, industrialization, naval activities, and shipping contributed to substantial pollution of this relatively poorly flushed estuary (Di Giulio and Clark 2015). Nutrients and bacteria largely associated with municipal effluents, pesticides in storm sewer runoff, heavy metals and polychlorinated biphenyls (PCB) from various industries, and creosote from wood treatment facilities are among the pollutants that generated the greatest concern (Di Giulio and Clark 2015). In a 1976 report required by the U.S. Environmental Protection Agency (USEPA) and the U.S. Congress, the Virginia State Water Control Board called the Elizabeth River one of the worst water pollution problems in Virginia (Virginia State Water Control Board 1976).

In addition to PCBs, other contaminants of concern in the sediments include Total Petroleum Hydrocarbons (TPH), and heavy metals such as arsenic, cadmium, chromium, lead, and mercury. Polychlorinated biphenyls are halogenated organic compounds that were once widely

used as insulating material in electrical transformers, heat transfer fluids, and in lubricants. The most common anthropogenic sources of localized heavy metal contamination in estuaries is industrial or residential effluents.

Wood treatment facilities along the Elizabeth River utilized creosote to preserve the wood and creosote is derived from the distillation of coal (Di Giulio and Clark 2015). The chemistry of coal-derived creosote is dominated by polycyclic aromatic hydrocarbons (PAH), which comprise the class of chemical contaminants that have been, and continue to be, of greatest contaminant of concern in the Elizabeth River (Di Giulio and Clark 2015). As cited by Di Giulio and Clark (2015), Bieri et al. (1986) was the first comprehensive analysis of PAH in the Elizabeth River system. This study measured PAH in sediment samples from 28 sites in the river, including sites from all three branches as well as the main stem downstream of the confluence of the branches. The highest PAH concentrations were observed near the wood treatment sites concluding that creosote spills from wood treatment facilities were the likely source of the PAH. As cited in Di Giulio and Clark (2015), two reports by Vogelbein and Unger (2008; 2003) to the Virginia Department of Environmental Quality provided data for sites in the Elizabeth River system, including the three branches, the Lafayette River, and sites proximate to former wood treatment facilities. The sample locations from the Vogelbein and Unger studies are provided in Figure 2-5. Overall, sediment data demonstrate continued highly elevated PAH concentrations near wood treatment facilities years to decades after cessation of plant operations with moderate to low levels reported in the Southern Branch downstream of the facilities, in the Western and Eastern Branches, and in the Lafayette River (Table 2-8; Vogelbein and Unger (2008; 2003) as cited in Di Giulio and Clark 2015). Generally low PAH concentrations were observed upstream of the wood treatment facilities in the Southern Branch (Table 2-8; Vogelbein and Unger (2008; 2003) as cited in Di Giulio and Clark 2015).

A large proportion of the river bottom sediments are sufficiently contaminated with chemical constituents, such that dredged sediments would likely need to be processed at a treatment facility (e.g., mixed with Portland cement) prior to disposal in an upland disposal site.

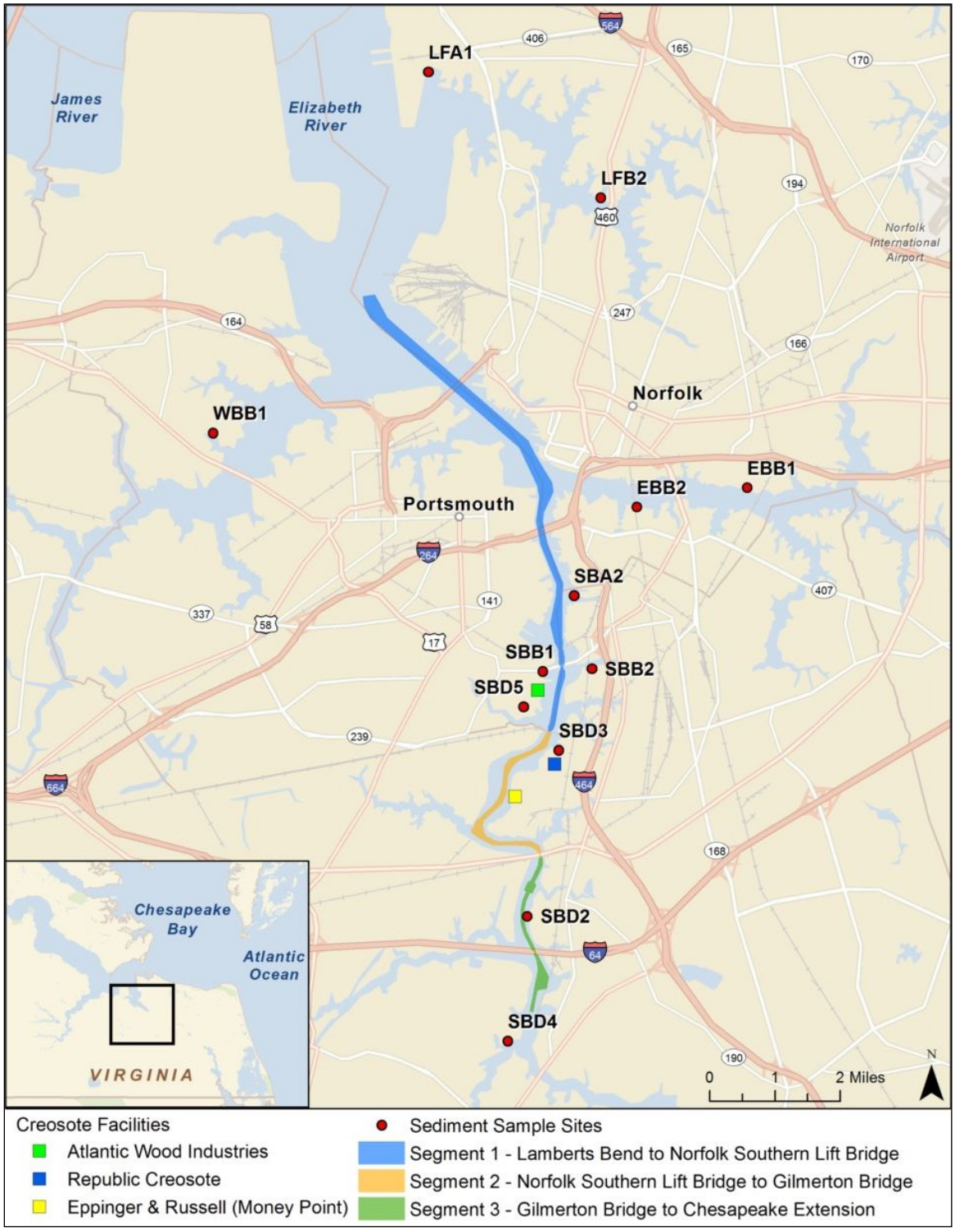


Figure 2-5. Wood Treatment Facilities and Sediment Sampling Locations

Table 2-8. Average total Polycyclic Aromatic Hydrocarbons in Elizabeth River Sediment

Elizabeth River Sample Site ID	**Polycyclic Aromatic Hydrocarbons (parts per billion)**	
	2001 Data	**2007 Data**
Lafayette River-A1 (LFA1)	5,596	24,678
Lafayette River–B2 (LFB2)	706	1,978
Western Branch–B1 (WBB1)	276	1,339
Eastern Branch–B1 (EBB1)	917	3,004
Eastern Branch–B2 (EBB2)	52,402	24,398
Southern Branch–A2 (SBA2)	25,295	23,730
Southern Branch–B2 (SBB2) (Scuffletown Creek)	13,562	26,375
Southern Branch–B1 (SBB1) (Atlantic Wood Industries site)	490,815	383,186
Southern Branch–D5 (SBD5)	4,428	5,850
Southern Branch–D3 (SBD3) (Republic Creosote site)	144,931	113,885
Southern Branch–D2 (SBD2)	190	2,226
Southern Branch–D4 (SBD4)	208	736

2.8.2 Segment-Specific Data

Segment 1: Elizabeth River Reach, Southern Branch Lower Reach, and Middle Reach
The Federal channel in the Elizabeth River and Lower Reaches of Segment 1 is approximately five miles long, 750 feet wide throughout most of the reach, and currently maintained to a required depth of 40 feet. In 2011, the U.S. Department of the Navy (Navy) deepened a significant portion of the existing Federal channel to a required depth of 47 feet and a width of 600 feet, over the downstream-most three-miles. Extensive geotechnical and environmental sediment sampling was completed to support the Navy's project (Navy 2009). Based on the data, all of the dredged material was removed (~ 3.2 million cubic yards from approximately 364 acres of the 454.5 acres of the Federal channel) using a hydraulic dredge with the material being directly pumped into the upland cells of CIDMMA.

The Middle Reach extends from the Belt Line RR Bridge (just north of the new Jordan Bridge) to the NS RR lift bridge. The Federal channel in this reach is approximately one mile long, 375 feet wide throughout most of the reach, and currently maintained to a required depth of 40 feet. The last maintenance dredging in this reach was in 2003, with the material being mechanically dredged and placed the CIDMMA Re-handling basin for permanent disposal at Craney Island.

The Middle Reach includes the Atlantic Woods Industries (AWI) site that was added to the USEPA's National Priorities List of most hazardous waste sites in 1990. The following summary

is taken from the USEPA's Five-Year Review Report (USEPA 2015) for the AWI site. At the time the Five-Year review was completed, the remedial action was classified as "*ongoing, and all components of the remedy have not been constructed to date*."

> *The AWI site is approximately 48 acres of land on the industrialized waterfront of Portsmouth, and 30 to 35 acres of contaminated sediments in the Southern Branch of the Elizabeth River. This land is surrounded by the Norfolk Naval Shipyard, the Southern Branch of the Elizabeth River and several other small industrial properties. From 1926 to 1992, a wood-treating facility operated at the site using both creosote and pentachlorophenol (PCP). The site was contaminated from the treatment operation, storage of treated wood and disposal of wastes. At one time, the Navy leased part of the property from AWI and disposed of waste on site, including used abrasive blast media from the sand blasting of naval equipment resulting in contamination with heavy metals such as copper, lead, zinc and arsenic. The Navy also disposed of sludge from the production of acetylene in a wetland on the border of the Southgate Annex of the Shipyard and the AWI site. Sediments in the Elizabeth River contain heavy metals and visible creosote and the groundwater and soil at the site are also contaminated with creosote and heavy metals.*

In accordance with their Five-Year Plan, the USEPA will apply institutional controls to ensure the remedy is protective in both the short term and long term scenarios ensuring that future construction does not adversely affect the remedy, providing notice to new landowners to prevent inappropriate future land use, educating and warning the public against consumption of fish and shellfish from the Southern Branch of the Elizabeth River, and preventing use of ground water for drinking purposes (USEPA 2015).

Within Segment 1, the Southern Branch of the Elizabeth River flows through a highly industrialized area, which includes several sites that are sources of pollution to the river (see Figure 2-6). The Norfolk Naval Shipyard that surrounds the AWI site is itself on the USEPA's National Priorities List. The Western Landfill of the Navy's Paradise Creek Disposal Site is considered part of the Norfolk Naval Shipyard Superfund Site. The Navy's Southgate Annex includes waterfront on the Southern Branch of the Elizabeth River and is used by the Navy for mooring inactive ships and for storage and at one time was used for blasting and painting of small boats and/or ship/submarine parts. Three other former creosote facilities were located nearby, including Eppinger and Russell Creosoting (Money Point), Republic Creosoting, and Wyckoff Pipe and Creosoting (USEPA 2015).

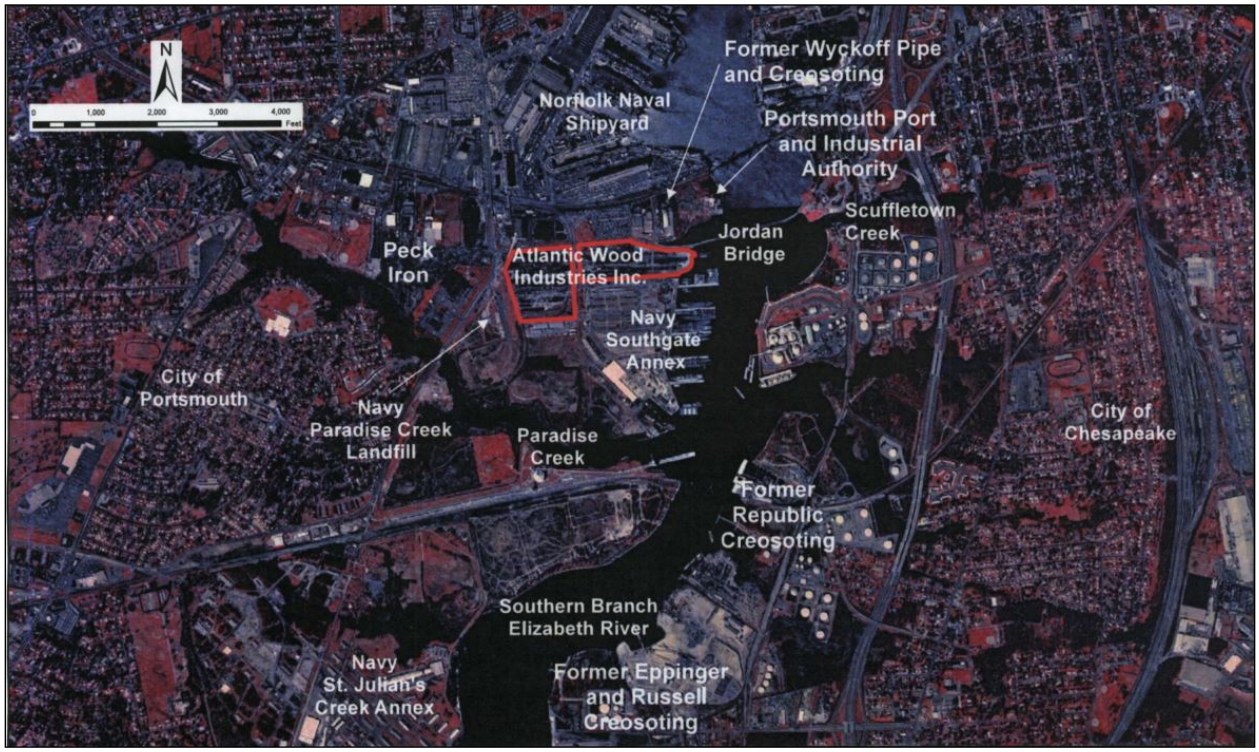


Figure 2-6. Location and Site of Nearby Industrial Areas

Environmental sampling in the channel (within the Federal channel limits), and below the depth of the maintenance material is limited. There are data from sampling within several adjacent properties (e.g., AWI, Apex Oil, Enviva, and Seagate) that indicate that some material within the Federal channel would be so contaminated to as to not be suitable for placement at the CIDMMA (either directly or in the re-handling basin) (Table 2-8). Research on the extent to which contaminated sediments affect native fishes (Atlantic killifish/mummichog, *Fundulus heteroclitus* and zebra fish, *Danio rerio*) have been ongoing with Duke University studies for more than 10 years (Riley et al. 2016, Di Giulio and Clark 2015, Fang et al. 2014, Clark et al. 2013, Jung et al. 2011, Levin et al. 2003, and Meyer and Di Giulio 2002).

Segment 2: Upper Channel, Reach A

Segment 2 extends from the Norfolk and Southern Railroad lift bridge to the Gilmerton Bridge, and includes the area known as Money Point. The Federal channel in this reach is approximately 2.4 miles long, varies from 250-500 feet wide throughout the reach, and is currently maintained to a required depth of 35 feet. The last maintenance dredging in this reach was in 2003, with the material being mechanically dredged and placed in the CIDMMA re-handling basin.

This reach passes along an area with prior creosote plants and has well documented areas of contaminated sediments. Environmental sampling below the depth of the maintenance material is limited; however, available information from prior testing suggests the material would likely contain sufficient chemical contamination to not be suitable for disposal at CIDMMA (Table 2-8).

The Elizabeth River Project (ERP) and other partners have removed more than 37 million pounds of PAH-contaminated sediments at Money Point (ERP 2016). A final portion of the Money Point PAH cleanup will be performed by the Port of Virginia as mitigation for the Craney Island Eastward Expansion (ERP 2016).

Segment 3
Segment 3 extends from the Gilmerton Bridge to the Chesapeake Extension. This channel segment is maintained to a required depth of 35 feet and has channel widths that range from approximately 250 to 300 feet. The channel along this segment of the Elizabeth River does not have a history of industrial contamination but is downstream from the industrial contamination areas described in Segments 1 and 2. Available information indicates the material would likely be suitable for disposal at CIDMMA (Fugro Consultants, Inc. 2016).

Sediment Disposal and Release of Effluence from the Craney Island Dredged Material Management Area
To determine whether dredged material is suitable for placement at CIDMMA or will be required to be disposed at an upland disposal facility, dredged material is tested for contaminants in a tiered approach in accordance with *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual, Inland 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* (2003).

2.8.3 Water Quality

The ROI includes the areas of navigation channel dredged, the CIDMMA, the effluent discharge area from the CIDMMA, areas transited by dredging vessels/equipment, and any potential sites where dredged material dewatering may occur. 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).

Due to its long history of military operations, industrial pollution, and urbanization, the Elizabeth River is considered one of the most polluted regions in the Chesapeake Bay watershed in terms of water quality and bottom sediment composition.

An annual Virginia Water Quality Assessment 305(b)/303(d) Integrated Report summarizes findings and makes recommendations for a list of impaired waters by the Virginia Department of Environmental Quality (DEQ). Every two years, a List of Impaired Waters is developed to describe segments of streams, lakes, and estuaries within the state that exhibit violations of water quality standards. In order to maintain the water quality standard, DEQ creates TMDLs (Total Maximum Daily Loads) on a tributary level that indicate the total pollutants that a water body can assimilate and still meet water quality standards.

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 DEQ and reported annually to EPA 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. A waterbody fails to support a designated use when it has one or more impairments.

The Elizabeth River has a TMDL and is also currently listed as an impaired waterway (Table 2-9; Figure 2-7; DEQ 2014). There is also a general condemnation for shellfish harvest throughout the ROI.

Table 2-9. Designated Impairments of the Elizabeth River in the Region of Influence (Category 4 & 5)

Waterbody and Affected Boundary	Use	Impairment
Chesapeake Bay and Tidal Tributaries	Fish Consumption	Polychlorinated Biphenyl (PCB) in Fish Tissue
James River and Various Tributaries	Fish Consumption	PCB in Fish Tissue
Chesapeake Bay Segment SBEMH (Southern Branch, Elizabeth River)	Aquatic Life, Deepwater Aquatic Life, Open-Water Aquatic Life	Dissolved Oxygen
Chesapeake Bay Segment ELIPH (Elizabeth River Mainstem)	Aquatic Life, Open-Water Aquatic Life	Dissolved Oxygen
James River - Lower	Aquatic Life, Open-Water Aquatic Life	Chlorophyll-a
Elizabeth River Southern Branch and its Tidal Tributaries	Fish Consumption	Dioxin (blue crab heptopancreas contamination)
Elizabeth River Upper Mainstem, Eastern Branch, Broad Creek, Southern Branch, and Paradise Creek	Recreation	Bacteria (*Enterococcus*)
Elizabeth River Mainstem	Aquatic Life	Estuarine Bioassessments
James River CBP segment JMSPH and Tidal Tributaries	Aquatic Life	Nutrient/Eutrophication Biological Indicators

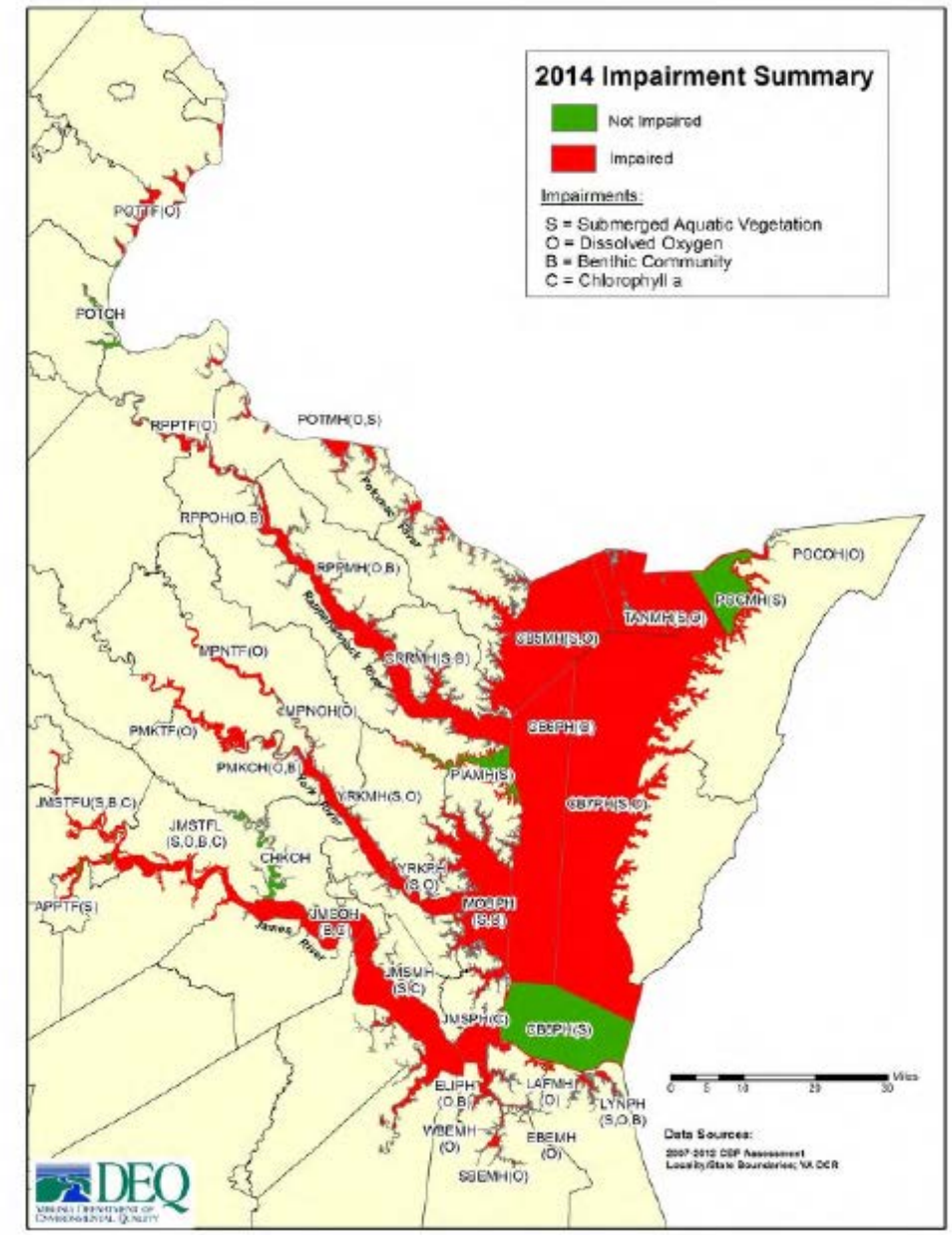


Figure 2-7. Impairment status of the Bay Aquatic Use

Today, The Elizabeth River receives point and non-point source loadings from its 300 square-mile drainage area, where approximately one-half million people reside (Conrad and Chisholm-Brause 2004; Cerco and Kuo 1981). Impacts from point and non-point source loadings are exacerbated by the relatively poor flushing characteristics caused by low freshwater input and relatively weak tidal currents (USACE 2000). Any freshwater entering the system is a result of stormwater runoff and Dismal Swamp drainage. This poor flushing tends to increase the amount of sediment and associated pollutants that are trapped within the river system (Neilson and Fang 1975). Total suspended solids levels are high, also indicating that water clarity is poor. Polychlorinated biphenyl and polyaromatic hydrocarbon levels are particularly high in the sediments throughout the river system (DiGuilio and Clark 2015; Elizabeth River Project (ERP) 2014). Tributyltin antifoulants from past boat maintenance activities are also a contaminant found in the sediments.

Although water quality can be described as, generally fair to poor, overall trends are improving due to a variety of clean-up efforts at several of the most contaminated sites, along with restoration of wetlands and oyster reefs. Many contaminants are declining as clean up progresses, and while bacteria levels and nitrogen are also declining, phosphorus has been noted to be on the increase recently. Contamination on the river bottom has been subject to significant remediation and efforts are underway at several key sites, including Money Point and Atlantic Wood, (ERP 2014) which have resulted in improved water quality. The USACE in partnership with the U.S. Environmental Protection Agency is currently dredging contaminated sediments out of the Atlantic Wood Superfund Site in the Elizabeth River; this remediation project is anticipated to be completed by 2017. For more information on potential chemical contaminants within the ROI, please refer to the Sediments and Hazardous, Toxic, and Radioactive Waste Section.

The salinity near the mouth of the river and much of the mainstem as well as the lower portions of the main branches (Southern, Eastern, Western, and Lafayette River) varies from surface to bottom, with a salt wedge of higher salinity water evident some distance upriver (approx. 20-26 km, depending on tidal cycle and time of year), though this wedge can dissipate at other times (see Figure 2-8). Slack water surveys conducted in support of the Craney Island Eastward Expansion indicates salinities within the project area range between 15 and 26 PSU) depending on water depth, tidal phase and time of year (USACE 2005). In the uppermost reaches of the river, outside the ROI, salinity decreases below 15 PSU, decreasing with distance upstream until salinity approaches zero PSU. Within the project ROI, salinity ranges are typically from 15-23 PSU.

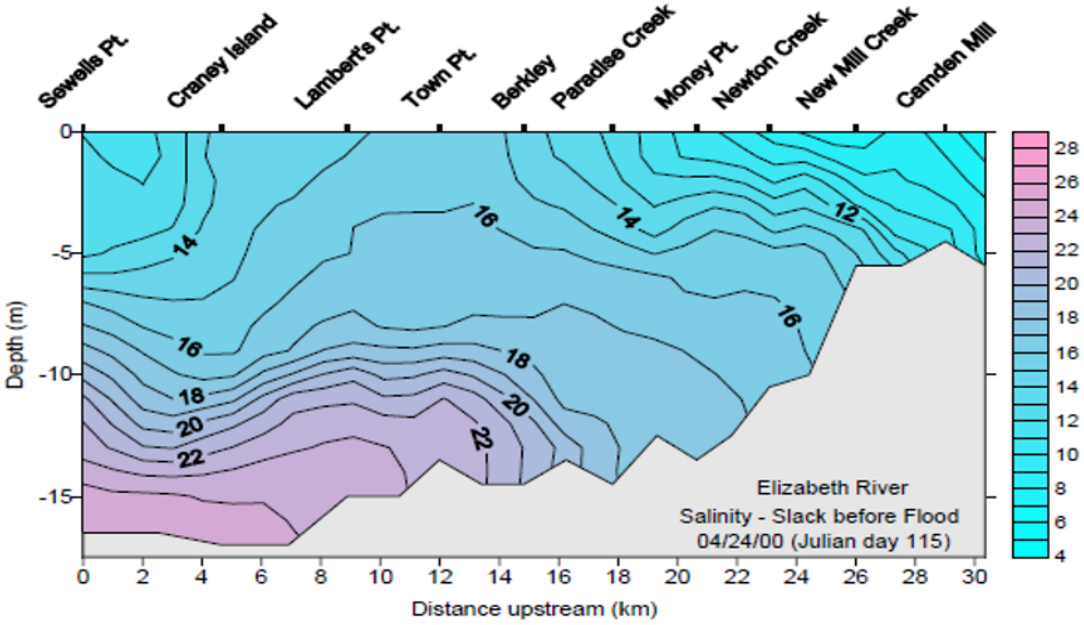


Figure 1. Salinity distribution (ppt) in the Elizabeth River on April 24, 2000.

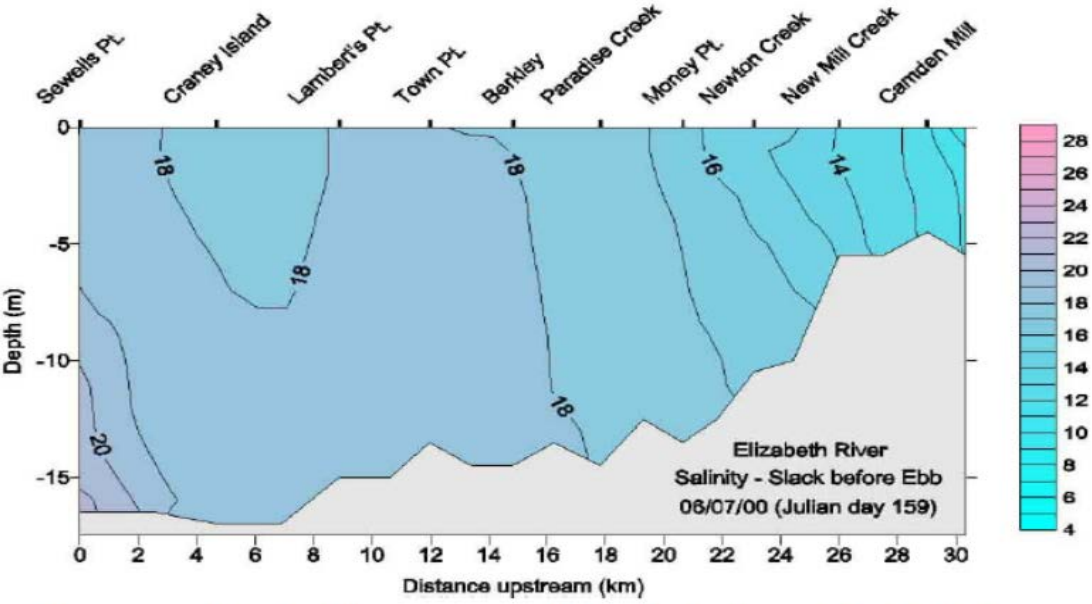


Figure 6. Salinity distribution (ppt) in the Elizabeth River on June 7, 2000.

Figure 2-8. Salt Wedge (top figure) and Non-Stratified (bottom figure) (Wang et al. 2001).

Dissolved Oxygen (DO) is considered one of the most important and commonly employed indicators of a water body's ability to support healthy aquatic life. Adequate concentrations of DO are necessary for fish and other aquatic life and can often times be less than ideal (five milligrams/liter and up) in the Elizabeth River, especially in deep channel areas and during the

summer, when stratification coupled with active decomposition of organic material in bottom waters occurs. As reported in the State of the Elizabeth River Scorecard 2014 Report (ERP 2014), DO levels were measured throughout the Elizabeth River and were evaluated using Virginia's DO criteria for open water, deep water, and deep channel habitat. The Lafayette River and Western Branch are the healthiest in the river, having almost no instances (less than five percent) where DO was less than four milligrams/liter. The mainstem and eastern branches were also generally good with respect to DO, having four milligrams per liter from five to 10 percent of the time. The poorest segment of the river, the southern branch, had less than four milligrams 12 percent of the time.

The Elizabeth River consistently met the DO criteria for deep water and channel habitat. This result is significant because the deep water category provides the largest habitat by volume. Exceedances are based on the open water habitat criteria, where most marine life is typically found. The Deep Channel minimum requirement is one milligram DO per liter.

No potable water supplies, Outstanding State Resource Waters, or Wild and Scenic Rivers are located in the vicinity of the project. Additionally, no designated sole source aquifers or wellhead protection areas are present in the project area.

According to State of the Elizabeth River Scorecard 2014 Report (ERP 2014), the river water quality has improved in recent years and general trends are described in the following table (Table 2-10).

Table 2-10. "State of the River" including Water Quality

Segment	Parameter	Grade	Trend
Main	Bacteria (in water)	A	none
	DO	B	none
	Bottom Health	C	none
	Contaminants on River Bottom	D	improving
	N (nitrogen)	B	improving
	P (phosphorus)	C	declining
	Contaminants in fish	C	none
	Bacteria in shellfish	D	none
Southern Branch	Bacteria (in water)	C	improving
	DO	C	none
	Bottom Health	D	improving
	Contaminants on River Bottom	F	improving
	N (nitrogen)	C	improving
	P (phosphorus)	C	declining
	Contaminants in fish	B	none
	Bacteria in shellfish	F	none
Lafayette River	Bacteria (in water)	B	none
	DO	A	none
	Bottom Health	C	none
	Contaminants on River Bottom	B	none
	N (nitrogen)	B	none
	P (phosphorus)	D	declining
	Contaminants in fish	C	none
	Bacteria in shellfish	F	none
Eastern Branch	Bacteria (in water)	B	none
	DO	B	none
	Bottom Health	D	none
	Contaminants on River Bottom	D	none
	N (nitrogen)	B	improving
	P (phosphorus)	D	declining
	Contaminants in fish	C	none
	Bacteria in shellfish	D	none
Western Branch	Bacteria (in water)	B	none
	DO	A	none
	Bottom Health	C	declining
	Contaminants on River Bottom	C	none
	N (nitrogen)	B	improving
	P (phosphorus)	D	declining
	Contaminants in fish	B	none
	Bacteria in shellfish	C	none

Source: Table reproduced from the State of the Elizabeth River Scorecard 2014 Report (ERP 2014).

Sediment Disposal and Release of Effluence from the Craney Island Dredged Material Management Area

To determine whether dredged material is suitable for placement at CIDMMA or will be required to be disposed at an upland disposal facility, dredged material is tested for contaminants in a tiered approach in accordance with *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual, Inland 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* (2003).

Prior to commencement of construction, dredged material will undergo evaluation procedures including chemical and biological testing in accordance with Federal guidance and regulations to provide information to reach a factual determination concerning Clean Water Act, Section 404 requirements (40 CFR 230.11) and applicable state water quality standards. 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.

Summary of Water Quality Modeling

Shen et al. (2017) and Wang et al. (2017) performed hydraulic and water quality modeling to characterize hydraulic conditions and water quality within the ROI and adjacent areas for Existing Conditions, Future Without Project (FWO) Conditions, and with implementation of a channel deepening Action Alternative. The modeling was used to simulate both the Action Alternative for this project as well as deepening of the Norfolk Harbor and Channels as this is being considered as a potential cumulative effect for this project.

A detailed description of the modeling domain, assumptions, and results is provided in Appendix J. Hydraulic modeling of the ROI and adjacent areas was accomplished with the EFDC/HEM3D Model during the 2010 – 2013 monitoring period. The DEQ provided the water quality data utilized to build the calibration and validation runs for the hydrologic and water quality simulation modeling. Because the hydraulic modeling was initiated prior to the selection of a Preferred Alternative to help inform the planning process, approximate future conditions with a channel deepening alternative were estimated and were not meant to reflect an exact simulation of the Action Alternative. The assumptions that were used in the hydraulic modeling are provided in Appendix J. To assess potential impacts of the Action Alternative the modeling simulations of the Future Without Project Alternative Plan were compared to the Future With Project conditions (i.e. with implementation of an action alternative).

2.8.4 Vegetation, Wetlands, and Submerged Aquatic Vegetation

The ROI includes the areas of navigation channel to be dredged, areas transited by dredging vessels/equipment, and dredged material placement/disposal sites, CIDMMA and CIEE. The ROI also includes the area of anticipated circulation pattern shifts and 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).

Upland Vegetation

The ROI is located within a highly industrialized and urbanized area in the cities of Chesapeake, Norfolk, and Portsmouth, Virginia. Nearly the entire waterfront along the ROI has been developed and as a result, impervious surface area is very high. By analyzing trends using the National Land Cover Database (2016), it was determined that 50 percent of the land adjacent to

the ROI has vegetation coverage. Natural riparian vegetation along the waterways adjacent to the project area is minimal.
Because the ROI is predominantly composed of subaqueous bottom, no upland vegetation occurs within the ROI except in the dredged material disposal areas that consist of the CIDMMA and potentially authorized upland disposal sites. Portions of CIDMMA are vegetated with approximately ten percent cover from low lying shrubs or grasses due to overgrowth on dredged material in cells. This vegetation is in a state of flux, as the disposal area is managed according to usage. However, the USACE does manage vegetation at CIDMMA for optimal erosion and sediment control.

Wetlands

Wetlands are defined by the Clean Water Act regulations as, "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." (USEPA 2016).

The Southern Branch of the Elizabeth River is an estuary subject to daily tides. Estuary environments can be altered with the combined stress of inundation, desiccation, and changes in salinity. These conditions limit the types of vegetation that can survive within the ROI, and the plant communities within this dynamic ecosystem have evolved the capacity to thrive in the ever-changing environment (Perry et al. 2001).

Since colonial times, the Elizabeth River Watershed has been the focus of development by maritime interests, including shipping, military bases, and other industrial activities. As such, substantial wetland losses have occurred over the years. An estimated 2,625 acres of tidal wetlands were lost between 1944 and 1977 in the Southern Branch of the Elizabeth River alone (Priest 1999). The Elizabeth River Watershed, in its entirety, has lost roughly 50% of its wetlands since World War II. (Elizabeth River project and Virginia Department of Environmental Quality 2008). Concurrent with the filling of these wetlands, pollution from industrial, commercial, and military uses over the years had also severely degraded water quality; the Elizabeth River, and particularly the Southern Branch, is widely considered to be the most degraded waterway in the Chesapeake Bay. With the onset of the Clean Water Act, wetland losses slowed to 36 acres from 1982 to 1990; and water quality has slowly began to improve (Priest 1999).

Over the course of many years of development and industry, shorelines have been built up, bulkheaded, or were filled to facilitate development; and large industrial and military deep water access piers and marine terminals have been constructed. Google aerial photography (2017) of Segments 1 and 2 suggests that the shorelines are at least 95% developed.

The entire navigation channel system within the ROI is subtidal, and classified as Estuarine and Marine Deepwater by U.S. Fish and Wildlife Service. The channel in the ROI ranges in depth from -35 to -50 feet MLLW and thus, is too deep to support wetland vegetation.

Tidal marsh exists only within few relatively narrow fringes of shoreline habitat along the banks of the Southern Branch and in portions of the shoreline fringing the CIDMMA. Within those areas, the entire habitat transition from open water, through salt marsh, to the adjacent uplands is generally less than 20 feet wide. The wetland fringes are typically comprised of dense, often mono-specific stands of smooth cordgrass (*Spartina alterniflora)*, and occur at elevations between mean low water (MLW) and mean high water (MHW). The reed grass community,

found further upslope of MHW in various areas, is dominated by the invasive reed grass (*Phragmites australis)*. Both community types are considered estuarine wetlands. Upslope of these emergent wetlands and along the banks are saltbush communities dominated by marsh elder (*Iva frutescens*), groundsel tree (*Baccharis hamifolia*), and bayberry (*Morella pensylvanica*). The USACE regularly treats reed grass via aerial application to help control its spread at the CIDMMA and adjacent areas.

Emergent wetland vegetation may form temporarily from time to time within the existing CIDMMA facility, as it is periodically altered by dredged material from various current dredging projects, and as that material settles and/or is managed. However, these are inadvertently created wetland vegetation sites and no jurisdictional wetlands are located within the confines of the CIDMMA itself.

Submerged Aquatic Vegetation

More than a dozen species of SAV are native to the Chesapeake Bay and its tributaries. Salinity, light penetration, water depth, and bottom sediment are factors which determine where each species can grow. Submerged Aquatic Vegetation survival depends on water clarity and the amount of sunlight available. Submerged Aquatic Vegetation provides food and shelter for diverse communities of waterfowl, fish, shellfish, and invertebrates, it also produces oxygen, a very important function in the Chesapeake Bay. Other ecological benefits of SAV include the ability to filter and trap sediment, and absorb nutrients like nitrogen and phosphorus (U.S. Fish and Wildlife Service, Chesapeake Bay Field Office 2016).

In 2015, the Virginia Institute of Marine Science (VIMS) mapped the annual distribution of SAV in the Chesapeake Bay and its tributaries using multispectral digital imagery supplemented with black and white aerial photographs. Based on this latest survey and mapping effort, as well as data from the years 2010 through 2015, there is no SAV within the ROI or along the Southern Branch of the Elizabeth River. Submerged Aquatic Vegetation beds are seen as indicators of a river's health; and the absence of SAV beds indicate that the degraded waters of the Southern Branch of the Elizabeth River are not the optimal environment for SAV.

2.9 Benthic Fauna

The ROI includes areas transited by dredging vessels/equipment and areas of navigation channel dredged. The ROI also includes the area of anticipated circulation patterns shifts and water quality impacts that has the potential to impact the benthic community. 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).

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

The benthic communities of the Elizabeth River include an array of fauna that play important roles in the food web. The Elizabeth River benthic community includes epifauna (organisms that live attached to surfaces on the river bottom) such as oysters, sponges, sea squirts, seas stars, and barnacles and infauna that burrow into bottom sediments and are characterized by worms (primarily polychaetes and nemotodes), clams, and other tunneling organisms such as tube worms. The benthic community in the in the Elizabeth River system is low in biomass and diversity due to the low dissolved oxygen, sediment contamination and sediment composition (almost entirely clays, silt and fines with no reef or hard bottom habitat either in the channel or on the side slopes) (Dauer 2008). The benthic community in the area proposed for dredging is dominated by polychaetes and other small, low dissolved oxygen, and pollutant-tolerant species. The organisms that colonize this type of benthic habitat are typically a limited suite of small, opportunistic species with a short life cycle, that are adapted to soft bottom environments with frequent disturbance. Such areas tend to recover quickly from disturbances, in as short a time of approximately six months to two years (Newell et al. 1998).

The mainstem of the Elizabeth River near its mouth is a region of low diversity and biomass and is generally dominated by small polychaetes. Conditions in the Southern Branch are generally similar, though with typically lower species diversity than sites closer to the river mouth (Dauer 2008). Hard clams (*Mercenaria mercenaria*) can be found in the area, at varying densities, typically 0-3/m^2 (Mann et al. 2005). Hard clams typically prefer firmer sediments with shell substrate, followed by sand, with mud and anoxic mud as found in the channel ROI being the least preferred habitat (< 0.05 clams/m^2) (Mann et al. 2005). Common bivalve species known to occur in the Elizabeth River include the thin-shelled clams (*Macoma balthica*) (the most numerous clam in terms of individuals found), *M. mitchelli* and *M. tenta*, the stout razor clam (*Tagelus plebeius*), as well as the dwarf surfclam (*Mulinia lateralis*), the eastern aligena (*Aligena elevate*), *Anadara* sp., the amethyst gemclam (*Gemma gemma*), and the angel wing clam (*Cyrtopleura costata*). However, most of these clams are found in shallower waters, not in the channel (Seitz and Lipcius 2002), which is consistent with the Dauer (2008) long-term data that indicates few bivalves inhabit the deep, channeled regions of the Elizabeth River.

Sediment composition varies with water depth within the ROI; at dredging depths, the percentage of silts and clays typically averages 80-percent and greater (Dauer 2008). The bottom conditions within the channels consist primarily of fine silts and clays, with a small portion of fine sands, gravel and shell, and as a result are usually soft bottom conditions. Such areas are typically not very productive (Seitz and Lipcius 2002) with a low Benthic Index of Biotic Integrity (B-IBI), which indicates low biomass and species diversity and are considered ecologically degraded (Dauer 2008). In general, the deeper the water, the higher the percentage of silts/clays in the bottom sediments, and the lower the B-IBI (Dauer 2008; Seitz and Lipcius 2002). It is to be expected that the benthos in the ROI will be found in primarily softer sediments most often dominated by polychaetes and nemotodes. Both groups of worms can be very numerous, but are typically very low in biomass and their presence, if dominant in biomass, often indicates an area of low secondary production with little species diversity as larger organisms are not present in these conditions (Mann et al. 2005), due to the fine sediments and low DO in waters above and within the sediments (Gillett and Schaffner 2009; Santos and Pires-Vanin 2004). Large benthic feeders, such as the northern quahog, are not typically found in deep, soft channel sediments (Mann et al. 2005) and commercially significant populations are not found in the navigation channel. There are significant oyster reefs in the Elizabeth River system, particularly in the Lafayette River and Eastern Branch, but they are not located within the ROI.

2.10 Plankton Community

The ROI for the plankton community includes the areas of navigation channel dredged and areas transited by dredging vessels/equipment. The ROI also includes the area of anticipated circulation patterns shifts and water quality impacts that has the potential to impact the plankton community. 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).

Plankton are free-floating organisms found in freshwater and marine ecosystems that are largely transported by wind and currents. Phytoplankton (microalgae) are tiny, single-celled organisms. Phytoplankton are primary producers because they generate food and oxygen in the Chesapeake Bay and its surrounding tributaries by a process called photosynthesis. To perform photosynthesis, phytoplankton need the energy of sunlight and they are typically found in the upper reaches of the water column. There are hundreds of species of phytoplankton in the Chesapeake Bay but typically, the most abundant phytoplankton in the Chesapeake Bay and its surrounding tributaries are the diatoms and dinoflagellates (Chesapeake Bay Foundation 2015).

The abundance of phytoplankton in the bay is seasonal with the highest abundance occurring during the spring when the highest concentration of nutrients flow into the Bay from melting snow and rain events. Nutrient pollution can cause algal blooms that can reduce oxygen levels in the Chesapeake Bay and its surrounding tributaries (Chesapeake Bay Foundation 2015). During a bloom, phytoplankton may accrue so densely in the water column that sunlight availability for other photosynthetic organisms is diminished. After a bloom, phytoplankton sink to the benthos; this can produce anoxic conditions, which can cause mortality of fish and other benthic organisms.

Zooplankton are the mostly microscopic, free-floating animal life and they are the most abundant animals found in the Chesapeake Bay and its surrounding tributaries (Chesapeake Bay Foundation 2015). Zooplankton form a crucial link in the food chain between the primary producers and higher levels of the food chain. Zooplankton consists of primary consumers (those that eat phytoplankton) and secondary consumers (larger zooplankton that consume the secondary consumers). Zooplankton are then consumed by fishes which are subsequently prey for larger fishes and wildlife (Reshetiloff 1997).

Copepods are tiny crustaceans that are approximately one millimeter long and are the most abundant zooplankton in the Chesapeake Bay and its surrounding tributaries (Chesapeake Bay Foundation 2015). Larval fish and shellfish, which include commercial and recreational fisheries species and species of restoration and management concern, comprise an important component of the zooplankton community. For example, oyster, blue crab, and finfish larvae such as red drum compose the zooplankton community seasonally.

Protozoa are single-celled zooplankton that consume bacteria and decaying plant and animal matter. Bacteria also play a crucial role in the bay and surrounding tributaries because they break down decaying plant and animal matter and provide nutrients in the food chain for higher level organisms. Comb-jellies and jellyfish are larger zooplankton that are visible to the naked eye and have some swimming capability, however, their location is largely driven by tides and currents and therefore, they are still considered zooplankton.

All fish within the Chesapeake Bay and its surrounding tributaries depend, whether directly or indirectly, on zooplankton because of its critical role in the food chain. Some fish such as anchovies, herring, and shad solely feed on zooplankton throughout their entire life cycle (Chesapeake Bay Foundation 2015). Other fish species depend on plankton for a portion of their lifecycle either directly or indirectly through the food chain.

2.11 Fish and Fish Habitat

2.11.1 Fish Resources

The ROI includes areas transited by dredging vessels/equipment, areas of the navigation channel dredged, and the Craney Island Dredged Material Management Area (CIDMMA), where suitable dredged material may be placed. The ROI also includes the area of anticipated circulation patterns shifts and water quality impacts that have the potential to impact fish and fishery resources. 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 Bay catch (U.S. Fish and Wildlife Service 2013). For centuries, the Chesapeake Bay and its tributaries have provided fishing grounds for both commercial and recreational purposes. 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 Bay (Chesapeake Bay Program 2016; National Wildlife Foundation 2016). The remaining species enter the 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 and are often found in shallow water, where they feed on a variety of invertebrates. Common resident species include the bay anchovy (*Anchoa mitchilli)*, 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 flouder (*Scophthalmus aquosus*), white perch (*Morone americana*), yellow perch (*Perca flavescens*), and silver perch (*Bidyanus bidyanus*). Although these species are permanent Bay residents, some are considered semi-anadromous meaning, they often move around the Bay and its tributaries due to changes in temperature, water quality, food availability, and for spawning. 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 anadromous species found in the ROI include: alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), American shad (*Alosa sapidissimia*), striped bass (*Morone saxatilis*), and white perch. 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).

The entirety of the Elizabeth River has a history of being characterized as a degraded, highly disturbed system, and the Southern Branch of the Elizabeth River, which has been industrialized for centuries, is notoriously the most polluted segment of the River (Elizabeth River Project (ERP) 2014). Over the past 20 years the Elizabeth River Project has aimed to restore and cleanup the impaired waters of the Elizabeth River. At Money Point, located in the Southern Branch, more than 36 million pounds of Polycyclic Aromatic Hydrocarbon (PAH) toxic contamination has been removed. The PAH removal has subsequently lead to reduced cancer and pre-cancer levels in the mummichog (*Fundulus heteroclitus*), an important indicator species, and an influx of fish and shellfish that were previously absent from the Money Point area (ERP 2014). Even so, waters throughout the Elizabeth River are currently under fish consumption advisories, and remain degraded.

Although the Elizabeth River is a degraded system, it is an important nursery habitat for commercial and recreational species, including speckled trout (*Cynoscion nebulosus*), spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonias undulatus*), Atlantic menhaden (*Bevoortia tyrannus*), weakfish (*Cynoscion regalis*), striped bass, black sea bass (*Centropristis striata*), and summer flounder (*Paralichthys dentatus*). The most intensive use for spawning is by forage fish, including the bay anchovy and Atlantic silverside. The river is also an important feeding ground for adult bluefish, weakfish, spot, and the Atlantic croaker (Priest 1981).

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 River and lower James River 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 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.

2.11.2 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 National Oceanic and Atmospheric Administration (NOAA) (2016) Guide to Essential Fish Habitat Designations in the Northeastern United States, EFH for 12 species was identified to potentially occur within the ROI. Refer to the EFH Assessment (Appendix X) for more information regarding EFH in the ROI and anticipated effects to EFH in the ROI.

2.12 Wildlife

The Region of Influence (ROI) for wildlife includes the areas of navigation channel dredged, areas transited by dredging vessels/equipment, and the Craney Island Dredged Material Management Area (CIDMMA). The ROI also includes the area of anticipated circulation patterns shifts and 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). For the purpose of the following discussion, wildlife consists of amphibians, birds, mammal species (excluding marine

mammals) and terrestrial reptiles. Marine mammals, sea turtles, and migratory birds are described in Section X, Special Status Species.

Avian species have the potential to occur throughout the ROI. For example, species may migrate through and/or forage within or adjacent to dredging locations. The CIDMMA provides habitat for a diversity of bird species that utilize shallow water, beach, and open flats (USFWS 2002). A variety of bird species reside, breed, migrate through, and/or overwinter at the CIDMMA. The CIDMMA is also used as a stopover area for waterfowl and shorebirds during migration events (USFWS 2002).

The CIDMMA provides habitat for a variety of other wildlife as well. Mammals known to occur at CIDMMA include rabbits (*Sylvilagus spp.*), groundhogs (Marmota monax), river otters (*Lontra canadensis laxatina*), raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), red foxes (*Vulpes vulpes*), coyotes (*Canis latrans*), and whitetail deer (*Odocoileus virginianus*) (USACE n.d.). The CIDMMA also contains potential habitat for terrestrial reptiles as well as amphibians.

2.12.1 Special Status Species

The ROI (or Action Area, as defined in 50 Code of Federal Regulation (CFR) 402.02 with respect to threatened and endangered species), is defined as those areas that are directly or indirectly impacted by an alternative. (The terms ROI and Action Area will be used interchangeably in this section.) The ROI consists of the areas transited by dredging vessels/equipment, areas of navigation channel dredged, and dredged material management/disposal sites. The ROI also 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 includes the range of noise impacts as they relate to special status species.

Federally Listed Endangered and Threatened Species

Animals and plants listed as endangered or threatened are protected under the Endangered Species Act of 1973, as amended (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. “Take” is defined as “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect.” “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.

This section provides a summary of the special status species that are known or have the potential to occur in the Action Area. The following references were consulted for compilation of the Special Status Species that have the potential to occur in the Action Area that is provided in Table 2-11:

- Virginia Aquarium Stranding Response Program’s Vessel Interaction datasets for sea turtles and marine mammals (Virginia Aquarium Foundation/Virginia Aquarium Stranding Response Program 2017a-2017b);

- Virginia Sea Turtle and Marine Mammal Stranding Network Reports (Swingle et al. 2017-2010; Barco and Swingle 2014);
- Information, Planning and Consultation System (IPaC) search conducted within the Action Area (U.S. Fish and Wildlife Service (USFWS) 2016a);
- Virginia Fish and Wildlife Information Service (VaFWIS) database search within a three mile radius of the Action Area (VDGIF 2016b);
- Virginia Natural Heritage Database Search (Department of Conservation and Recreation (DCR) 2016);
- National Oceanographic and Atmospheric Administration, National Marine Fisheries Service (NMFS) (2012) batched Biological Opinion that includes the Norfolk Harbor and Channels; and the
- Large Whale Strike Database (Jensen and Silber 2003).

Relevant consultation correspondence and a copy of the reports generated from the Federal and state databases is provided in the Biological Assessment provided in Appendix E. In addition, in 2012, a batched Biological Opinion (BO) was completed by the National Marine Fisheries Service (NMFS) for maintenance of existing U.S. Army Corps of Engineers navigation channels, including the Elizabeth River Southern Branch, the Norfolk Harbor Channels Project, and several other Norfolk District dredging projects. It was also used as a reference guide (NMFS 2012) to determine those Federally listed species known or with the potential to occur in the ROI, and to provide a frame of reference for potential impacts to listed species under the jurisdictional authority of the NMFS. Federally listed species known or with the potential to occur in the ROI are described in Table 2-11. There are no proposed or candidate species known or with the potential to occur in the ROI.

The NMFS designated Critical Habitat for the Gulf of Maine, New York Bight, and Chesapeake Bay Distinct Population Segments (DPSs) of Atlantic sturgeon in the Federal Register in 2017. The critical habitat locations in Virginia include the Potomac, Rappahannock, York, and James Rivers, out to their confluence with the Chesapeake Bay; there is no Atlantic Sturgeon Critical Habitat in the Action Area. While some of the listed species in Table 2-11 do have designated critical habitat, there is no designated critical habitat located within the ROI of the Elizabeth River Southern Branch Deepening Project for those species. Based on our review of the Virginia stranding data, there is no documented occurrence of the blue whale in the Action Area or in coastal waters of Virginia. However, we included this species in our analysis as it was included in the NMFS (2012) Biological Opinion. Based on our review of the stranding data, we did not note the occurrence of a north Atlantic right whale (*Eubalaena glacialis*) or sperm whale (*Physeter microcephalus*) in the Action Area, however, we included these species in our analysis as it was included in the NMFS (2012) Biological Opinion.

A detailed description of Federally listed species, their current status, and threats to these species and their habitat and is provided in the Biological Assessment that is located in Appendix E. Please note that all of the species listed in Table 2-11 are also state listed with the same status level as described for the Federal listing. Additional state listed species are described in Table 2-12.

Table 2-11. Federally Listed Species Known or with the Potential to Occur In the Region of Influence (1)

Taxonomic Category/Common Name	Scientific Name	Status	Critical Habitat
Birds			
Piping plover	*Charadrius melodus*	T	Y*
Red knot	*Calidris canatus rufa*	T	N
Fish			
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*

(1) Virginia Aquarium Foundation/Virginia Aquarium Stranding Response Program 2017a-2017b; Swingle et al. 2017-2010; USFWS 2016a; VDGIF 2016b; DCR 2016; Jensen and Silber 2003

DPS = Distinct Population Segment; E = Endangered; T = Threatened; Y = Yes; N = No; ^Species status is reported as it pertains to the DPS/Region of Influence; *Critical Habitat not located in the Region of Influence

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 pears and sea otters). Only cetceans, pinnipeds, and sirenians have the potential to occur in

the ROI. All marine mammals in the U.S. are protected under the MMPA.

The 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. (NOAA 2016m). 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. For most activities "harassment" refers to the act of pursuit, torment, or annoyance which:

- Can injure a marine mammal or a marine mammal stock in the wild which is referred to as Level A Harassment; or
- Has the potential to disturb a marine mammal or marine mammal stock in the wild by disrupting behavioral patterns that include but are not limited to the following: migration, breathing, nursing, breeding, feeding or sheltering which is referred to as Level B Harassment.

Table 2-12 provides 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). Documented occurrences of marine mammals in the ROI per marine stranding data are also indicated (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 population segment that occurs in Virginia, is no longer Federally listed but is still protected under the MMPA.

Table 2-12. Marine Mammal Species Documented In Stranding Records from Virginia, 1988-2013 (1)

Taxonomic Category/Common Name	Scientific Names	Strandings
Baleen Whales		
Bryde's whale	*Balaanoptera brydei*	historic
fin whale (2) (3)	*Balanoptera physalus*	11
humpback whale	*Megaptera novaeangliae*	33
minke whale	*Balaenoptera acutorostrata*	9
northern right whale (2)	*Eubalena glacialis*	4
sei whale (2) (3)	*Balaenoptera borealis*	2
Delphinids		
Atlantic spotted dolphin	*Stenella frontalis*	4
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	14
bottlenose dolphin (3)	*Tursiops truncatus*	1,593
Clymene dolphin	*Stenella clymene*	C. Potter, pers. Comm
common dolphin (3)	*Delphinus delphis*	98
long-finned pilot whale (3)	*Globicephala melas*	14
melon headed whale	*Peponocephala electra*	2

Taxonomic Category/Common Name	Scientific Names	Strandings
pantropical spotted dolphin	*Stenella attenuata*	historic
pygmy killer whale	*Feresa attenuata*	3
Risso's dolphin	*Grampus griseus*	22
rough toothed dolphin	*Steno bredanensis*	14
short-finned pilot whale (3)	*Globicephala macrorhynchus*	7
striped dolphin	*Stenella coeruleoalba*	16
Other toothed whales		
Cuvier's beaked whale	*Ziphius cavirostris*	historic
dwarf sperm whale	*Kogia sima*	10
Gervais' beaked whale	*Mesoplodon europaeus*	6
harbor porpoise	*Phocoena phocoena*	318
pygmy sperm whale	*Kogia breviceps*	24
Sowerby's beaked whale	*Mesoplodon bidens*	2
sperm whale (2)	*Physeter macrocephalus*	1
True's beaked whale	*Mesoplodon mirus*	1
Pinnipeds		
grey seal	*Halichoerus grypus*	15
harbor seal	*Phoca vitulina*	82
harp seal	*Pagophilus groenlandica*	38
hooded seal	*Cystophora cristata*	12
Sirenians		
west Indian manatee (2)	*Trichechus manatus*	annual sightings

(1) Threatened and endangered species and documented occurrences of marine mammals in the Region of Influence per survey and/or marine stranding data are also indicated. (Swingle et al. 2017-2010; Barco and Swingle 2014).

(2) Species is Federally listed in Virginia under the protection of the Endangered Species Act.

(3) Documented to occur in the Region of Influence based on survey and/or stranding data. 'Historic' refers to published accounts for the species. For these species, no animals were documented in the Virginia stranding record from 1988-2013.

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

The bald eagle (*Haliaeetus leucocephalus*) is currently protected under the American Bald and Golden Eagle Act, as amended, and the Migratory Bird Treaty Act, as amended (MBTA). It is also a state listed threatened species. A large raptor, it 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. Nests are massive often exceeding several thousand kilograms in weight (USFWS 2016d).

Bald eagles breed throughout much of Canada and Alaska, in addition to scattered sites across the lower 48 states, from California to the southeastern U.S. coast and Florida. Wintering habitat covers most of the contiguous U.S., with some year-round distribution in the northwest. Northern birds return to breeding grounds as soon as weather and food availability permit, generally between January and March (USFWS 2016d).

Although bald eagles are occasionally seen in the area, and historically nested near CIDMMA, The Center for Conservation Biology (2016), indicates that no bald eagle nests currently exist within the ROI or on or within three miles of the CIDMMA.

Species Protected under the Migratory Bird Treaty Act of 1918 and Executive Order 13186 Responsibilities of Federal Agencies to Protect Migratory Birds

The MBTA and Executive Order 13186 (EO) require agencies to protect and conserve migratory birds and their habitats (Table 2-13). Any activity that results in the take of migratory birds or eagles is prohibited unless authorized by the USFWS.

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. Then, 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).

Migratory birds are defined as those described by the USFWS in the 50 CFR 10.13 and consist of species that that belongs to a family or group of species in the United States as well as Canada, Japan, Mexico, or Russia. Most birds native (naturally occurring in the U.S.) to the U.S. belong to a protect family and are protected by the Migratory Bird Treaty Act. A species qualifies for protection under the MBTA if it meets one or more of the following four criteria:

(1) It (a) belongs to a family or group of species named in the Canadian convention of 1916, as amended in 1996; (b) specimens, photographs, videotape recordings, or audiotape recordings provide convincing evidence of natural occurrence in the United
States or its territories; and (c) the documentation of such records has been recognized by the American Ornithologists Union or other competent scientific authorities.

(2) It (a) belongs to a family of group of species named in the Mexican convention of 1936, as amended in 1972; (b) specimens, photographs, videotape recordings, or audiotape recordings provide convincing evidence of natural occurrence in the United
States or its territories; and (c) the documentation of such records has been recognized by the AOU or other competent scientific authorities.

(3) It is a species listed in the annex to the Japanese convention of 1972.

(4) It is a species listed in the appendix to the Russian convention of 1976.

Table 2-13. Migratory Birds Known or with the Potential to Occur in the Region of Influence (USFWS 2016a)

Common Name	**Scientific Name**
American bittern	*Botaurus lentiginosus*
American kestral	*Falco sarverius paulus*
American oystercatcher	*Haematopus palliates*
Bald eagle	*Haliaeetus leucocephalus*
Black rail	*Laterallus jarnaicensis*
Black skimmer	*Rynchops niger*
Black-throated green warbler	*Dendroica virens*
Brown-headed nuthatch	*Sitta pusilla*
Fox sparrow	*Passerella iliaca*
Gull-billed tern	*Gelochelidon nilotica*
Horned grebe	*Podiceps auritus*
Hudsonian godwit	*Limosa haemastica*
Least bittern	*Ixbrychus exilis*
Least tern	*Sterna anillarum*
Lesser yellowlegs	*Tringa flavipes*
Loggerhead shrike	*Lanius ludovicianus*
Marbled godwit	*Limosa fedoa*
Nelson's sparrow	*Ammodramus nelsoni*
Peregrine falcon	*Falco peregrinus*
Pied-billed grebe	*Podilymbus podiceps*
Piping plover (1)	*Charadrius melodus*
Prarie warbler	*Dendroica discolor*
Prothonotary warbler	*Protonotaria citrea*
Purple sandpiper	*Calidris maritima*
Red knot	*Calidris canutus rufa*
Red-headed woodpecker	*Melanerpes erythrocephalus*
Rusty blackbird	*Euphagus carolinus*
Saltmarsh sparrow	*Ammodramus caudacutus*
Seaside sparrow	*Ammodramus maritimus*
Sedge wren	*Cistothorus platensis*
Short-billed dowitcher	*Limnodromous griseus*
Short-eared owl	*Asio flammeus*
Snowy egret	*Egretta thula*
Swainson's warbler	*Limnothlypsis swainsonii*

Common Name	Scientific Name
Whimbrel	*Numenius phaeopus*
Wood thrush	*Hylocichla mustelina*
Worm eating warbler	*Helmitheros vermivorum*
Yellow rail	*Coturnicops noveboracensis*

(1) This species is also a Federally listed species and it is addressed in the Biological Assessment in Appendix E).

Migratory Bird Habitat at the Craney Island Dredged Material Management Area
Since 1989, the USACE, Norfolk District has actively engaged in a program to protect migratory bird species that have opportunistically utilized the CIDMMA. The inflow of dredged material, which consists of sands, silts, and clays high in organic matter, supports aquatic invertebrate populations on which migrating and resident waterbirds forage and the shallow ponds provide roosting and sanctuary habitat. Sand deposits from dredged material placement operations replenish potential nesting habitat for ground-nesting species. Voluntary monitoring of bird nesting and active management of avian habitat at the CIDMMA has served to enhance avian habitat and reduce any potential impacts of dredged material placement/disposal on migratory birds utilizing the CIDMMA. The USACE, Norfolk District continually balances CIDMMA's authorized mission to support navigation by providing dredged material placement/disposal capacity and managing nesting and foraging areas to promote the success of avian species utilizing the site to the maximum practicable extent (Robert Pruhs, pers comm).

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. In 2017 there were 23 confirmed breeding birds. 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*), gull billed terns (Gelochelidon *nilotica*), mallards (*Anas platyrhynchos*), Canadian geese (*Branta canadensis*), 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). The USACE previously partnered with the College of William and Mary to protect nesting birds on the island and enhance nesting habitats. In the late 1980s, fine sand and shell were placed at the island to improve nesting habitats (USFWS 2002). Wood decoys were also deployed to attract nesting birds to the habitat. Another management measure that has been taken at the island is the removal of mammalian predators. Least tern nesting numbers have varied year to year. In 2015, 153 nesting pairs of least terns were identified. 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 to maintain a

balance between predators and nesting species. 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 implementation of additional management efforts, piping plover nesting is not anticipated to occur at CIDMMA (USFWS 2002).

State Listed Endangered and Threatened Species

The following table provides additional state listed species that have the potential to occur within a three-mile radius of the ROI (VDGIF 2016b) (Table 2-14). However, within the limits of the ROI, there is no potential habitat for the Mabee's salamander or the canebrake rattlesnake, and we would not expect these species to occur in the ROI. Therefore, there would be no impacts to these species and they are dismissed from further consideration. State-listed birds and bats have the potential to forage within, migrate through, and stopover in the ROI.

Table 2-14. Additional State Listed Species with the Potential to Occur within a Three-Mile Radius of the Region of Influence (VDGIF 2016b)

Common Name	Scientific Name	State Status
Amphibian		
Mabee's salamander	***Ambystoma mabeei***	T
Birds		
Black rail	*Laterallus jamaicensis*	E
Gull-billed tern	*Gelochelidon nilotica*	T
Loggerhead shrike	***Lanius ludovicianus***	T
Migrant loggerhead shrike	*Lanius ludovicianus migrans*	T
Peregrine falcon	*Falco peregrines*	T
Wilson's plover	*Charadrius wilsonia*	E
Mammals		
Ratinesque's eastern big eared	*Corynorhinus ratinesquii*	E
Tri-colored bat	*Perimyotis subflavus*	E
Reptile		
Canebrake rattlesnake	***Crotalus horridus***	E

E=Endangered; T=Threatened

2.13 Air Quality

The ROI for air quality is defined by the U.S. Environmental Protection Agency's (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 Virginia Department of Environmental Quality (VDEQ), Division of Air Quality, has adopted the NAAQS in its USEPA-approved State Implementation Plan (SIP) and approved monitoring program (USEPA 2015).

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 that are in violation of one or more of the NAAQS. Maintenance areas are Air Quality Control Regions that USEPA previously designated as nonattainment areas, but have been subsequently designated as attainment and are subject to a maintenance plan.

Federal agencies are required to demonstrate that their 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 Hampton Roads Area is in attainment for all the NAAQS standards (USEPA 2015).

The Commonwealth of Virginia has maintained a network of air monitoring stations in Virginia since 1980 and the ROI falls within the Air Quality Control Region 6 (AQCR 6), which includes all major cities in the Hampton Roads area, as defined in 9 VAC5-20-200 as the Hampton Roads Intrastate Air Quality Control region (VDEQ 2015). The long-term air quality trends since 2004 for all criteria pollutants demonstrate decreasing ambient concentrations (VDEQ 2015).

2.14 Climate Change

The ROI for the climate change and sea level rise analysis is limited to the waters of the Elizabeth River and Southern Branch of the Elizabeth River as well as the shorelines and adjacent upland areas proximate to the proposed navigation improvements and dredged material placement areas.

Climate change and global warming have been observed during the 20th and 21st centuries and have resulted in changes in localized sea levels. The 2014 Intergovernmental Panel on Climate Change (IPCC) report states that over the period of 1901 to 2010, the global mean sea level rose by 0.62 feet (IPCC 2014). 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). However, subsidence--the process of land sinking--is responsible for more than half (53-percent) of the measured relative sea level rise in the Chesapeake Bay area (HRPDC 2011) though sea-level rise due to climate change is now the dominant factor in relative sea level rise in the project ROI, as the present rate of sea level rise of 4.85 mm/yr only 2.10 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).

The IPCC also predicts local sea level rise, addressing the localized factors of subsidence and oceanic currents at any particular location. Changes to the relative sea level can result from a number of factors including isostatic rebound (a process by which the earth's crust, having been compressed beneath the weight of glaciers, bounces back), faulting and consolidation of sediments in fill structures, and sediment compression caused by groundwater withdrawals (Boon 2010). 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). 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. 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). The use of sea level change scenarios as opposed to individual scenario probabilities underscores the uncertainty in how local relative sea levels will actually play out into the future. At any location, changes in local relative sea level reflect the integrated effects of global mean sea level change plus local or regional changes in geologic, oceanographic, or atmospheric origin. Our 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), the results can be seen in the following figure 2-9.

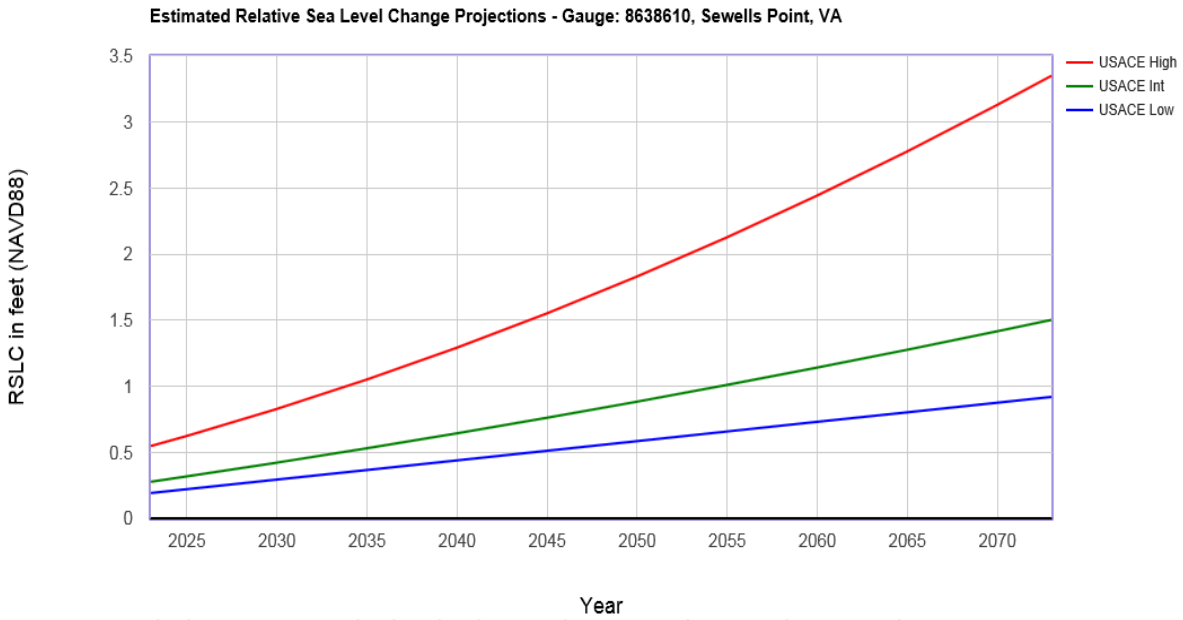


Figure 2-9. Relative Sea Level Rise in the Project ROI, lower Chesapeake Bay

An increase in storm surge events is another issue related to climate change because the IPCC predicts an increase in the intensity of hurricanes, which increases wind speed and

precipitation, leading to flooding and property damage (IPCC, 2014). Hampton Roads is also prone to significant storm surges roughly every four to five years, which could be influenced by the effects of climate change (HRTPO 2013), increasing in frequency.

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.

2.15 Floodplains

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. As discussed further below, considering the proposed project alternatives, it is expected that there will be minimal threats for loss of life and injury, damage to property, and impacts to the environment with respect to floodplain management.

Craney Island Dredged Material Management Area (CIDMMA) construction was initiated in August 1954 and completed in January 1957, to hold approximately 96 million cubic yards of dredge material, with an expected useful life of 20 years. By 2010, Craney Island had received more than 253 million cubic yards of dredged material. The 2,500 acre facility has a primary perimeter containment dike approximately eight miles in length and two division dikes that divide the site into three sub-containment areas. From east to west, the average distance within a containment area is approximately 1.8 miles, and north to south, approximately 0.5 miles. The drainage area within each containment area is approximately one square mile. The top of dike elevations currently range from approximately 30 to 45 feet, referenced to the North American Vertical Datum of 1988 (NAVD88). The USACE is also in the process of raising the dikes to approximately 40 to 50 feet, NAVD88. By using best management practices, such as spillways, annual rotation of sub-containment cells, more active dewatering by increased ditching, raising and stepping-in dikes, and the installation of vertical plastic drip drains, maximum future dike elevations under existing foundation strengths are expected to range from approximately 50 to 55 feet, NAVD88.

Typically, a single containment area is active for one year while the two inactive areas are extensively managed for water removal. On the west side of the facility, each containment area has two primary spillways, each with four, 36-inch diameter outlet pipes. The east side is higher

in elevation, where material flows downslope to the west, depositing the heaviest particles first. The spillways allow the release of water after the sediments have settled out. In general, under typical pumping operations, it can take up to five days to reach a working pool level with three feet of freeboard. Spillway stop-logs (boards) are used to control water levels during pumping operations. Current maximum depth within a containment area, from the top of the dike to the interior ground, is approximately seven feet on the west side and gradually decreases moving to the east dikes. Looking at a typical cross section of the dike, the distance from the centerline of the top of the dike to the exterior toe can range from over 200 feet for the west dike, 150 feet for the north, and 100 feet for the east and south dikes. The top width of the dike is generally around 40 feet.

Craney Island is bounded by water on the west and north sides by the Hampton Roads Harbor, on the east by the Elizabeth River, and on the south side by the U.S. Naval Supply Center and a residential neighborhood within the City of Portsmouth. On the west, north, and east sides, the distance from the top of dike to the edge of water generally ranges from 300 to 600 feet. On the south side, the closest residence is over 400 feet in distance and the U.S. Naval Supply Center tanks are approximately 2,000 feet.The east side of Craney Island is planned for a future port terminal to handle containerized cargo in a partnership with the Virginia Port Authority, known as the Craney Island Eastward Expansion. Initial construction has started, but a final completion date is not known as this time, as work is dependent on funding availability.

2.16 Noise and Vibration

Noise and vibration is often defined as any sound that is undesirable because it interferes with communication, is intense enough to damage hearing, or diminishes the quality of the environment. Response to noise varies by the type and characteristics of the noise source; distance from the source; receptor sensitivity; and time of day. Noise can be intermittent or continuous, steady or impulsive, and it may be generated by either mobile or stationary sources, and changes in noise are typically measured and reported using a weighted sound intensity (or level), which represents sound heard by the human ear and is measured in units called decibels (dBA). The ROI includes the navigation channels dredged, dredged material placement/disposal areas, and the transit of dredging vessels through the project area. The geographic extent of noise impacts is dependent upon factors such as the type of dredging equipment, length of time spent dredging, and environmental conditions such as wind speed and direction.

Noise monitoring conducted during dredged material placement/disposal activities (i.e., from dredged material pumping) at the CIDMMA (USACE 2006) showed that during operational hours, noise levels within the material placement areas ranged from 43 dBA to 68 dBA. When dredging activities ceased for the day, noise levels dropped to a range of 35 dBA to 60 dBA (USACE 2006), indicating a relatively small contribution to ambient noise from dredged material pumping. Similar noise monitoring throughout the residential communities surrounding the CIDMMA site showed that noise levels were affected by routine road/street traffic with the highest daily levels corresponding to typical peak travel times in the morning, noon, and evening (USACE 2006).

The most likely dredges to be employed for the deepening and widening of channels would be hydraulic pipeline and mechanical dredges. Sound production is largely influenced by sediment properties – to excavate hard, cohesive and consolidated soils, the dredger must apply greater force to dislodge the material (Robinson et al. 2011) Sound from dredges can be variable,

depending on the phase of operation, and the type of dredge used, but typically occur at low frequencies (<500) (Reine et al. 2014). The following sections describe sound from the types of dredges that have the potential to be used for this navigation project.

Hydraulic Pipeline Cutterhead Dredges
These dredges are commonly used throughout the U.S. for both new work and maintenance dredging operations. They are capable of removing most types of material and pumping the slurry through pipelines for several miles or longer with the use of booster pumps. The major processes contributing to hydraulic dredging sounds include:

1. Dredged material collection sounds originating from the rotating cutterhead in contact with the bed and intake of the sediment-water slurry,
2. Sounds generated by pumps and impellers driving the suction of material through the pipes,
3. Transport sounds involving the movement of sediment through the pipes, and
4. Ship and machinery sounds, including those associated with the lowering and lifting of spuds and moving of anchors by dredge tenders (Reine et al 2012)

In a study by Clarke (2002), cutterhead sounds peaked at 100-110 dB in the frequency range of 70-1,000 Hz and were inaudible at approximately 500 meters from the source.

Mechanical Bucket Dredges
These dredges produce a repetitive sequence of sounds generated by winches, bucket impact with the substrate, bucket closing, and bucket emptying. The noise generated from a mechanical dredge entails lowering the open bucket through the water column, closing the bucket after impact on the bottom, lifting the closed bucket up through the water column, and emptying the bucket into an adjacent barge. Once the barge is full, it would be towed by a tug to an approved disposal or placement site. The maximum noise spike with mechanical dredges occurs when the bucket hits the bottom. All other noises from this operation (i.e., winch motor, spuds, etc.) are minimal. Clark et al. (2002) found that the sound of a bucket impact with the substrate was at the limit of detection by a low-noise hydrophone and hydrophone audio amplifier at seven kilometers from the impact point.

<u>Ambient Noise in Elizabeth River and Southern Branch</u>
Ambient noise is the all-encompassing sound associated with a given environment at a specified time. Humans hear sound from 0-140 dB, and sound above this threshold is associated with pain. There are several sources of ambient noise within the ROI which can be attributed to both natural (wind waves, fish, tidal currents, mammals) and anthropogenic (commercial and recreational ships/vessels, dredging, pile driving, etc.) inputs. The ROI is a working waterway with adjacent land use characterized largely by industrial, commercial, and military uses. In fiscal year 2015, 38 ships (non-Navy) a week called at the Port of Virginia, importing and exporting containers to and from all corners of the world; 63-percent was moved to and from the port by trucks and 33-percent was moved by train (POV 2015). The U.S. Department of the Navy uses the channel and there are three airports are within 15 miles (Norfolk International Airport, Chamber's Field, and Langley Air Force Base). Noise sources for vessels include cranes, whistles, and various motors for propulsion, while adjacent dockside noise sources include cranes, trucks, cars, and loading and unloading equipment. Ship traffic, including ships transiting the study area can generate sounds ranging from 10 to 1,000 Hz.

Within the Hampton Roads Crossing Study Final EIS (FHA 2001), the FHA characterized the existing noise conditions by collecting data at sample locations adjacent to the proposed highway work as shown in Figure 2-10. The highway and local street traffic represented the dominant sources of existing noise in the Hampton Roads study corridors. Within the study area, the loudest anthropogenic noise input can reach 120 dBA (Figure 2-10), which is caused by low flying jet aircraft; this is intermittent and depends largely on wind direction, time of day, and occurs in specific areas, where jet take offs and landings occur (FHA 2001).

In addition to noise and vibrational inputs attributed to this being a bustling commercial, industrial, and military center, the potential areas affected by noise and vibration include expanses of parks, open spaces, and greenways, as well as residential areas. These areas are considered to be sensitive noise receptors, or areas where human activity may be adversely affected by excess noise inputs (NYC DEP n.d.). These receptors include, but are not limited to schools, churches, cemeteries, homes, golf courses, and parks/playgrounds. Sensitive noise receptors are located in areas that generally have lower ambient noise levels, which can range anywhere from 40 dBA (quiet suburban area at night) to 70 dBA (in typical urban areas, i.e. downtown Norfolk) (NYC DEP n.d.) (Table 2-15).

While some anthropogenic underwater noise is produced intentionally (e.g., naval sonar, echosounders), most noise sources are an incidental by-product of human activity (e.g., shipping, construction) (Farcas et al. 2016). For underwater environments, ambient noise includes tides, currents, and waves, as well as noise produced by marine mammals, fish, invertebrates, and by humans. Low frequency noise levels such as these tend to carry long distances in the water but are attenuated the farther away one is from the source (Navy 2009). Refer to the fish habitat section for further characterization of the underwater noise environment in the ROI.

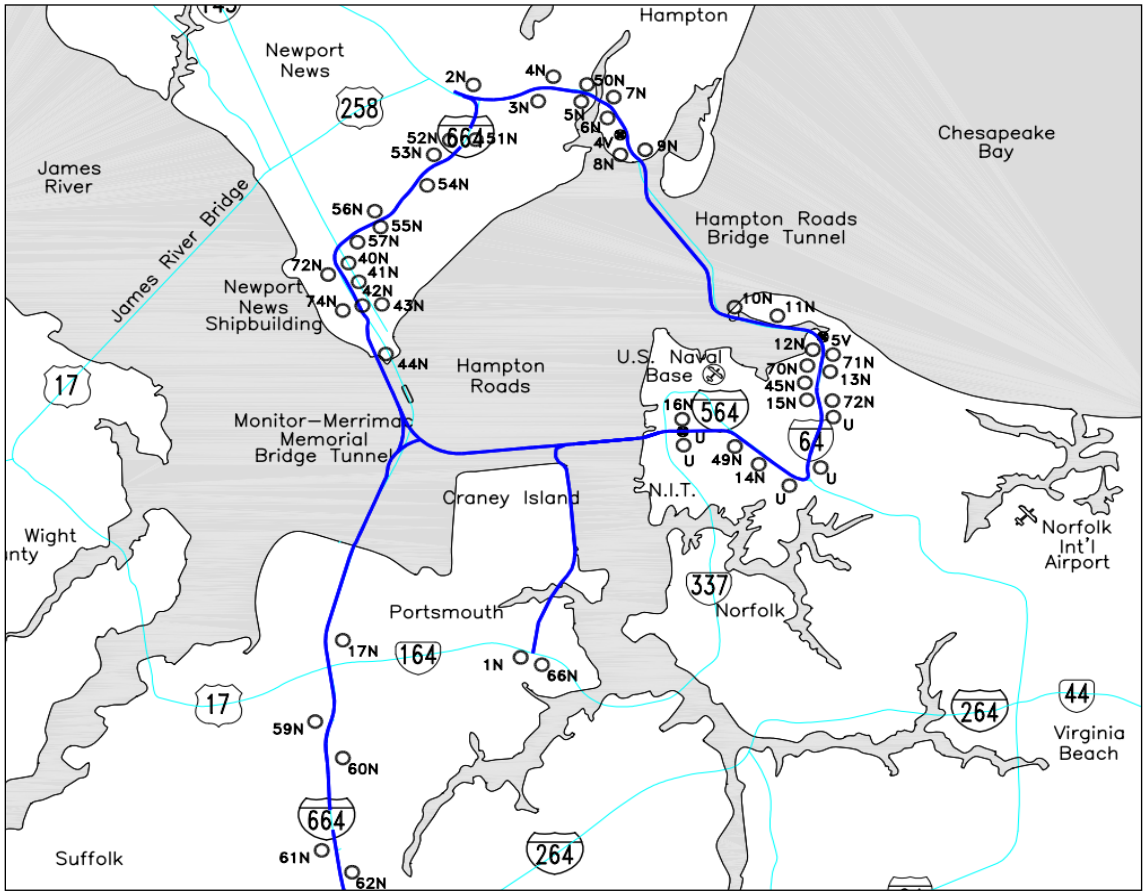
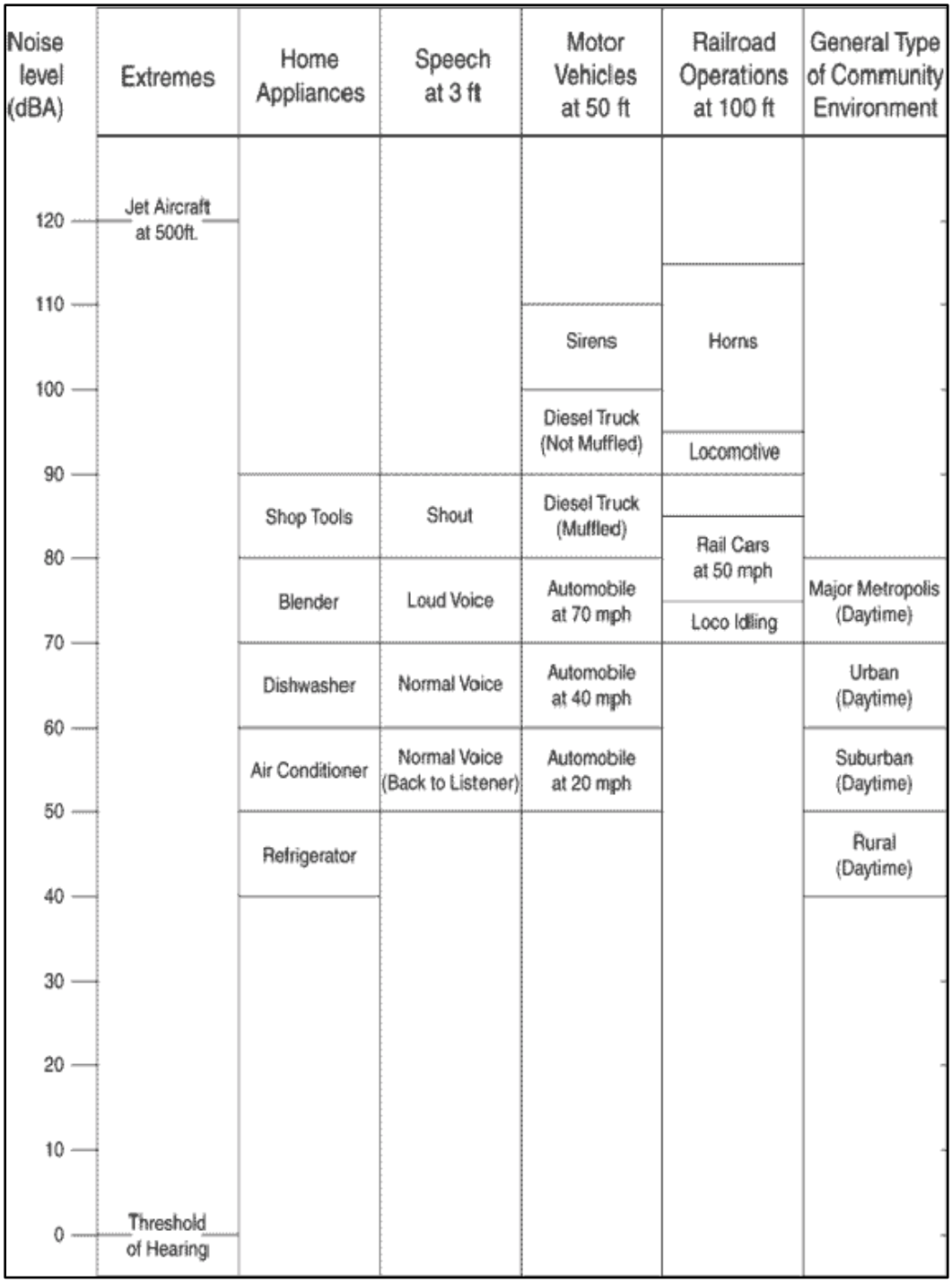


Figure 2-10. Hampton Roads Crossing Study Noise and Vibration Measurement Sites

Table 2-15: Displays a Comparison of Noise Levels for Various Sound Sources (USDOT N.D.)



2.17 Occupational Safety and Health

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 sites, dredging operations to deepen and widen channels, potentially dewatering of contaminated sediments, and placing the dredged materials at placement sites. Risk factors in this OSH environment include operation of heavy equipment, slip and fall hazards, potential exposure to hazardous materials in the dredged material and water, and navigational hazards (American National Standards Institute 2011).

The USACE Norfolk District's Operations Branch recorded the number of labor-hours during dredging contractor operations and the number of Occupational Safety and Health Administration (OSHA) reportable accidents for six years spanning Fiscal Year 2011-Fiscal Year 2016 (it does not include dredging by other USACE Districts on Norfolk projects) and this is provided below in Table 2-16. Table 2-16 also includes the number of days of labor lost due to accidents, and days of restricted duty due to accidents. This is summarized in Table 2-16 below along with the rate of accidents per 10,000 operating hours.

Table 2-16. USACE Norfolk District Dredging Contractor Operations Accidents per Labor-Hour

	Hours	Accidents	Days Lost	Restricted duty	Accidents/ 10,000 hrs.
FY11	297364.5	1	no data	no data	0.03
FY12	106012.5	1	0	19	0.09
FY13	198186	5	17	4	0.25
FY14	188801.5	0	0	0	0.00
FY15	108272.9	1	31	0	0.09
FY16	154432	1	0	3	0.06
Total	1053069	9	48	26	0.09

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

- Mobilization;
- Hydrographic surveying;
- Hauling gear maintenance and cable replacement;
- Navigation;
- Pipeline installation;
- Dredging;
- Trip wire replacement;
- Disposal site activities;
- Severe weather precautions; and
- 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

2014). The APP specifies the safety and occupational health plan, responsible personnel and their OSHA certifications, safety training for all personnel, protective equipment, and Clothing and Personal Protective Equipment (PPE) required for workers. The PPE includes:

- Appropriate clothing for weather conditions;
- Steel toed boots;
- Hard hat;
- Protective eye wear 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 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 (U.S. Army Corps of Engineers 2009).

Bureau of Labor Statistics data on reported nonfatal occupational injuries tabulates the rate of cases reported for 100 workers over a year (200,000 hours). Separate statistics for dredging are not available, but the rate for heavy and civil engineering construction, where dredging would be placed, was 3.0. In comparison, the rate for all industries was 3.4, with securities brokerage at .02 the low and the highest was air transport with 7.5 (Bureau of Labor Statistics 2015).

Specific to the USACE and contracted dredging operations in a 12 month period throughout the USACE dredging operations, there were seven serious accidents, where there were fatalities, disabling injuries, or major property damage on contractor and USACE marine operations; these included three fatalities and two disabling injuries (Anderson 2016).

The fatalities were:

- A cook fell overboard while dumping garbage and drowned. The cook was not wearing a floatation vest, and was not required to as are deck hands.
- A crew member who had not reported for work, but whose vehicle was in the parking lot, was found dead under the gangway.
- A crew member was lost when a vessel overturned during anchor handling.

The disabling injuries were:

- A dredge worker lost a finger when repositioning pipe, which had been nudged by a tender.
- A dredge worker lost his left leg below knee when caught in line and pulled into a block when lowering a pipeline connection (Anderson 2016).

Ten work injuries were reported during Norfolk District dredging operations from Fiscal Year 2009 through Fiscal Year 2015, summarized in Table 2-17 (obtained from Norfolk District Safety Manager).

Table 2-17. Injuries in Norfolk District Dredging Operations

Fiscal Year	# Accidents	# Injuries	# Days Lost
2009	1	1	1
2010	1	1	1
2011	1	n/a	n/a
2012	3	3	2
2013	3	3	6
2014	0	0	0
2015	1	1	20
Total	10	9	30

Examples of Dredging Accidents In Table 2-16

Worker slipped and fell into the water while trying to unhook a pipeline.
Worker was struck by section of pipeline that had shifted.
Worker sustained a sprained wrist from fall in the galley when the vessel was struck by large swell.
Worker cut fingers while attempting to attach a dragline pipe to a front end loader.
Worker pinched fingers while trying to use a wrench to close a leaking valve.
Worker twisted ankle after stepping in a hole in a wooden deck mat.
Worker was dragged overboard by a rope attached to a pipeline.
Worker was struck by swing anchor on a tender vessel deck and knocked overboard.

n/a = Not Applicable

Contract requirements for handling Unexploded Ordnance (UXO) are included in USACE dredging contracts where 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 dredging. 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 U.S. Army maintained remotely operated defensive minefields during World War II, and German U-Boats laid offensive magnetic mines around the channel near Cape Henry.

Information on past Safety and Work Plans for dredging contracts on the Elizabeth River and Southern Branch were not available, however the contract for the nearby Thimble Shoal and Cape Henry Maintenance Dredging project was for a comparison. This 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 six 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, an Ordnance and Explosives Safety Specialist (OESS) provided 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.

Little active combat, especially any that would have left explosive ordnance, has taken place in the ROI. The departing Royal Governor, Lord Dunmore, had British ships fire on Norfolk on New Year's Day 1776 (Parramore et. al. 1994). In June 1813, British forces attempted to take control of the harbor, but were turned back at Craney Island by American soldiers, sailors, and

militia manning guns from the USS Constitution moored at Gosport Navy Yard. Although Union forces burned ships, and may have tossed ammunition overboard in evacuating Gosport in 1861, by that time the main magazine was at Fort Norfolk where the Navy had established facilities for loading shells in 1855. Prior to this, another depot was established at St. Julien's Creek, just south of the Navy Yard. In 1880 the ordnance manufacturing activity was moved from there and reestablished at St. Julien's Creek. Although yet another ordnance depot was established during World War I at Yorktown, and continues as the Yorktown Naval Weapons Station, the Saint Julien's Creek depot continued in operation until the 1970's.

The St. Julien's Creek Annex was listed as a Superfund site in 2000. Contaminants from repair and maintenance of various types of equipment at the facility were found, as well as ordnance and residues from ordnance fabrication, testing, disassembly, and destruction. There was a very high level of activity at St. Julien's Creek Annex at times, for example 73,000 mine cases were loaded in 1918 with as many as 1000 mines loaded with as much as 300,000 pounds of TNT per day (Hartmann 1975).

Areas of the river near St. Julien's Creek Annex and the Norfolk Naval Shipyard (Figure 2-11) have the potential to conceal lost ordnance of various types. Recently a Civil War era shell came up during dredging at a Superfund site being remediated just south of the Norfolk Naval Shipyard, the location of a former creosote treatment operation.

The Sediments and HTRW Section provides a detailed account of potential chemical constituent contaminants of concern (namely PAH, TPH, PCBs, and heavy metals) and their potential locations based on past industrial activities and existing, relevant sediment sampling that was previously collected within portions of the sediment profile in the ROI. Based on this information, there is a potential of encountering contaminated sediments within the ROI. In areas where contaminated sediments are found, dewatering of contaminated sediments may be required prior to transport to an upland disposal site(s). Based on the past industrial activities and existing sediment data, there is a high likelihood of encountering contaminated sediments in Segment 1 and Segment 2 of the ROI. Required, detailed sediment monitoring to determine the location and extent of chemical contamination in the sediment profile will not be conducted until the Preconstruction, Engineering, and Design Phase of the project.

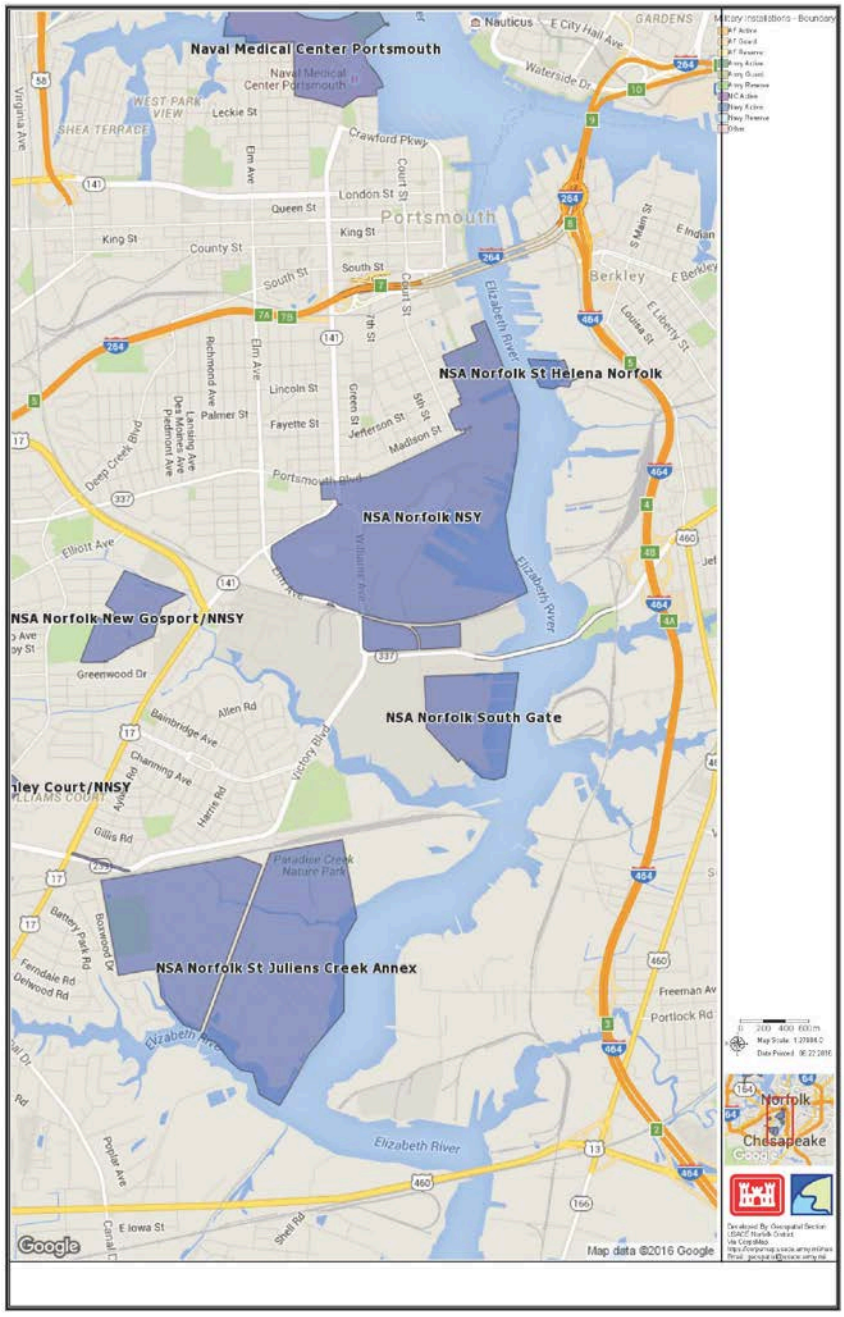


Figure 2-11. Locations of the Norfolk Naval Shipyard and St. Julian's Creek Annex

2.18 Cultural Resources

Cultural resources considered in this section are those defined by the National Historic Preservation Act (NHPA) as properties listed in or eligible for listing in the National Register of Historic Places (NRHP) and are referred to as historic properties. Historic properties eligible for listing in the NRHP include prehistoric and historic sites, structures, buildings, objects, and collections of these in districts. Eligibility for listing in the NRHP is based on one or more of four

criteria: a) association with important historic events or patterns of history, b) association with persons important in history, c) representative of the work of a master or exemplary as a type, or d) have yielded or may yield information important to history or prehistory. Section 106 of the NHPA and its implementing regulations at 36 CFR Part 800, require the lead Federal agency, in this case the USACE, to assess the potential effects of an undertaking on historic properties that are within the proposed project's Area of Potential Effect (APE), which is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist" (36 C.F.R. § 800.16[d]). This is the equivalent of the Region of Influence (ROI) in NEPA terminology. The lead Federal agency consults with the State Historic Preservation Officer (SHPO) who acts on behalf of the Advisory Council on Historic Preservation (ACHP) to identify historic properties affected, determine whether the effects are adverse, and resolve the adverse effects. The ACHP may participate in the resolution of adverse effects, or if there is any disagreement between the lead agency and the SHPO.

Several other Federal laws may be applicable to these resources, including the Archaeological and Historic Preservation Act of 1974, the American Indian Religious Freedom Act of 1978, the Archaeological Resources Protection Act of 1979, the Abandoned Shipwreck Act of 1987, the Native American Graves Protection and Repatriation Act of 1990, and the Sunken Military Craft Act of 2004. Shipwreck sites are protected under the Abandoned Shipwreck Act of 1987 (Public Law 100-298; 43 U.S.C. 2101-2106). This act transferred title of abandoned shipwrecks within state lands or waters to the states. The act has provisions for protection of historic shipwrecks, and compliance with the Archaeological Resources Protection Act of 1979. Additionally, the Sunken Military Craft Act of 2004 protects sunken vessels and aircraft of the U.S. military worldwide, as well as foreign military craft within U.S. waters, regardless of NRHP status. Sunken military craft remain the property of the U.S. Government rather than the states.

The APE (or ROI) for direct physical effects to cultural resources of this project has been defined as areas where dredging might take place and areas where dredged materials might be placed. The visual APE (sometimes referred to as indirect APE) has been defined as areas within one mile of construction activities.

Known and anticipated archaeological resources of potential NRHP eligibility in the direct APE are likely to be limited to shipwreck sites. Although the existence of submerged terrestrial sites from the Pleistocene and early Holocene epochs is possible, methods are lacking for identifying and evaluating such sites. Existing information on shipwreck sites has been gathered from the Virginia Department of Historic Resources (DHR) databases and the National Oceanic and Atmospheric Administration (NOAA) data bases. NRHP listed or eligible properties in DHR's database, including terrestrial architectural resources within one mile of the project, are shown in Figures 2-12 and 2-13, and listed in Table 2-18 (Virginia Department of Historic Resources 2016).

There are 72 NRHP listed or eligible properties within one mile of the project area (Table 2-18). This figure does not include individual properties that contribute to the many historic districts on the list. The Elizabeth River from the Naval Shipyard north is included in the area of the Battle of Hampton Roads battlefield because it was the avenue of approach for the *Merrimac* (*CSS Virginia*). Although not included, the scuttling site of the *Merrimac* is at the north end of the project, although it is unlikely that much remains after the vessel was blown up in the scuttling, and what was left salvaged. There are two National Historic Landmarks in Portsmouth, Lightship No. 101 used as a museum on the waterfront, and Drydock No. 1 at the Norfolk Naval

Shipyard. Along with numerous buildings that are individually listed or eligible in the NRHP there are 15 historic districts within about one mile of the project. Among the most notable are Ghent, West Freemason, and Berkley North historic districts in Norfolk; Old Town, Downtown, and Portsmouth Naval Hospital historic districts in Portsmouth, and the South Norfolk, Dismal Swamp Canal, and St. Julien's Creek Annex historic districts in Chesapeake.

In addition to these, the Captain John Smith Chesapeake National Historic Trail passes through the project area Lamberts Point to the Norfolk Naval Shipyard near the mouth of the Southern Branch of the Elizabeth River. The trails consist of land based information centers, water access points, and radio transmitter buoys. There is an information center for the trail at the Nauticus Museum in downtown Norfolk, and a buoy in the river off shore from there. Although the Keeper of the National Register of Historic Places has opined that some sections of the trail are NRHP eligible, it is unlikely that the cultural landscape, urban and developed, in the project area would support this. Effects would be limited to the presence of dredges during construction, with no lasting effects to the viewshed.

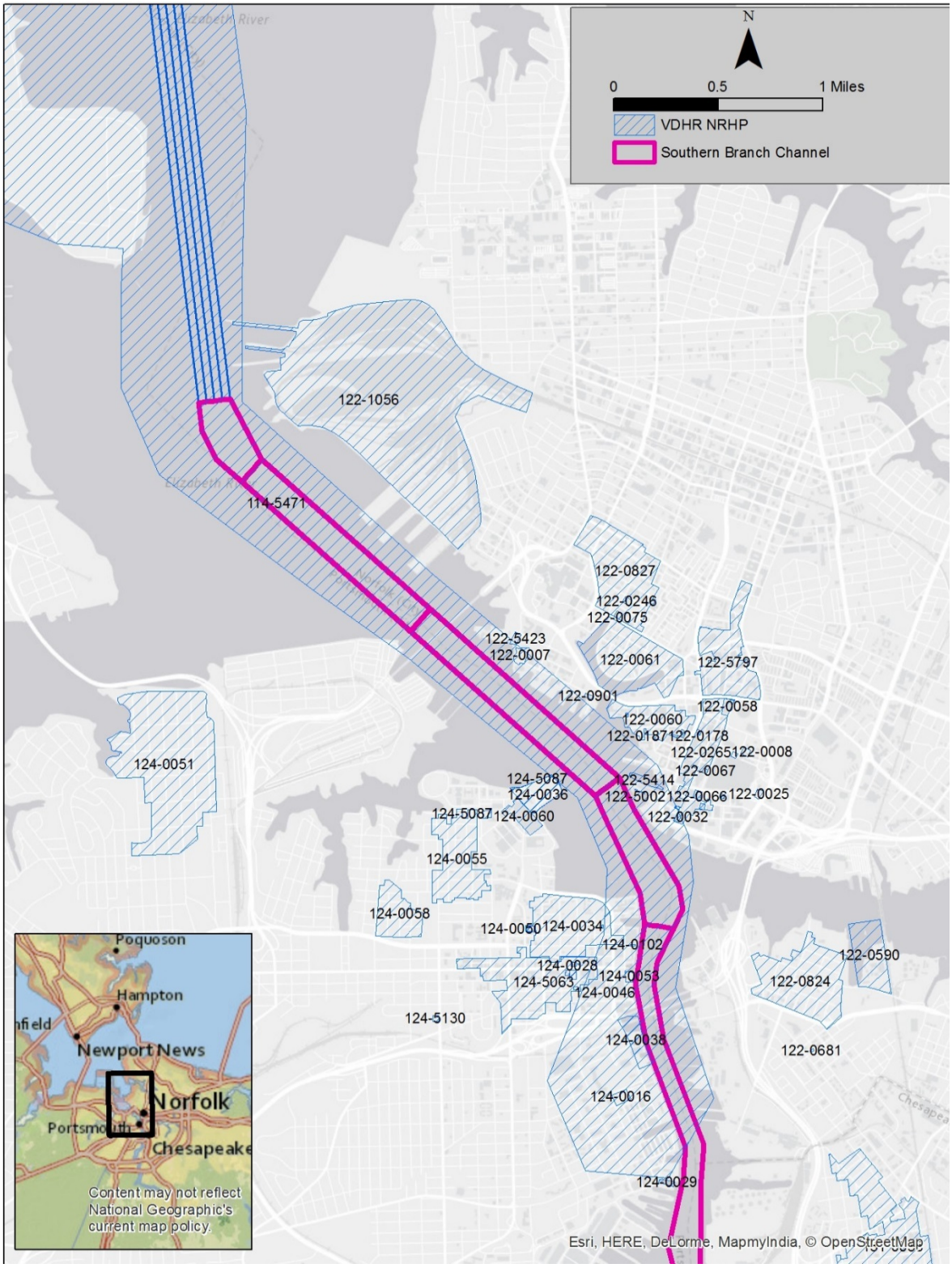


Figure 2-12. Historic Properties within One Mile of the Project Area, North

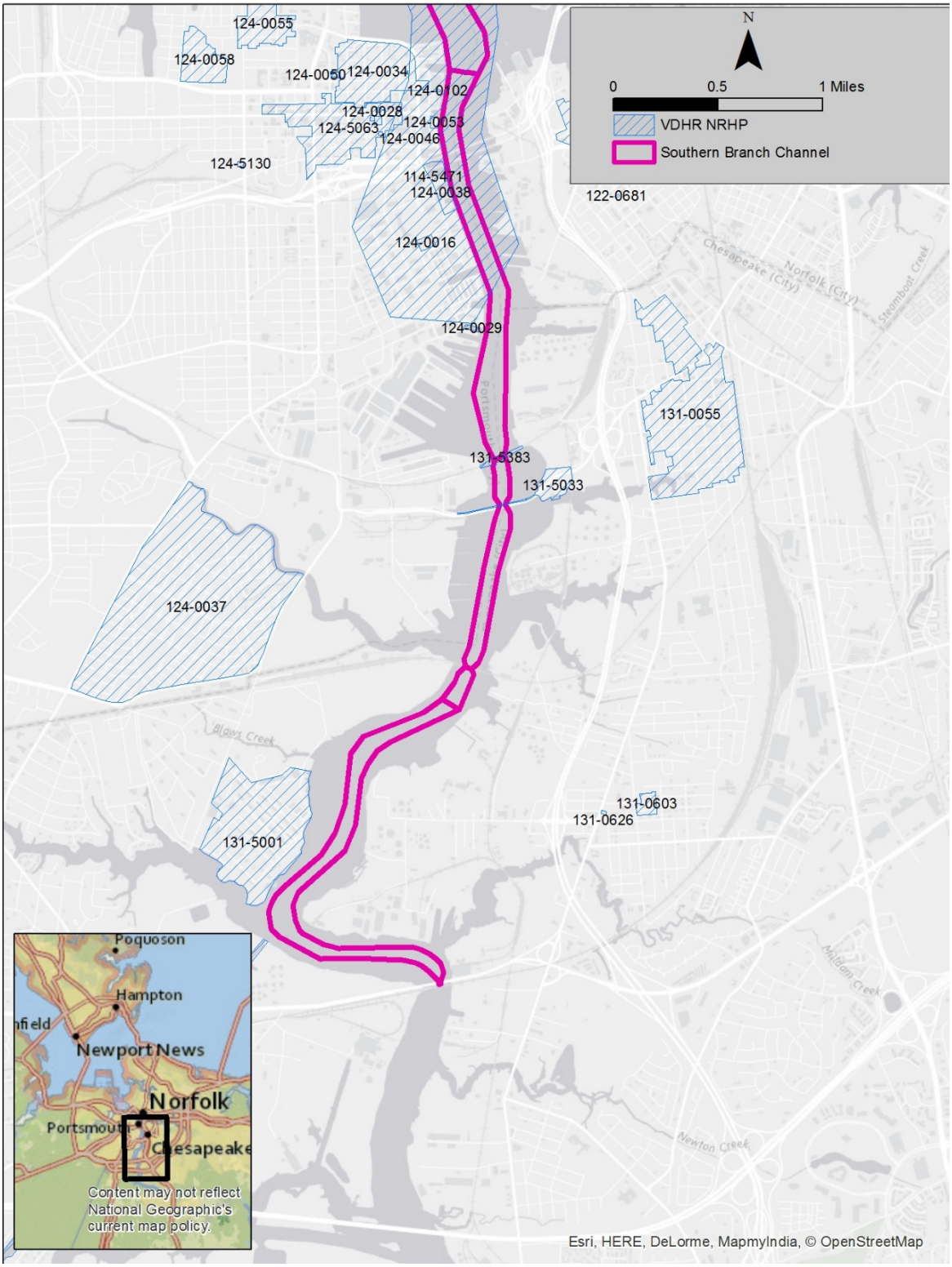


Figure 2-13. Historic Properties within One Mile of the Project Area, South

Table 2-18. NRHP and Eligible Historic Properties within One Mile of the Project Area

DHR ID	Historic Property Name	NRHP Status
114-5471	Battle of Hampton Roads (Historic/Location), Battle of the Ironclads (Historic), Monitor vs. Virginia	NRHP Eligible
122-0001	Allmand-Archer House (Historic/Current), House, 327 Duke Street (Function/Location)	VLR/NRHP
122-0007	Fort Norfolk (Historic)	VLR/NRHP
122-0008	Freemason Street Baptist Church (Historic)	VLR/NRHP
122-0016	Kenmore (Historic), Lamb, William Wilson, House (Historic)	VLR/NRHP
122-0017	Moses Myers House (Historic/Current)	VLR/NRHP
122-0018	Norfolk Academy (Historic), Norfolk Juvenile Court (Historic)	VLR/NRHP
122-0019	MacArthur Memorial (Current), Norfolk City Hall (Historic)	VLR/NRHP
122-0021	Purdy-Whittle House (Historic), Taylor-Whittle House (Current), Whittle House (Historic)	VLR/NRHP
122-0024	St. Mary's Catholic Church (Historic/Current), St. Mary's Church (Historic/Current)	VLR/NRHP
122-0025	Borough Church (Historic), St. Paul's Episcopal Church (Historic/Current)	VLR/NRHP
122-0032	U.S. Customs House (Historic/Current)	VLR/NRHP
122-0033	Willoughby-Baylor House (Historic)	VLR/NRHP
122-0040	First Baptist Church (Historic/Current)	VLR/NRHP
DHR ID	Historic Property Name	NRHP Status
122-0058	U.S. Post Office and Courthouse (Historic), Walter E. Hoffman U.S. Courthouse (Current)	VLR/NRHP
122-0060	West Freemason Street Area Historic District (NRHP Listing), West Freemason Street Historic District	VLR/NRHP
122-0060-0210	Seaboard Air Line Railway Building, 221-229 W Bute St (Historic/Location), Wainwright Building	VLR/NRHP

122-0061	Ghent Historic District (Historic/Current)	VLR/NRHP
122-0066	Monticello Arcade (Historic/Current)	VLR/NRHP
122-0067	Wells Theatre (Historic)	VLR/NRHP
122-0075	Christ and Saint Luke's Church (Historic), Christ Church (Historic), St. Luke's Episcopal Church (Hi	VLR/NRHP
122-0077	Collier, George C., Skipjack (Historic), Skipjack Allegheny (Historic), Skipjack Norfolk (Current)	NRHP Eligible
122-0078	Auslew Gallery (Current), Old Virginia Bank and Trust Building (Historic), Southern Bank of Norfolk	VLR/NRHP
122-0082	Old Norfolk City Hall (Historic), U.S. Post Office and Courts Building (Historic)	VLR/NRHP
122-0165	Queen Street Baptist Church (Historic)	VLR/NRHP
122-0171	Lorraine Hotel (Historic), Thomas Nelson Hotel (Current)	NRHP Eligible
122-0178	Epworth United Methodist Church (Historic)	VLR/NRHP
DHR ID	Historic Property Name	NRHP Status
122-0187	Andrew Carnegie Free Public Library (Descriptive), Norfolk Theatre Centre (Historic), Old Norfolk Pu	NRHP Eligible
122-0211	St. John's African Methodist Episcopal Church (Historic)	VLR/NRHP
122-0246	Ghent Methodist Church (Historic), Ghent United Methodist Church (Historic/Current)	NRHP Eligible
122-0255	Sacred Heart Church (Historic/Current)	NRHP Eligible
122-0265	Downtown Norfolk Historic District (Historic)	VLR/NRHP
122-0590	Colonna's Shipyard (Historic/Current)	NRHP Eligible
122-0681	Corner Stone Christian Center (Current), Trinity A.M.E. Church (Historic)	NRHP Eligible
122-0824	Berkley North Historic District (NRHP Listing), Ferry's Point	VLR/NRHP

	(Historic), Herbertsville (Historic),	
122-0827	North Ghent Historic District (Historic/Current)	VLR/NRHP
122-0901	American Tobacco Co. Warehouse (Historic), Sears, Roebuck and Co. Warehouse (Historic)	VLR/NRHP
122-1056	N & W Railyard Site-Norfolk Southern Railway Historic District (Descriptive), Norfolk & Western Rail	NRHP Eligible
122-5002	Huntington Tugboat (NRHP Listing), Huntington Tugboat Museum (Current), Tug Huntington (Historic)	VLR/NRHP
122-5414	U.S.S. Wisconsin (BB-64) (NRHP Listing), Whiskey (Historic)	VLR/NRHP
DHR ID	Historic Property Name	NRHP Status
122-5423	Krisp-Pak (Historic), Norfolk Cold Storage and Processing Company, Inc. (Historic), Riverview Lofts	VLR/NRHP
122-5797	Auto Row Historic District (Current Name), Granby Street Auto Row Historic District (Historic),	VLR/NRHP
124-0006	Norfolk County Courthouse (Historic), Portsmouth Courthouse (Current)	VLR/NRHP
124-0012	The Hill House (Historic), Thompson-Hill House (Historic)	NRHP Eligible
124-0016	Quarters A, B, and C, Norfolk Naval Shipyard (NRHP Listing)	VLR/NRHP
124-0028	Trinity Episcopal Church (NRHP Listing)	VLR/NRHP
124-0029	Drydock No. 1, Norfolk Navy Shipyard (Historic/Current), Norfolk Naval Shipyard Facility 0911 (Current)	VLR/NRHP/NHL
124-0034	Portsmouth Old Towne Historic District (Current)	VLR/NRHP
124-0034-0039	Dinwiddie Street Methodist Church (Historic), Monumental United Methodist Church (Historic/Current)	VLR/NRHP

124-0036	Norfolk Naval Hospital (Portsmouth Naval Hospital) (Historic/Current)	VLR/NRHP
124-0037	Cradock Historic District (Current)	VLR/NRHP
124-0038	Old Lighthouse Service Depot (Historic)	NRHP Eligible
124-0046	Pythian Castle (NRHP Listing)	VLR/NRHP
DHR ID	Historic Property Name	NRHP Status
124-0050	Emmanuel African Methodist Episcopal Church (Historic/Current), Emmanuel AME Church (Historic/Current	NRHP Eligible
124-0053	Old City Hall (Historic), Seaboard Coastline Building (Historic/Current)	VLR/NRHP
124-0055	Park View Historic District (Historic)	VLR/NRHP
124-0058	Cedar Grove Cemetery (Historic)	VLR/NRHP
124-0060	Portsmouth Naval Hospital Quarters A & B (Historic)	NRHP Eligible
124-0101	Commodore Theatre (Historic)	VLR/NRHP
124-0102	Cape Charles (Historic), Cross Rip (Historic), Lightship No. 101 (Historic), Overfalls (Historic), P	VLR/NRHP/NHL
124-0183	Portsmouth and Norfolk County Confederate Memorial (Historic)	VLR/NRHP
124-5063	Downtown Portsmouth Historic District (Historic/Current), High Street Corridor Historic District	VLR/NRHP
124-5063-0008	St. Paul's Catholic Church (Historic/Current)	VLR/NRHP
124-5087	Portsmouth Naval Hospital Historic District (Descriptive)	NRHP Eligible
124-5130	Portsmouth Colored Community Library (Historic/Current), Portsmouth Community Library (NRHP Listing)	VLR/NRHP
131-0035	Dismal Swamp Canal (NRHP Listing), Dismal Swamp Canal Historic District (Descriptive), Dismal Swamp	VLR/NRHP
DHR ID	Historic Property Name	NRHP Status
131-0055	South Norfolk Historic District (NRHP Listing)	VLR/NRHP
131-0603	Old Portlock House (Current)	NRHP Eligible

131-0626	Chesapeake Museum & Information Center (Historic), Old Portlock School No. 5 (Historic)	VLR/NRHP
131-5001	St Juliens Creek Annex Historic District (Historic)	NRHP Eligible
131-5033	Bridge # 1801, Rt 337, South Fork Deep Branch Creek (Function/Location), Jordan Bridge (Historic/Current)	NRHP Eligible
131-5383	Norfolk and Portsmouth Belt Line Railroad Bridge, Elizabeth River (Historic/Location)	NRHP Eligible
* not mapped		
NHL = National Historic Landmark		114 = Newport News
NRHP = National Register of Historic Places listed		122 = Norfolk
VLR = Virginia Landmarks Register		124 = Portsmouth
131 = Chesapeake		

Previous archaeological surveys have been reviewed and the survey areas mapped. A portion of the APE has had previous archaeological survey, however large areas remain unsurveyed. Survey over Segment 2 is 100% complete; however only about 10% of Segment 1 has been surveyed (Figure 2-14). Areas surveyed within the last 20 years will not be resurveyed. Unsurveyed areas subject to potential project impacts will be surveyed by a qualified marine archaeologist using side-scan sonar and marine magnetometer (or magnetic gradiometer), also known as a Phase I survey. Anomalies from this remote sensing survey that are identified as potential sites would be investigated with further remote sensing survey for magnetic and sonar data, sub-bottom profiler data, and diver investigation to determine the NRHP eligibility of the site (also known as a Phase II survey). Through a Programmatic Agreement (Appendix I) with the SHPO, additional surveys needed to complete the identification of historic properties in the APE will be deferred to the Preconstruction Engineering and Design (PED) phase of this project, if it is approved by Congress. The Virginia Ports Authority is participating in the Programmatic Agreement as an invited signatory, and the Naval History and Heritage Command is participating as a concurring party.

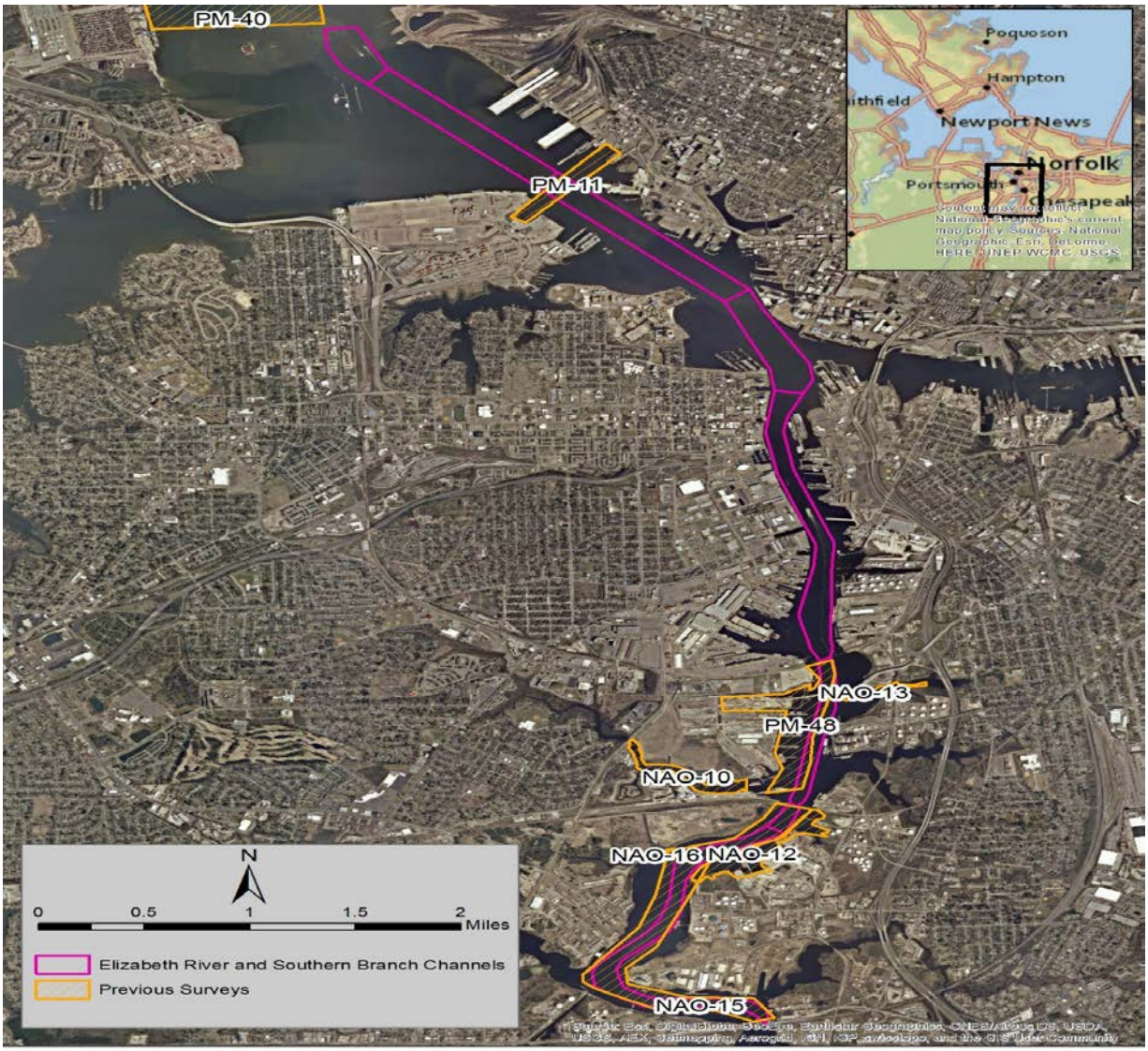


Figure 2-14. Previous Archaeological Surveys in Segment 1

2.19 Aesthetics

The ROI for visual resources is the residential, recreational, and tourist sites with views of the Elizabeth River channels and the dredged material handling and placement sites. All dredged material that meets the contamination criteria of the Craney Island Dredged Material Management Area (CIDMMA) will be disposed of therein, but material that exceeds the CIDMMA contamination limits would be disposed of at upland landfills after being treated at the Port Weanack Land, LLC soil processing facility in Charles City, Virginia.

The visual experience is dependent upon the pattern of the land (i.e., the topography), the pattern of water bodies, vegetation, and manmade development at any location. Within the vicinity of the proposed project, the topography is relatively flat. Because much of the ROI is low elevation with very slight relief, viewers can generally see long distances from locations that are only slightly higher than the surrounding area.

Views along the Elizabeth River include a waterfront with a mix of industrial, commercial, naval, marine, and urban shoreline uses. South of the downtown areas, the Elizabeth River waterfront is highly industrialized and includes many facilities that support the U.S. Navy and the commodities shipping industry (Navy 2009). Figure 2-15 illustrates the extent of waterfront development for commercial, industrial, and military use; the photograph is looking north within the Southern Branch of the Elizabeth River with the Norfolk and Plymouth Belt Line (N&PBL) railroad lift bridge in the foreground.

Throughout the ROI, there are numerous towering cranes and related land-side infrastructure used for loading and unloading ships along the waterfront. Navigation within the ROI includes large Navy vessels, commercial deep draft navigation vessels, smaller tugs and service vessels, as well as small recreational vessels. There are attractive waterfronts in downtown Norfolk and Portsmouth that include marinas, riverfront parks, and tourist venues, but all reflect the visual character of a highly industrialized, working waterfront.

Figure 2-15. Southern Branch Waterfront View

2.20 Recreation

The ROI for recreation is limited to those waters and upland areas within, and adjacent to, the channel segments to be dredged and dredged material placement sites. Although opportunities for recreation are present within the ROI, the major use of the Elizabeth River within the ROI is for marine vessel navigation to and from marine terminals and shipyards via the Norfolk Harbor and Channels (Navy 2009). Most of the Elizabeth River is not swimmable due to bacterial contamination (the exception being the Lafayette River, the northeastern branch of the Elizabeth River), which limits water-contact recreational opportunities.

Recreational boaters use the Elizabeth River for access to downtown Norfolk and Portsmouth and other attractions along the river as well as for access from points upstream to Hampton Roads waters and the Chesapeake Bay (Navy 2009). Recreationalists use the Elizabeth River for access to the James River, Hampton Roads, the Chesapeake Bay, and the Atlantic Ocean. Along the Norfolk and Portsmouth waterfront there are many recreational attractions that draw recreationists to the waterfront, such as concert venues. Several marinas and sailing clubs with

docks and boat ramps are within the ROI (Navy 2009). Recreational fishing in the Elizabeth River occurs mostly from boats and includes estuarine and marine fish species (e.g., Atlantic croaker, grey sea trout, striped bass, summer flounder, and bluefish) as well as blue crab (Navy 2009); the Elizabeth River is closed to commercial or recreational harvesting of shellfish (e.g., clams and oysters) (Navy 2009).

Between 1607 and 1609 Englishman John Smith mapped nearly 3,000 miles of the Chesapeake Bay and its tributary rivers. In 2006, the U.S. Congress designated the waterway routes of Smith's explorations of the Chesapeake as a national historic trail, establishing the first national water trail (NPS 2016); the most southeastern segment of the trail includes the Elizabeth River.

The Elizabeth River Trail is a 10.5-mile biking and pedestrian trail within the City of Norfolk that follows a railroad right-of-way between Harbor Park Stadium and the Norfolk International Terminals (see Figure 2-16). The trail provides recreational and educations opportunities, views of Norfolk's waterfront, and an alternate mode of transportation from the Norfolk Naval Base into downtown Norfolk. In addition, the Elizabeth River Park is also within the ROI providing an important boat launch access for power boats, sea kayaks, and other vessels for recreationists. The City of Chesapeake renovated the park in 2015 by adding multiple shelters and gazebos, improved docking facilities, a dog park, and a paved trail around the park with ADA access (City of Chesapeake 2016).

Paradise Creek Nature Park opened in 2013 and is located near the left descending bank of the Southern Branch of the Elizabeth River in Portsmouth. This 40-acre park was created by the non-profit organization The Elizabeth River Project, in collaboration with the City of Portsmouth, Port of Virginia, and many other partners. The purpose of the Paradise Creek Nature Park is to show visitors how a river can be restored after decades of urban degradation; the park hosts volunteer service days, park tours, and many other environmental education activities and programs (ERP 2016).

Figure 2-16. Elizabeth River Trail Map

2.21 Socioeconomics and Environmental Justice

Socioeconomics include the basic attributes of demographics and economic characteristics within a particular area including population, race, employment, and income. As shown in Figure 2-17, the ROI for socioeconomics is the U.S. Census Bureau's Virginia Beach-Norfolk-Newport News, VA-NC Metropolitan Statistical Area (MSA), which encompasses 15 jurisdictions: the cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach and Williamsburg; the Virginia Counties of Gloucester, Isle of Wight, James City, Southampton, and York; and the North Carolina Counties of Currituck and

Gates (HRPDC 2013b). At the time of the 2010 U.S. Census, Surry County was included in the MSA, while Gates County was not (HRPDC 2013a). The 2010 decennial census data are used to summarize the socioeconomic characteristics within the ROI unless otherwise noted (U.S. Census Bureau 2010).

Population

The U.S. Census Bureau's 2010 Census reported that the population of the MSA was 1,671,683 (U.S. Census Bureau 2010). Table 2-19 compares the population data from the 2000 and 2010 census and calculates the percent change for each of the municipal boundaries that were within the Hampton Roads MSA at the time the respective census was taken.

Income

The Hampton Roads Planning District Commission (HRPDC) is a regional organization that represents local governments in Hampton Roads and does extensive research and reporting on the demographic and economic characteristics within the area. In 2014, HRPDC published a Benchmarking Study with a section focused on regional economy statistics (HRPDC 2014). The U.S. Census Bureau's five-year American Community Survey for the MSA reported per capita income of $28,954, median household income of $59,293, and unemployment was 7.9-percent (U.S. Census Bureau 2014).

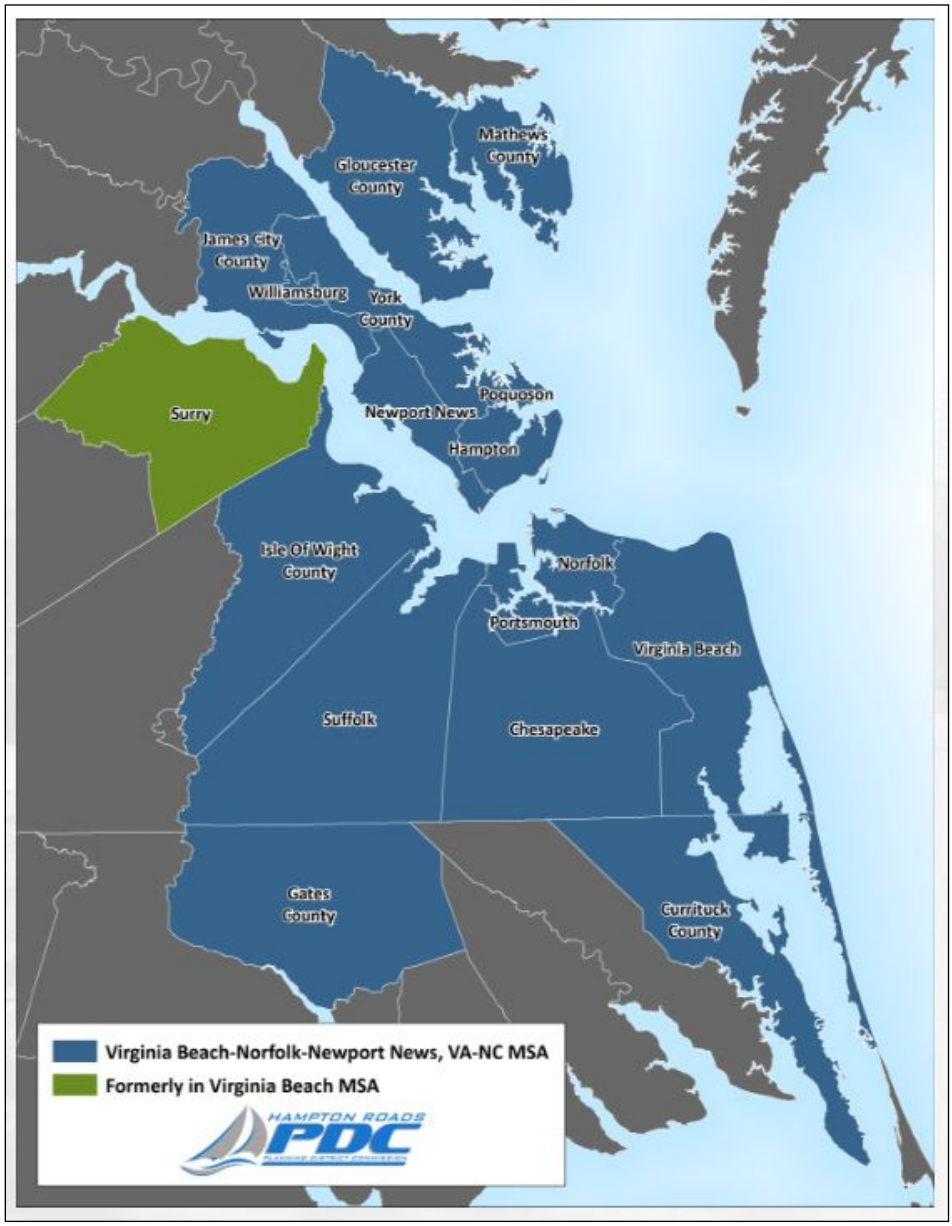


Figure 2-17. Virginia Beach-Norfolk-Newport News, VA-NC MSA

Table 2-19. Virginia Beach-Norfolk-Newport News, VA-NC MSA Population

MSA Component	2000 Census	2010 Census	Percent Change
Virginia Cities			
Chesapeake	199,184	222,209	11.6
Hampton	138,437	137,436	-0.7
Newport News	180,150	180,719	0.3
Norfolk	234,403	242,803	3.6
Poquoson	11,566	12,150	5.1
Portsmouth	100,565	95,535	-5.0
Suffolk	63,677	84,585	32.8
Virginia Beach	425,257	437,994	3
Williamsburg	11,998	14,068	17.3
Counties			
Currituck Co., NC	18,190	23,547	29.5
Gates Co., NC	10,516	12,197	16
Gloucester Co., VA	34,780	36,858	6
Isle of Wight Co., VA	29,728	35,270	18.6
James City Co., VA	48,102	67,009	39.3
Surry Co., VA	6,829	7,058	3.4
York Co., VA	56,297	65,464	16.3
Total MSA Population[4]	1,569,679	1,674,902	6.7

Local Economy

The total economic impact in Virginia in FY 2013 directly and indirectly attributable to the Port of Virginia was $60.3 billion in spending (Pearson and Swan 2014). Some of this spending was for goods and services produced outside of Virginia, but the Virginia value-added to the Gross State Product (GSP) was $30.5 billion, equal to 6.8-percent of the estimated $448.8 billion total GSP in FY 2013 (Pearson and Swan 2014).

The Hampton Roads area has the largest concentration of military bases and facilities of any metropolitan area in the world and the employment in Hampton Roads consists mainly of military personnel and Federal civilians as well as other industries that are connected to the Department of Defense. The healthcare sector has experienced significant growth in recent years, and was the only industry that added employment continuously throughout the 2008 recession.

Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Population and Low-Income Populations, directs Federal agencies to identify and address, as

[4] Includes all counties within the MSA for both the 2000 and 2010 census.

appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations[5] (Executive Order, 1994). When conducting NEPA evaluations, the USACE incorporates Environmental Justice (EJ) considerations into both the technical analyses and the public involvement (CEQ 1997).

The CEQ guidance defines "minority" as individual(s) who are members of the following population groups: American Indian or Alaskan native; Asian or Pacific Islander; Black, not of Hispanic origin; and Hispanic (CEQ 1997). The Council defines these groups as minority populations when either the minority population of the affected area exceeds 50-percent of the total population, or the percentage of minority population in the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographical analysis.

Low-income populations, as defined for the purposes of EJ analyses, are identified using statistical poverty thresholds from the Bureau of the Census Current Population Reports, Series P-60 on Income and Poverty (U.S. Census Bureau 2010). In identifying low-income populations, a community may be considered either as a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect. The threshold for low-income status for the 2010 census was an income of $10,956 for an individual and $21,954 for a family of four (U.S. Census Bureau 2010). This threshold is a weighted average based on family size and ages of the family members.

Executive Order 12898, "*Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*," issued in 1994, directs Federal and state agencies to incorporate EJ as part of their mission by identifying and addressing the effects of all programs, policies and activities on minority and low-income populations.
The fundamental principles of EJ are as follows:

> (i) Ensure the full and fair participation by all potentially affected communities in the decision-making process;
>
> (ii) Prevent the denial of, reduction in or significant delay in the receipt of benefits by minority and low-income populations; and
>
> (iii) Avoid, minimize or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations.

The following table shows the 2010 U.S. census population and the ethnic mix (as a percentage) for each of the cities and counties located within the Virginia Beach-Norfolk-Newport News, VA-NC MSA (Table 2-20).

[5] Low-income is defined as a person whose household income is at or below the Department of Health and Human Services poverty guidelines.

Table 2-20. Percent Race and Poverty by County, 2010 Census

City or County	2010 Population	White	Black	Native American	Hispanic	Percent Below Poverty
Chesapeake	222,209	62.6	29.8	0.4	4.4	8.3
Hampton	137,436	42.7	49.6	0.4	4.5	14.7
Newport News	180,719	49.0	40.7	0.5	7.5	14.5
Norfolk	242,803	47.1	43.1	0.5	6.6	18.2
Poquoson	12,150	95.1	0.6	0.3	1.8	4.1
Portsmouth	95,535	41.6	53.3	0.4	3.1	17.5
Suffolk	84,585	52.3	42.7	0.3	2.9	11.6
Virginia Beach	437,994	67.7	19.6	0.4	6.6	7.4
Williamsburg	14,068	74.0	14.0	0.3	6.7	18.4
Currituck Co., NC	23,547	90.3	5.8	0.5	3.0	8.9
Gates Co., NC	12,197	63.7	33.2	0.5	1.4	17.0
Gloucester Co., VA	36,858	87.2	8.7	0.4	2.5	9.1
Isle of Wight Co., VA	35,270	71.8	24.7	1.0	1.9	10.5
James City Co., VA	67,009	80.3	13.1	0.3	4.5	8.7
Surry Co., VA	6,829	51.3	46.1	0.3	1.2	10.8
York Co., VA	65,464	76.4	13.4	0.4	4.4	5.4

In 2013, the Hampton Roads Transportation Planning Organization (HRTPO) created an Environmental Justice Methodology Tool that can be used to identify potential environmental justice issues in an area (HRTPO 2015).

2.21.1 Land Use and Induced Development

Land use is a general term used to describe how land is or may be utilized or developed within a given area and typically includes industrial, commercial, residential, agricultural, and parks and open space. Because of the extent of property dedicated to military activities in the project area, military is also a defined land use category. The ROI for the land use analysis is limited to those shoreline and adjacent upland areas proximate to the proposed navigation improvements as well as land use near dredged material placement areas. All dredged material that meets the contamination criteria of the Craney Island Dredged Material Management Area (CIDMMA) will be disposed of there, but material that exceeds the contamination limits will be disposed of at upland landfills. The most viable upland landfill is the Charles City County Landfill in Providence, Virginia (VDEQ Permit No. SWP531), followed by the Bethel Landfill in Hampton, Virginia (VDEQ Permit No. SWP580) and the King and Queen Sanitary Landfill in Plymouth, Virginia (VDEQ Permit No. SWP554). Material may need to be mixed with cement at the Port Tobacco/Weanack Land, LLC soil processing facility in Charles City, Virginia (Virginia Pollutant Abatement Permit No. VPA00579) before landfill disposal.

Existing land uses in the ROI consist of industrial features from the Port of Virginia (e.g., Norfolk International Terminals, Virginia International Gateway, Norfolk Southern Railroad, Portsmouth Marine Terminals, Lamberts Point Coal) and military uses (e.g., Norfolk Naval Shipyard, Lamberts Bend Deperming Station), municipal parks (e.g., Hospital Point Park, Town Point Park, Portsmouth's River Front Park), marinas (e.g., Tidewater Yacht Marina, Waterside Marina, Ocean Marina Yacht Center) and very limited residential areas. The CIDMMA is an approximately two square-mile industrial dredged material disposal area located on the western shore of the mouth of the Elizabeth River. Throughout the ROI, actions to modify the existing channel would all be conducted where the adjacent shorelines are dominated by industrial land use in an urban context.

The Hampton Roads Transportation Planning Organization (HRTPO) has created a regional land use map by merging sixteen local comprehensive plans and existing land uses into a single data set that encompasses the ROI (HRTPO 2011). The following table (Table 2-21)shows the categories and descriptions of the land use categories assigned in the HRTPO's Regional Land Use Classification System that are then depicted in Figure 2-18. The majority of land use within the ROI is classified as industrial (purple) and military (blue). Industrial uses in the ROI include the Port's Norfolk International Terminals, the Norfolk Southern Coal Terminal at Lamberts Point, and the Virginia International Gateway Terminal. There is very little land designated for commercial use in the ROI (HRTPO, 2011).

Table 2-21. HRTPO's Regional Land Use Classification System

Activity	Classification	CODE	Description
Residential	Rural Residential	RR	Encompasses residential uses with <1 dwelling units per acre (SFR >40,000 Sq. Ft lots
	Low Density Residential	RLD	Encompasses residential uses with 1-4 dwelling units per acre (12,000 - 40,000 Sq. Ft lots)
	Medium Density Residential	RMD	Encompasses residential uses with 4 - 12 dwelling units per acre (SFR <12,000 Sq. Ft lots)
	High Density Residential	RHD	Encompasses residential uses with >12 dwelling units per acre
Commercial	Neighborhood Commercial	CN	Encompasses limited scale shopping, business, or trade activity
	Community Commercial	CC	Encompasses inter-neighborhood shopping, business, or trade activity
	Regional Commercial	CR	Encompasses regional shopping, business, or trade activity
Industrial	Light Industrial	IL	Encompasses light industrial uses (Research & Development, warehousing, service, etc)
	Heavy Industrial	IH	Encompasses heavy industrial uses with possible adverse environmental impacts (manufacturing, etc)
	Port / Aviation Industrial	IPA	Encompasses Port, General and Commercial Aviation related industrial operations
Mixed Use	Mixed Use Commercial/Residential	MCR	Encompasses commercial/ residential mixed use activity
	Mixed Use Commercial/Industrial	MCI	Encompasses commercial/ industrial mixed use activity
Military	Military	MM	Encompasses military related facilities
Institutional	Utilities	IU	Encompasses utility facilities
	Public/Semi-Public	IP	Government/Educational/Religious/Social or healthcare facilities
	Transportation Network	IT	Encompasses transportation facilities
Agriculture	Agricultural	AA	Encompasses agricultural operations
Vacant	Vacant	V	Encompasses vacant developable lands
Parks, Open Space, & Greenways	Parks and Recreation	NP	Encompasses open space and recreational uses
	Resource Conservation	NC	Encompasses conservation lands
	Historic /Cultural	NH	Encompasses Historic Preservation / Cultural uses

Source: HRTPO, 2011

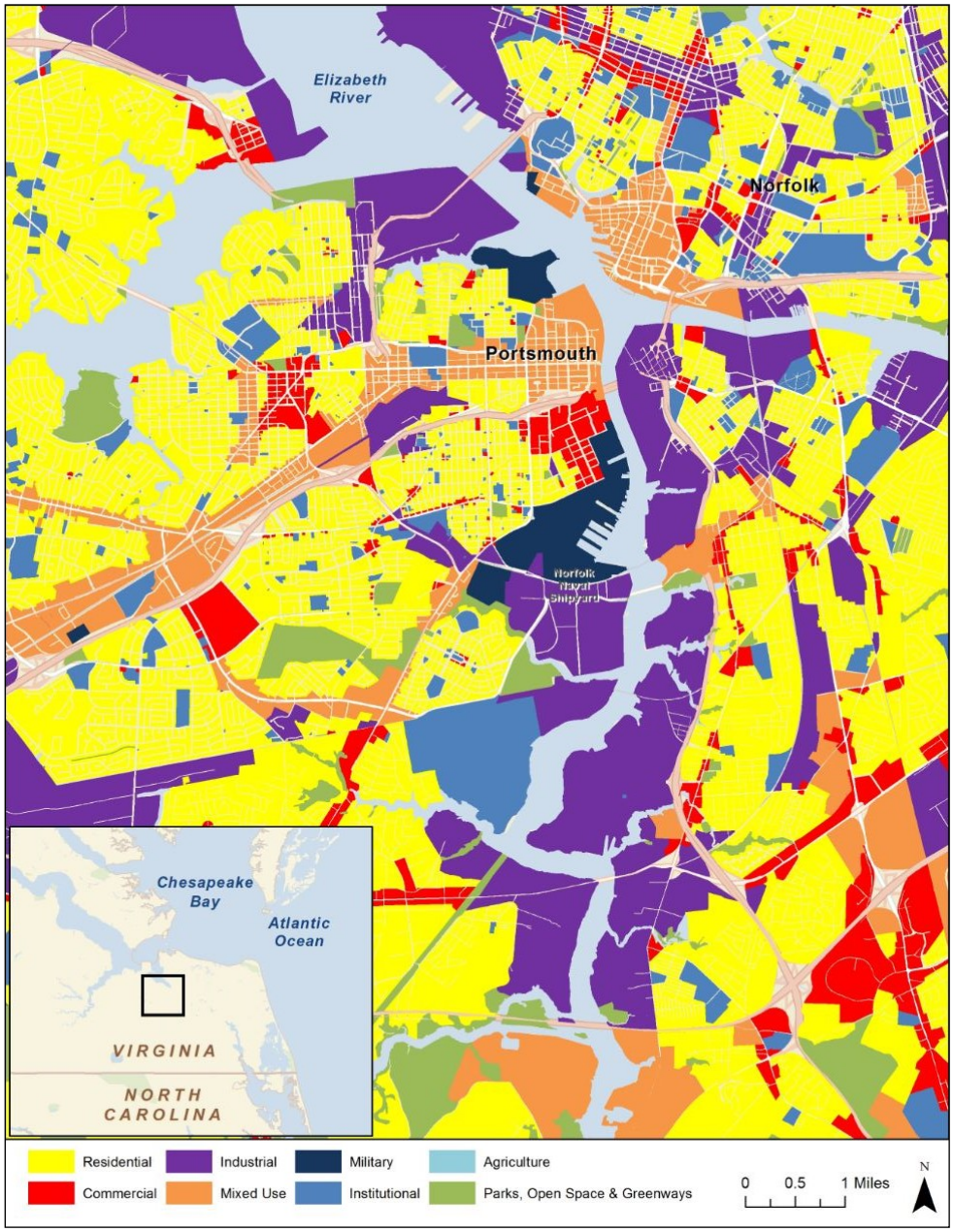


Figure 2-18.Land Use Adjacent to Elizabeth River

2.22 Transportation

The ROI for transportation and traffic is defined as those regionally significant roadway segments that presently accommodate the movement of freight into and out of the Hampton Roads region and would provide trucks and worker vehicles with access to the various Port of Virginia terminals. Because traffic congestion is a regional issue, data is not limited to facilities on the Elizabeth River and Southern Branch of the Elizabeth River, but are presented for all of the Port of Virginia facilities, including Newport News Marine Terminal and the Dominion Coal Terminal on the James River.

General

The Hampton Roads Planning District Commission (HRPDC) represents 17 local governments "*to encourage and facilitate local government cooperation and state-local cooperation in addressing on a regional basis problems of greater than local significance*." [6] The HRPDC serves as a resource of technical expertise to its member local governments and provides assistance on local and regional issues, including transportation. The HRPDC staff also serves the Hampton Roads Transportation Planning Organization (HRTPO), providing urban and regional transportation planning expertise. The HRTPO is the Metropolitan Planning Organization (MPO)[7] for the Hampton Roads Metropolitan Planning Area (MPA).

Hampton Roads is a multimodal region that includes ports, airports, rail, private trucking, shipping and warehouse distribution facilities, as well as a network of road and rail corridors for the delivery of freight, goods, and services (HRTPO 2014). Trucks are the primary mover within this system and are responsible for delivering the majority of what local citizens consume and use on a daily basis. The Port of Virginia conducts international trade of containerized, bulk, break-bulk, and roll-on/roll-off cargo; railroads (e.g., Norfolk Southern and CSX) transport various commodities, such as coal, automobiles, and chemicals (HRTPO 2014).

The HRTPO is responsible for transportation planning and decision-making in the region and has annually prepared a report detailing average weekday traffic volumes for major roadways in Hampton Roads since 2006 (HRTPO 2015). Since 2012, this analysis has included roadway speed data sourced from millions of GPS-enabled fleet vehicles (e.g., taxis, delivery vans, trucks) and data from smartphone users allowing an analysis of peak period roadway congestion levels based on volumes and speeds. The current HRTPO annual report on volumes, speeds, and congestion on major roadways in Hampton Roads has a robust evaluation of congestion in the ROI (HRTPO 2015).

In 2014, 17,100 trucks entered or exited Hampton Roads through major gateways each weekday (HRTPO 2015a). The number of trucks passing through Hampton Roads gateways has increased each of the last two years for which data are available (2013-2014), but the number of trucks is still much lower than the levels seen before the economic downturn that started in 2008 (HRTPO 2015a). For example, more than 20,000 trucks passed through major gateways in 2007, just prior to the recession (HRTPO 2015a).

There was a total of 1.22 million miles of truck travel each day in Hampton Roads in 2013 according to VDOT estimates, which accounted for 3.1-percent of the 39 million vehicle-miles of travel experienced each day throughout the region (HRTPO 2015a). Even though regional truck travel increased 7-percent from 2012 to 2013, truck travel levels are still 15-percent lower than those seen in 2007 (HRTPO 2015a).

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[6] The member localities within the HRPDC are the cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Smithfield, Suffolk, Virginia Beach, and Williamsburg as well as Gloucester, Isle of Wight, James City, Southampton, and Surry Counties.

[7] Federal regulations require that urbanized areas throughout the United States have a Metropolitan Planning Organization (MPO) to conduct a continuing, cooperative, and comprehensive transportation planning process. A Metropolitan Planning Organization (MPO) is a transportation policy-making organization comprised of representatives from local, state, and federal governments; transit agencies; and other stakeholders.

Although the amount of freight handled by the Port of Virginia now exceeds the levels prior to the economic downturn, the amount of truck travel both in Hampton Roads and at the gateways to the region is still well below pre-recession levels, as cited above. One reason is that Port of Virginia trucks only represent a small percentage of all regional truck travel; approximately 10-percent of all regional truck travel is originating from, or destined to, the Port of Virginia according to an HRTPO analysis of Port data (HRTPO 2015a). Additionally, an increasingly larger percentage of the Port's freight that was previously handled by trucks is now being transported by rail.

In 2005, 67-percent of all freight handled by the Port was transported by truck, while 25-percent was transported by rail (HRTPO 2015a). In 2014, freight transported by truck decreased to 63-percent, with rail's share increasing to 33-percent; the Port of Virginia anticipates that the share of freight transported by truck will continue to decrease in the future, and that 40 to 50-percent of cargo handled by the Port may eventually be transported by rail (HRTPO 2015a).

In an effort to plan effectively for moving freight and improving system performance, the HTRPO has also completed two studies evaluating the existing conditions involving freight movement in the area: the Hampton Roads Regional Freight Study (HTRPO 2012) and Existing and Future Truck Delay in Hampton Roads (HRTPO 2013). Figure 2-19 depicts the predicted change in 24-hour, weekday truck volumes (2010 existing to 20-year forecast) as estimated by the HRTPO.

Roadway congestion is a primary concern facing the users of the Hampton Roads transportation system. In order to evaluate current roadway conditions, assess regional transportation needs, and outline strategies to manage current and future roadway congestion, the HRTPO staff maintains a Congestion Management Process (CMP). The CMP is an ongoing program in which congestion in the multi-modal, regional transportation system is evaluated and for which improvements are recommended. In addition, the CMP is used as a guide to develop recommendations for the HRTPO's Transportation Improvement Program (http://www.hrtpotip.org/) and the Long-Range Transportation Plan (http://www.hrtpo.org/page/long-range-transportation-planning-(lrtp)/).

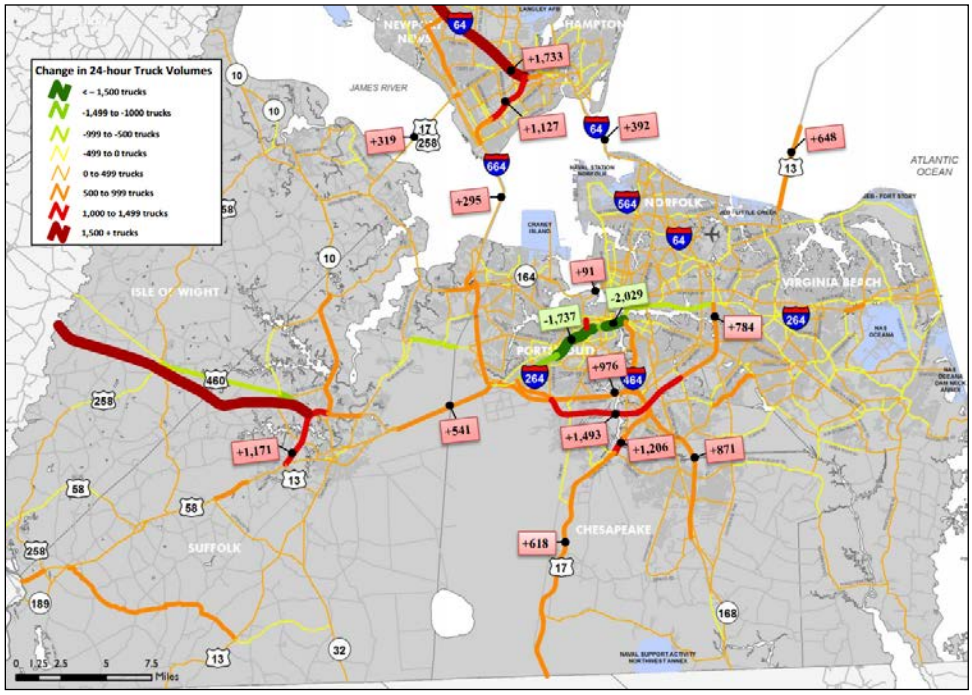

Figure 2-19. 20-Year Predicted Change in Weekday Truck Volumes

In 2014, the Port of Virginia ranked third among East Coast ports in the volume of containerized cargo handled. Hampton Roads is the largest exporter of coal in the country and nearly 42 million tons of coal were shipped through the region in 2014 (HRTPO 2015). Understanding how the bulk or containerized commodities move from deep draft vessels onto surface transportation modes (truck or rail) or from truck and rail to deep draft vessels requires an understanding of how the Port of Virginia cargo and coal facilities operate.

Port Facilities on the Elizabeth River and Southern Branch

The reaches of the Elizabeth River and Southern Branch of the Elizabeth River Project are heavily industrialized, providing marine access to numerous industrial facilities and Norfolk Naval Shipyard (NNSY). The following lists the active terminals and maritime facilities located on the reaches. Note that there are no currently active terminals along Upper Channel Reaches B, although the reach does include the site of a former coal fired Dominion Generation Corporation power generation facility.

Port Facilities/Terminal Operators adjacent to the Southern Branch of the Elizabeth River Lower Reach include:

- Tidewater yacht marine: marina and boatyard.
- Ocean Marine Yacht Center: Marina and boatyard;
- BAE Systems – Norfolk Ship Repair: Naval shipyard
- General Dynamics: Naval shipyard;
- U.S. Gypsum: Aggregates, sand, stone;
- Arc Terminal: Petroleum products;

- Kerneos Aluminate Technologies: high alumina cement production; and
- Norfolk Naval Shipyard: Naval shipyard and Navy Base.
- Apex Oil Terminal: Petroleum products; and
- Perdue Farms: Grains, Liquid bulk food products
- Enviva Wood Pellet Terminal: Wood pellets;
- Hess Oil: Petroleum products;
- Kinder Morgan Money Point Terminal: Aggregates, sand, stone;
- DCP Midstream Propane Terminal: Propane and other natural gas liquids; and
- Elizabeth River Recycling: Scrap metal
- Precon Marine: Heavy marine construction and waterfront construction contractor; and Tri-port Fuel Pier

Analysis of the data returned over 80 different terminal locations (some active, some inactive). These were aggregated into the 27 terminals shown in **Error! Reference source not found.**-22.

Table 2-22: Dock Aggregation

Dock	Channel	Planning Segment	Commodities
LAMBERT POINT DOCKS	Lambert Bend to Pinner Point	ERSB-Segment-1	Dry-Bulk Grains, Barge Aggregates, Dry-Bulk Fertilizers, Ores & Minerals, Wood Pellets, Lards Fats & Oils, Liquid Bulk Chemicals, Petroleum, General Cargo, Passenger Cruises
PINNERS POINT DOCKS	Pinners Point to Town Point Reach		
CRUISE TERMINAL	Town Point Reach		
TOWN POINT REACH DOCKS			
EAST BRANCH DOCKS			
US GYPSUM	Southern Branch - Lower Reach		
BERKLEY DOCKS			
ELMSLEY DOCKS			
TRANSMONTAIGNE			
ARC TERMINALS			
JORDAN BRIDGE DOCKS			

PERDUE FARMS TERMINAL APEX TERMINAL PARADISE POINT DOCKS ENVIVA TERMINAL	Southern Branch - Middle Reach		
KINDER MORGAN SOUTH HILL TERMINAL	N&W Railway Lift Bridge Reach	ERSB-Segment-2	Liquid Bulk Petroleum Products, Dry & Liquid Bulk Chemicals, Ores & Minerals, Liquid Bulk Fertilizers, LPG, Aggregates, General Cargo, Scrap Iron
BUCKEYE-HESS TERMINAL KINDER MORGAN SOUTHEAST TERMINAL MONEY POINT DOCKS SOUTHERN AGGREGATES MILLDAM CREEK DOCKS KINDER MORGAN ELIZABETH RIVER TERMINAL SOUTHERN STATES RECYCLING TERMINAL	Gilmerton Bridge Reach		
TRIPORT TERMINAL	Gilmerton Bridge Reach to End of Newton Creek Turning Basin	ERSB-Segment-3	Petroleum, Fertilizers, Chemicals, Aggregates
NEWTON CREEK DOCKS TERMINUS DOCKS	End of Newton Creek Turning Basin to Upstream Limit		

3 FEATURES AND ECONOMIC CONDITIONS

This section presents the projected future navigation features and economic conditions without the implementation of a Federal project. The Without Project condition describes the most likely view of the future if no new action is taken to correct the problems and realize the opportunities identified in the planning process. The Without Project condition is used as the basis for comparison for every planned solution the planning team formulates.

3.1 NAVIGATION FEATURES – CHANGES FROM EXISTING CONDITION

3.1.1 Channels, Turning Basins, Terminal Facilities, and Bridges

Under the future Without Project condition, there would be no channel and turning basin modifications to the ERSB project. The USACE will continue to maintain the existing Federal channel and it is anticipated that the Department of the Navy will continue to maintain its' 47-foot segment of the Federal channel. Under the Without Project condition, the maintenance dredging actions that would take place (e.g., dredge operation, pumps, tug/truck transportation, and final placement) would generate emissions related to the combustion of diesel fuel.

It is projected that no significant upgrades or improvements to the Terminal Facilities located along the waterway would take place and that companies would continue maintain their properties and water depths at their docks.

There are a number of larger-scale construction projects within the study that would be expected to be completed under the Without Project condition including:

- Channel modifications to the Norfolk Harbor and Channels Project,
- Norfolk International Terminals Piers 1 and 2 removed, with area deepened to -50 feet,
- Craney Island Eastward Expansion – full build-out (USACE 2006), and
- I-64 High Rise Bridge Corridor (City of Chesapeake 2014).

3.1.2 Without--Project Maintenance Dredging

The Southern Branch Project's constructed depth and width have been maintained through periodic dredging operations. The following table shows the historical dredging quantities removed from the Southern Branch Project between 1980 and 2016 (Table 3-1). Over that 36-year period, Segment 1 has had almost 1.2 million cubic yards of material removed and Segment 2 has had almost 620,000 cubic yards with the most recent maintenance dredging in these segments being completed in 2003 and 2004, respectively. The 1.5 mile long, upstream most reach of Segment 3 (Upper Channel Reach C) has never had maintenance dredging performed.

Table 3-1. ERSB Historical Maintenance Dredging

Segment	Dredging Volume (CY)	Year	Placement Location
Segment 1	538,611	1991	CIDMMA

Segment	Dredging Volume (CY)	Year	Placement Location
	341,707	1993	CIDMMA
	100,577	1997	CIDMMA
	201,675	2003	CIDMMA
Total	1,182,570		
Segment 2	239,271	1981	CIDMMA
	172,894	1989	CIDMMA
	74,118	1993	CIDMMA
	29,243	1995	CIDMMA
	21,800	1999	CIDMMA
	82,049	2004	CIDMMA
Total	619,375		
Segment 3	13,128	1999	CIDMMA
	45,234	2004	CIDMMA
Total	58,362		
Source: (USACE, 1994; USACE, 2016)			

Under the future Without Project condition, there would be no channel modifications to ERSB. However, routine USACE maintenance of the existing Federal channel are assumed to require dredging a portion of the ERSB project area during 17 of the 50 years in the period of analysis (2023-2073). As shown in Table 3-2, dredging actions would remove approximately 2,820,000 cubic yards of dredged material over the 50-year period of analysis.

The frequency of dredging actions in the future is projected for analysis, but is not reliably predicted; the frequency and extent of maintenance dredging that occurs on a Federal project is typically strongly influenced by budget availability. Although Table 3-2 shows 23 dredging events over the 50-year period of analysis, some years are assumed to have multiple segments dredged during the same cycle, so the total number of dredge events is assumed to be 17.

Table 3-2. Without Project Maintenance Dredging Quantities

Segment	Volume per Dredge Event (CY)	Number of Dredging Events in 50 YRS	TOTALS (CY)
Segment 1			
Eliz River Reach	235,000	7	1,650,000
Lower Reach	50,000	2	100,000
Middle Reach	25,000	2	50,000
Segment 2			
Upper Channel Reach A	90,000	10	900,000
Segment 3			
Upper Channel Reach B	60,000	2	120,000
Upper Channel Reach C	0	0	0
Totals		17	2,820,000

Under the Without Project condition, material would be placed into the CIDMMA, NODS, or in landfills, depending on source of the material being generated and whether the CIDMMA has been filled. Current estimates are that the CIDMMA will be filled in 2038. Until 2038, all maintenance-generated dredge material placement would be placed into CIDMMA. Once filled, the continued maintenance of the Southern Branch Project would require the use of offshored disposal at NODS. This would require use of a split hull dump barge to haul the material to NODS for placement at NODS.

3.2 ECONOMIC CONDITIONS -- PROJECTED GROWTH

3.2.1 Socio-Economics

Long-term forecasts for the region surrounding the ERSB indicate continued growth of both population and employment, but at slower rates than has been experienced in the past decades. The HRPDC's Hampton Roads *2040 Socioeconomic Forecast* predicts that the population and employment within the Hampton Roads MSA will both increase by 2040. The HRPDC has estimated population growth for the constituent counties and cities as listed in Table 3-3; the total population is projected to increase from 1,666,310 in 2010 to 2,037,000 (approximately 22-percent) by 2040.[8]

Table 3-3. Hampton Roads Planning District Commission Predicted Population Change

City or County	2010 Population	2040 Population Forecast	Percent Change
Chesapeake	222,209	314,600	41.58

[8] Hampton Roads Planning District Commission (HPRDC). 2013a. Hampton Roads 2040 Socioeconomic Forecast. Retrieved from: http://www.hrpdcva.gov/uploads/docs/2040_Final_Forecast_Tables_for_HRPDC.pdf.

City or County	2010 Population	2040 Population Forecast	Percent Change
Hampton	137,436	137,200	-0.17
Newport News	180,719	189,100	4.64
Norfolk	242,803	253,200	4.28
Poquoson	12,150	12,400	2.06
Portsmouth	95,535	98,200	2.79
Suffolk	84,585	182,700	116.00
Virginia Beach	437,994	497,500	13.59
Williamsburg	14,068	17,200	22.26
Gloucester Co., VA	36,858	40,200	9.07
Isle of Wight Co., VA	35,270	62,800	78.06
James City Co., VA	67,009	104,200	55.50
York Co., VA	65,464	82,700	26.33

3.2.2 Port Operations

Commodity Forecast

The import and export commodity forecast and report completed by IHS were used to help inform trends for analysis of the future conditions. The trends taken from the IHS forecast were applied to the ERSB existing condition assessment to estimate future throughput over time by commodity, the results of which are shown in the following table (Table 3-4). Beyond the year 2045 commodity throughput was held constant through the end of the 50-year period of analysis (period of analysis is 2023 through 2072).

Table 3-4. Commodity Projections

Commodity Name	Assumption	2015	2023	2030	2035	2040	2045
Dry-Bulk Grains	Change over Time	2,788,735	3,322,894	3,974,839	4,356,438	4,710,435	5,029,599
Dry-Bulk Fertilizers	Change over Time	642,163	717,154	799,737	856,052	909,661	959,305
Dry-Bulk Aggregates	Change over Time	177,360	191,311	212,604	228,091	242,938	256,911
Barge Aggregates	Constant	1,123,198	1,123,198	1,123,198	1,123,198	1,123,198	1,123,198
Dry-Bulk Chemicals	Change over Time	212,682	306,957	429,304	528,280	639,003	760,959
Ores & Minerals	Change over Time	96,512	98,901	98,587	94,497	88,852	81,954
Lards Fats & Oils	Change over Time	154,217	154,217	154,217	154,217	154,217	154,217

Commodity Name	Assumption	2015	2023	2030	2035	2040	2045
Liquid-Bulk Petroleum	Change over Time	213,884	193,433	194,560	195,409	198,618	204,303
Barge Petroleum	Constant	1,007,950	1,007,950	1,007,950	1,007,950	1,007,950	1,007,950
Liquid-Bulk Fertilizers	Changes over time	372,655	416,725	465,347	499,789	534,675	569,550
Liquid-Bulk Chemicals	Changes over time	160,576	229,019	317,349	388,550	468,366	555,788
LPG/LNG	Changes over time	137,534	200,833	200,833	200,833	200,833	200,833
Scrap Iron	Changes over time	388,832	550,171	730,791	864,070	1,004,660	1,150,210
Wood Pellets	Changes over time	409,934	491,228	587,551	656,817	725,970	793,137
General Cargo	Changes over time	154,755	182,327	217,418	241,949	267,155	292,728
Passengers	Constant	47,734	47,734	47,734	47,734	47,734	47,734

Dry-Bulk Grains tonnage is expected to grow significantly (nearly double) from the 2015 starting tonnage to the 2045 projected tonnage (3-4). This is important because Dry-Bulk Grains is the commodity associated with many of the potentially benefitting Segment-1 trade units. Scrap Iron and Dry-Bulk Chemicals are two other examples of benefitting commodities that are projected to experience growth over the forecast period.

Fleet Forecast

Future fleet composition is assumed to be similar to existing conditions. There is no transition to larger vessels anticipated either with or without a Federal navigation project. The fleet is only anticipated to be loaded more efficiently in the FWP than in the FWOP in response to the depth measures.

Projected Cargo Traffic Characterization (Vessel Calls)

Because commodity growth is expected in the future, the number of annual vessel calls needed to carry this growing throughput is also expected to increase. The following table shows the estimated number of future calls by year needed to move commodities through the ERSB in the Without Project condition (Table 3-5). Note that the total number of calls increases from one year to the next throughout the forecast period (2023 - 2045).

Table 3-5. Estimated Number of Calls by Year – Future Without Project Conditions

Year	Planning Segment-1	Planning Segment-2 & 3	Total

2023	2591	1471	4062
2030	2811	1491	4302
2035	2951	1514	4465
2040	3099	1526	4625
2045	3232	1549	4781

4 PLAN FORMULATION

Preliminary plans were formulated by combining management measures. Each plan was formulated in consideration of the following 4 criteria described in the Principles and Guidelines (P&G):

- Completeness: Extent to which the plan provides and accounts for all necessary investments or actions to ensure realization of the planning objectives
- Effectiveness: Extent to which the plan contributes to achieving the planning objectives
- Efficiency: Extent to which the plan is the most cost-effective means of addressing the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment
- Acceptability: Workability and viability of the alternative plan with respect to acceptance by Federal and non-Federal entities and the public, and compatibility with existing laws, regulations, and public policies

PLAN FORMULATION RATIONALE

The underlying rational of the Planning Process is described in ER 1105-2-100 as "Formulation of Alternative Plans."

- Alternative plans are formulated to identify ways of achieving planning objectives within the project constraints, in order to solve the problems and realize the opportunities listed in Step 1 of the Planning Process which is to "Specify Problems and Opportunities."
- Structural and nonstructural management measures are identified and combined management measures to form alternative plans.
- Planners will keep focus on complete plan(s) while doing individual tasks, to ensure their plans address the problems of the planning area.
- Section 904 of the WRDA (Water Resources Development Act) of 1986 requires USACE to address the following during the formulation and evaluation of alternative plans:
    - Enhancing national economic development (NED) - including benefits to particular regions that are not transfers from other regions
    - Protecting and restoring the quality of the total environment
    - The well-being of the people of the United States
    - Preservation of cultural as well as historical values
- Nonstructural measures must be considered in the plan formulation process as means to address problems and opportunities.
- Revised costs of mitigation will be included in the final cost/benefit analysis.

Plan formulation has been conducted with a focus on achieving the Federal objective of water and related land resources project planning, which is to contribute to National Economic Development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Alternative plan development considered study area problems, opportunities, and constraints.

Alternative plan evaluation includes all effects, beneficial or adverse, to each of the four evaluation accounts identified in the Principles and Guidelines (1983), which are NED, Environmental Quality, Regional Economic Development, and Other Social Effects.

4.1 PROBLEMS, OPPORTUNITIES, AND PLANNING CONSTRAINTS

4.1.1 Problems

There are two major problems occurring on the Federal navigation project:

- The existing channel depth and configuration cause inefficiencies in maritime commerce.
- The existing channel configuration does not allow for Department of Defense (DOD) and commercial navigation activities to occur simultaneously.

Multiple issues were identified as contributors to these two major problems. For the first problem, existing channel depth and configuration cause inefficiencies in maritime commerce, specific issues include:

- Channel depth forces tide timing for large deep draft vessels. This restricts arrival and departure of vessels, contributes to congestion in the Federal channel, and results in inefficient use of berths. The effects of this are increased operating costs, delays, and customer service issues.
- Some deep draft vessels must 'light load' to safely navigate the channel, causing underutilization of vessel capacity.
- Insufficient draft at the turning basin at Money Point impacts safety of navigation and contributes to vessel congestion.
- There is no place within the channel for large ships to "meet," resulting in one-way traffic in the channel. This delays cargo schedules, causes port congestion, and berth inefficiency.
- Some turns in the channel are very sharp and difficult for large vessels to navigate, which may delay vessel transits through the channel.

The specific issues contributing to the second problem, existing channel configuration does not allow for DOD and commercial navigation activities to occur simultaneously, are:

- Commercial and recreational vessel navigation may be restricted in the Federal channel at times when U.S. Navy vessels are navigating the channel.
- The proximity of the Federal channel to Norfolk Naval Shipyard waterfront restricts vessel speed in the channel.

4.1.2 Opportunities

Opportunities are the desirable future outcomes which address the water resource problems and improve conditions in the study 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. Deeper channels would allow vessels to load more cargo and increase transportation efficiency of commodities. Additionally, 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 might reduce restrictions on vessels meeting or overtaking, which would reduce delays and transportation costs in the channel. Less restricted navigation could allow for more steady flow of vessels into berths and allow more efficient use of landside infrastructure.
- Reduce Impacts to Commercial Traffic due to DOD Activities. Improved channel configuration could possibly allow for both commercial and DOD activities to occur simultaneously. Improved anchorages could allow Navy and commercial users of the channels and anchorages to operate more efficiently.

- Improved safety of navigation. With channels designed to accommodate the fleet, navigational safety would likely be improved.

4.1.3 Planning Constraints

Constraints are conditions to be avoided or things that cannot be changed, which limit the development and selection of alternative plans. Specific constraints for this analysis include:

- Avoid impacts to existing bridges and tunnels. There are numerous tunnels and bridges (both rail and vehicle) located within the study area, many of which have been recently replaced or improved.
- The shoreline within the study area is heavily developed and the current Federal channel already occupies the majority of the waterway. The proximity of waterfront development (mostly industrial) along the waterway limits channel widening alternatives that are feasible for implementation.
- Avoid or minimize impacts to DoD Facilities and activities in the study area. This includes maintaining Antiterrorism/Force Protection buffer space required between the channel and Norfolk Naval Shipyard infrastructure and minimizing the hydrodynamic effects of passing ships. Also avoid or minimize impacts to buried assets (cables, sensors, etc.).
- Avoid or minimize impacts to natural and historic resources within the study area.
- Avoid or minimize impacts to various environmental mitigation and restoration sites within the study area.
- Avoid or minimize negative impacts associated with contaminated sediment and/or dredged material. The Southern Branch of the Elizabeth River has legacy sediment contamination from creosote plants and other industries that formerly operated along the River.
- Avoid or minimize impacts to recreational boaters and commercial fishermen that also utilize the channel.

4.1.4 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 study planning objectives and, consequently, to the Federal objective” (page 2-1). Plan formulation has been conducted for this GRR/EA with a focus on achieving the Federal objective of water and related land resources project planning, which is to contribute to National Economic Development (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 primary planning objective of this study is to reasonably maximize the Elizabeth River and Southern Branch of the Elizabeth River’s contribution to national economic development (NED), consistent with protecting the Nation’s environment, by addressing the physical constraints and inefficiencies in the existing navigation system’s ability to safely and efficiently serve the forecasted vessel fleet and process the forecasted cargo volumes. The specific objective for this study is to reduce cargo transportation costs for the existing and future fleet over the period of analysis on the Elizabeth River and Southern Branch of the Elizabeth River.

4.2 MANAGEMENT MEASURES, SCREENING, AND ALTERNATIVES

The management measures identified were developed with information gathered during discussions and interviews with Norfolk Harbor operations and management personnel, Norfolk Harbor Pilots Association, terminal operators, shipping agents, and tugboat operators that work in Norfolk Harbor. The PDT compiled a list of measures for this study during a meeting held on September 16th, 2015.

One structural measure, channel deepening, advanced through the screening process to be used in the development of alternatives. No nonstructural measures were carried forward. Management measure identification and screening are presented below.

4.3 Structural Measures

Structural measures identified as potential improvements to the Elizabeth River and the Southern Branch of the Elizabeth River include:

- Improve existing turning basins and/or create new turning areas
- Channel deepening
- Channel widening

4.3.1 Turning Basin Improvements

Expanding existing turning areas and/or creating new turning areas could potentially allow for larger, more efficient vessels to use the Elizabeth River and the Southern Branch of the Elizabeth River and might reduce congestion related delays. However, the width of the channel in the Elizabeth River and the Southern Branch of the Elizabeth River is constrained by shoreline development including bridge abutments, industrial facilities, and U.S. Navy facilities. Therefore, no additional widening or new turning basins were carried forward.

4.3.2 Channel Deepening

Deepening the existing channel (including current turning basins) could potentially allow for deeper and more efficient loading of the existing fleet and allow for the use of larger vessels in the Elizabeth River and the Southern Branch of the Elizabeth River. The evaluation of deepening will include the deepening of berthing areas and consider the use of tidal advantage. Tidal advantage is the use of high tide to provide additional underkeel clearance, which allows vessels with deep drafts to transit the channel. This is a common practice within the study area that is projected to continue into the future. The use of tidal advantage is included as a standard operating procedure in the evaluation of alternative plans.

4.3.3 Channel Widening

The width of the channel in the Elizabeth River and the Southern Branch of the Elizabeth River is constrained by shoreline development including bridge abutments, industrial facilities, and U.S. Navy facilities. Detailed channel design may identify areas to widen for navigational safety, but these potential widening efforts would not be aimed at improving economic efficiency. Widening the channel to allow vessel meeting or overtaking is impractical.

4.4 Nonstructural Measures

Non-structural measures identified as potential improvements to the Elizabeth River and Southern Branch of the Elizabeth River included:

- Reduce vessel speed in the channel;
- Increase the use of tugboat assistance to improve vessel maneuverability;
- Improve vessel scheduling and timing of transits (Vessel Traffic System); and
- Increase use of lightering.

4.4.1 Reduce Vessel Speed in the Channel

Reducing vessel speed while transiting the channel will reduce the amount of squat affecting the vessel. Reducing vessel squat would allow the vessel to ride higher in the water, thereby reducing the vessel's draft while transiting the channel. Implementation of vessel speed reduction is constrained by the need to maintain sufficient speed for maneuverability and the need to reduce crab angle when transiting the channel under windy conditions. The amount of squat reduction potentially gained by slowing to a minimum safe speed would be inconsequential because vessels typically operate at or very near this speed under existing conditions. Therefore, reducing vessel speed in the channel does not meet the planning objectives and is not carried forward.

4.4.2 Improve Vessel Scheduling and Timing of Transits (Vessel Traffic System)

Implementation of a Vessel Traffic System (VTS) could potentially reduce the need for restrictions on vessels meeting in the channel. Vessel Traffic Systems are used at the nation's busiest waterways, such as New York Harbor and the Sabine Neches Waterway and are implemented under the direction of the US Coast Guard. The traffic management system currently employed by the Norfolk Harbor Pilots includes ship to ship and ship to dispatch communication via radio/telephone as ships traverse the harbor. The existing traffic management system moves vessel traffic through the Federal channels as efficiently as current conditions allow and delays are not due to insufficient communication and coordination. Implementation of a VTS in The Elizabeth River and the Southern Branch of the Elizabeth River would add more traffic management resources to harbor operations, but would not improve on the traffic management system already in place. Therefore, implementing a VTS does not meet the planning objectives, and is not carried forward.

4.4.3 Increase Tugboat Assistance

Tugboats are used to improve the maneuverability of vessels that have slowed during channel transits, to turn vessels, and to dock vessels. The standard operating practices for tug assistance are sufficient for vessels currently using the channel. Additional tug assistance would not improve the efficiency of vessels transiting the channel because additional use of tugs would not improve vessel loading, increase the size of vessels using the channel, or appreciably increase vessel speed. Additional use of tugs is not carried forward.

4.4.4 Use Lightering

During a lightering operation, a vessel is loaded or unloaded to an operable draft in order to transit the channel. Most of the deeper draft channel transits are outbound coal transits. Lightering exports requires that the cargo on the vessel making the ocean transit be initially placed onto two light loaded vessels so that the cargo can exit the harbor. The cargo would be

consolidated onto one vessel by a cargo transfer operation that would occur in deep water. Lightering for bulk exports is an inefficient operation which is not currently practiced at the Elizabeth River and the Southern Branch of the Elizabeth River. This measure is not carried forward.

4.5 Local Service Facility Improvements

Increasing terminal efficiency through the use of more and/or larger cranes and other equipment enhancements could potentially reduce the vessel's time at the dock and/or allow for larger vessels to be loaded and unloaded efficiently. Enhancement options discussed with the users include:

4.5.1 Container Terminals

The use of more and/or larger ship-to-shore cranes could reduce the vessel's time at the dock and/or allow for larger vessels to be loaded and unloaded more efficiently. The impact of this measure is expected to be fairly limited, based on the recent reactivation of the single container terminal in the Elizabeth River channel, Portsmouth Marine Terminal, in 2014 to provide additional container handling capacity in the harbor. Its ship-to-shore cranes are capable of servicing vessels up to 17 containers wide. However, replacing these cranes with larger cranes would necessitate substantial and prohibitively expensive wharf improvements. The VPA is not pursuing substantial wharf improvements at the Portsmouth Marine Terminal and as a result, this measure is not carried forward for additional consideration.

4.5.2 Liquid and Dry Bulk Terminals

Bulk operations have a low-margin/high-volume model where operational efficiency is a critical focus during initial design and during ongoing process improvements. The existing bulk facilities are sufficient for the amount and types of cargo handled. Any marginal improvements to terminal facilities are not projected to have a substantial effect on reducing channel congestion. This measure is not carried forward for more detailed analysis.

4.6 Development of Planning Segments

As presented in *Section 1.9.1—Planning Segments Utilized for the Study*, the Elizabeth River and Southern Branch of the Elizabeth River channels are grouped into three planning segments for the purpose of formulating and evaluating alternative plans. Planning Segments 1, 2, and 3 are the lengths of river between Lamberts Bend to the Norfolk Southern Lift Bridge, the Norfolk Southern Lift Bridge to the Gilmerton Bridge, and the Gilmerton Bridge to the Chesapeake Extension, respectively. Figure 4-1 shows all segments and reaches on one map.

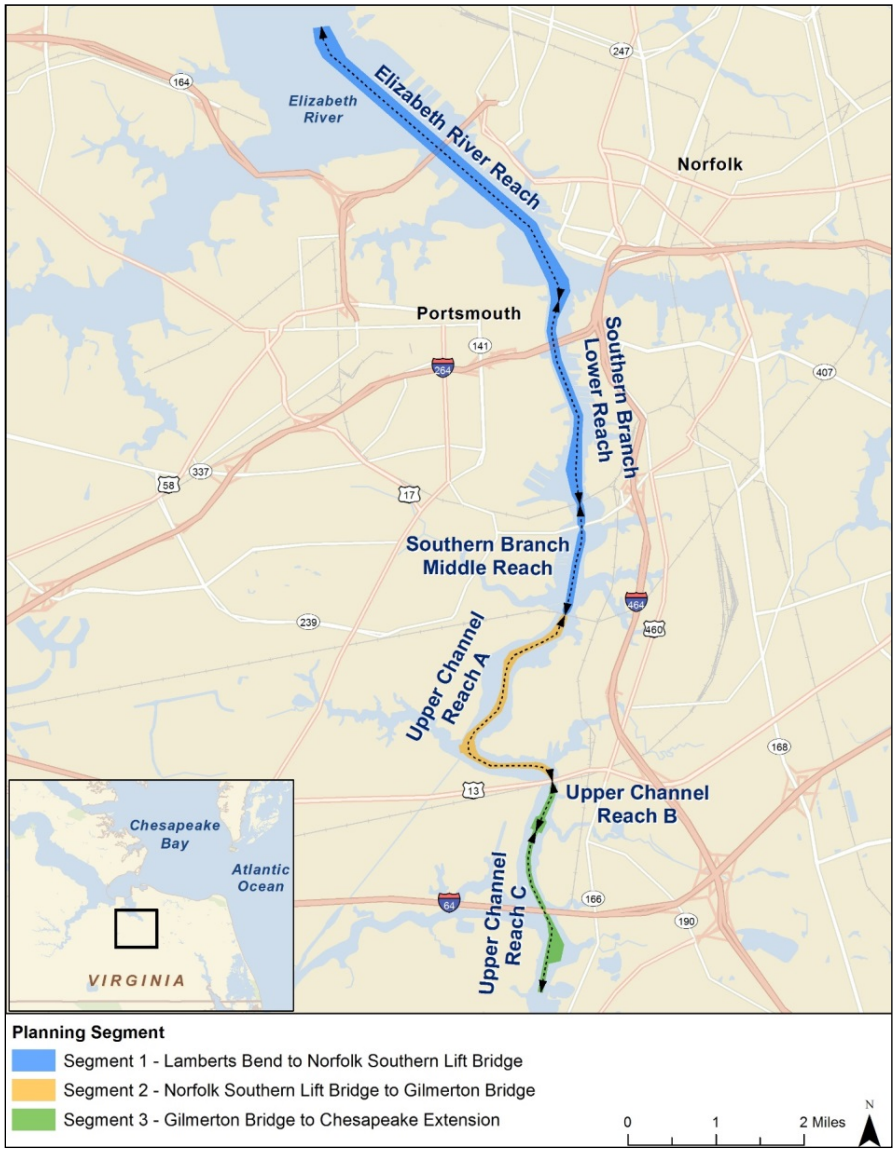

Figure 4-1. Segments and Reaches of the Elizabeth

4.6.1 Screening of Measures

The study constraints and planning objectives were used to screen the range of measures as discussed in *Section 4.1--Problems, Opportunities, and Planning Constraints*. Table 4-1 shows all of the measures considered for this study and the results of initial measures screening.

Table 4-1. Elizabeth River & Southern Branch of the Elizabeth River Measures Summary

Measure	Notes	Considered in Alternatives
Adjust vessel speed	Vessels already operate at the slowest speed possible without affecting maneuverability	No
Traffic Management (Vessel Traffic System)	USCG and Pilots currently collaborate for effective traffic management	No
Increase tugboat assistance	Standard tug operations are sufficient and additional tugs would not improve transportation efficiency	No
Use lightering	Lightering would not increase efficiency because most deep draft vessels are bulkers carrying exports	No
Terminal Improvements	Projected terminal improvements are included in the Without Project condition, additional improvements would not substantially improve transportation efficiency	No
Turning Basins*	Existing turning basins are inadequate for existing vessels	Yes
Channel Deepening	Includes deepening of berthing areas, projected to improve transportation efficiency; evaluation of deepening considers use of tidal advantage	Yes
Channel Widening	Dimensions of the waterway, existing vehicle and railroad bridges, and extensive development along the shoreline make channel widening unfeasible	No

* Only turning basin deepening was considered within the screening measures as part of the channel deepening measure carried forward. No new turning basins or additional widening was considered.

4.7 Measures Carried Forward

The measures carried forward for consideration in the development of alternatives are shown in Table 4-2.

Table 4-2. Elizabeth River & Southern Branch of the Elizabeth River Alternative Plan Elements by Segment

Segment	Measures
1 Lamberts Bend to Norfolk Southern Lift Bridge	Deepening from 40 to 45+ feet: channel and Turning Basin Opposite Naval Shipyard
2 Norfolk Southern Lift Bridge to Gilmerton Bridge	Deepening from 35 to 40+ feet: channel and Money Point Turning Basin
3 Gilmerton Bridge to Chesapeake Extension	Deepening from 35 to 40+ feet: channel, Newton Creek Turning Basin, Mains Creek Turning Basin
Notes: (1) Deepening will be evaluated in one-foot increments, (2) Deepening includes berth deepening for benefiting terminals.	

Considering the configuration and usage of the Federal project, turning basin improvements are necessary elements for the project to remain functional and therefore will be considered non-separable from channel deepening. As non-separable elements, turning basins will be evaluated concurrently with channel deepening of the segment in which they are located. Deepening of the channel and turning basins contained in each planning segment will be evaluated in one-foot increments for the range of depths under consideration.

4.8 Plan Formulation and Evaluation Strategy

Once measures were established and initial screening completed (Tables 4-1 and 4-2), a Project Delivery Team meeting was held to develop a plan formulation and evaluation strategy for the study. This strategy will be used to combine the measures in the different planning segments (Table 4-3) into alternatives. The key considerations driving the plan formulation strategy are:

- Segments 1, 2 and 3 should each be economically justified;
- Segment 3 is dependent on the implementation of Segment 2 and therefore, if justified, should be combined with Segment 2

In this plan formulation strategy, the deepening of each segment (Table 4-3) will be evaluated separately, in phases, and then the established depths for each segment will be arranged in different combinations to form alternative plans:

- Phase 1--Depths (one-foot increments ranging from 40 to 45+ feet) will be evaluated for Segment 1, which includes the turning basin opposite Norfolk Naval Shipyard.

- Phase 2--Depths will then be evaluated for Segment 2, which includes the Money Point turning basin, using the same method as Segment 1, but for depths ranging from 35 to 40+ feet.

- Phase 3--Then, a depth will be evaluated for Segment 3, which includes the Newton Creek and Mains Creek turning basins. However, because Segment 3 is dependent on Segment 2, the range of depths evaluated will be capped at the depth established for Segment 2. This means that Segment 3 can only be the same depth or shallower than Segment 2 because Segment 3 is dependent on Segment 2 improvements. If there are sufficient benefits to justify a project at Segment 3 and a depth has been established, it will be combined with Segment 2 for the alternatives analysis.

- Phase 4—Depths from Segments 1 and 2 are combined with the depth determined for Segment 3 and evaluated. The most cost effective channel depths (i.e., the NED channel depths) identified from Phases 1 through 3 are combined to form alternative plans which comprise the final array. The NED Plan is identified. A Locally Preferred Plan (LPP), if one is requested and supported by the Non-Federal Sponsor, is also identified at this time.

Table 4-3. Plan Formulation Strategy

	Planning Segment	Depth
PHASE 1 Evaluate Segment 1 Depth	Segment 1	40
	Segment 1	41
	Segment 1	42
	Segment 1	43
	Segment 1	44
	Segment 1	45+
PHASE 2 Evaluate Segment 2 Depth	Segment 2	35
	Segment 2	36
	Segment 2	37
	Segment 2	38
	Segment 2	39
	Segment 2	40+
PHASE 3 Evaluate Segment 3 Depth Given Segment 2 Depth	Segment 2 Plan + Segment 3	35
	Segment 2 Plan + Segment 3	36
	Segment 2 Plan + Segment 3	37
	Segment 2 Plan + Segment 3	38
	Segment 2 Plan + Segment 3	39
	Segment 2 Plan + Segment 3	40+
PHASE 4 Forwarded for Final Array	Segments 1, 2 and 3	Combinations
	No Action Plan (Alternative 0)	
	NED Plan (Alternative Plan 1)	Depths TBD
	LPP (Alternative Plan 2), if requested and supported by the Non-Federal Sponsor	Depth TBD

Evaluation criteria were developed by the Project Delivery Team (Table 4-4) based on the planning objectives and constraints. The evaluation criteria and the metrics used to evaluate those criteria will be further developed prior to the In-Progress Review on 21 July 2016, before the Tentatively Selected Plan Milestone (21 August 2017).

Table 4-4. Draft Evaluation Criteria

Criteria	Metric	Inventory	Notes
Project Costs	Dollars	Dredged Quantities & Unit Costs	Data is available to develop cost estimates
Economic Benefits	Dollars	Commodity and Fleet Forecasts	HarborSym will be used to calculate transportation cost savings
Environmental Benefits	Yes/Neutral	Water Quality Modeling	Potential improved flushing of Southern Branch
Environmental Impacts	Significance/Intensity	Best Professional Judgement	Historical sediment sampling & analysis is available
Contribution to Federal Objective	Y/N	Qualitative Assessment	Systems of Accounts analysis
Meets Planning Objectives	Y/N	List objectives met	
Avoid Planning Constraints	Y/N	List constraints not avoided	

4.9 ECONOMIC ANALYSIS AND COMPARISON OF ALTERNATIVES

This section covers the development of benefits and costs for the various alternatives under consideration, the economic evaluation of those benefits and costs, and designation of the National Economic Development (NED) Plan and the Locally Preferred Plan (LPP), if applicable.

4.9.1 HarborSym Economic Model

The plan formulation strategy is based on the economic analysis of the potential benefits and costs of the alternatives under consideration for implementation. The tool used for this analysis is USACE's HarborSym Model which is a certified model for the economic analysis of deep draft navigation projects. While HarborSym primarily generates alterative plan benefits through the measurement of transportation cost savings, it also compares these benefits to the costs of the alternatives which are developed separately and input into the model.

HarborSym calculates transportation costs for entire routes and time in port for all vessel calls projected throughout the period of analysis. The model is used to estimate transportation cost changes due to waterway improvements through the implementation of proposed alternatives by comparing with and Without Project conditions. Transportation costs savings, which are project benefits, may result from use of larger vessels, more efficient use of larger vessels, more efficient use of existing vessels, reduction in transit time, lower cargo handling and tug assist costs, or use of waterway transportation rather than alternative land mode. In the case of the Southern Branch, the transportation cost savings (i.e., benefits) would result mainly from the more efficient use of existing vessels.

HarborSym performs data-driven Monte Carlo simulations of vessel transits through harbors, based on user input. The model incorporates uncertainty through randomizing parameters over

multiple model iterations, based on a user-inputted range for parameters such as vessel speed through a specified area (reach), loading and unloading times at docks, docking and undocking times, at-sea distances, etc.

The simulations are based upon vessels moving through reaches from the harbor entrance to their destination dock. At each time increment (step) the model determines if each vessel can move from one node to the next, without violating transit rules. If a transit rule would be violated by a vessel entering a reach, such as passing another vessel when the channel width is too narrow, then the vessel waits until the next time step. This waiting continues until the rule is no longer violated and the vessel resumes its journey. HarborSym records and accumulates the total time and cost of vessel transits through the harbor and at sea. Becausemany variations of events can occur over a total voyage, several iterations of the simulation were run to obtain the average values for time in the harbor, time waiting, and total operating costs of vessels in the harbor and at sea.

HarborSym depends on user-defined parameters and inputs to reasonably represent the harbor of study. In development of the Southern Branch waterway model, USACE economists collaborated with the Virginia Pilots Association, the Virginia Port Authority, and various port users to learn the port's configuration, the typical paths through the port used by different vessel types, transit rules, and more. Historical data available through the Waterborne Commerce Statistics Center (2010-2014) was used to define the annual number of calls, tonnage per vessel call, vessel types and classes, vessel trade routes, and commodities moved. The Pilots' Log (2010-October 2015) and conversations with the Pilots provided additional data on the annual number of calls, vessel types and classes, trade routes of vessels calling the Southern Branch, transit times, maneuvering/turning times, and more. The Port Authority provided data on berthing area dimensions, dock locations, and cruise ship calls. Both the Pilots Association and the U.S. Coast Guard provided transit rules within the harbor. The Virginia Maritime Association and other members of the port community provided additional dock-specific information.

4.9.2 Alternative Analysis

Alternative Cost Estimates

Estimates of materials and methods necessary to construct and maintain the different channel improvement alternatives were developed using the USACE's Cost Engineering Dredge Estimating Program (CEDEP), best professional judgment, and previous analyses for similar, completed projects. Construction assumptions are feasibility level assumptions regarding the proposed alternative channel modification actions. These construction assumptions are the basis for project cost estimates and environmental impact assessments.

Segment 1 - Construction Methods, Schedule, Dredging Equipment, and Material Placement.

Segment 1 is approximately six miles long extending from Lamberts Bend to the Norfolk Southern Lift Bridge including the Elizabeth River Reach and Southern Branch of the Elizabeth River's Lower Reach, and the Southern Branch Middle Reach (Table 4-1 and Figure 4-1).

Elizabeth River Reach and Southern Branch Lower Reach. As depicted in Figure 4-2, the Elizabeth River Reach and the Southern Branch Lower Reach were deepened by the Navy in 2011 to -49 feet (47 feet +2 feet of overdredge). The hash-marked area within Figure 4-2

shows that the Navy deepening was nearly the entire width within the Federal channel. The Navy's deepening varied from 600 feet in the Elizabeth River Reach and from 450 to 700 feet in the Southern Branch Reach. Construction within these two reaches has been assumed to be performed similar to what the Navy completed in 2011, as described below.

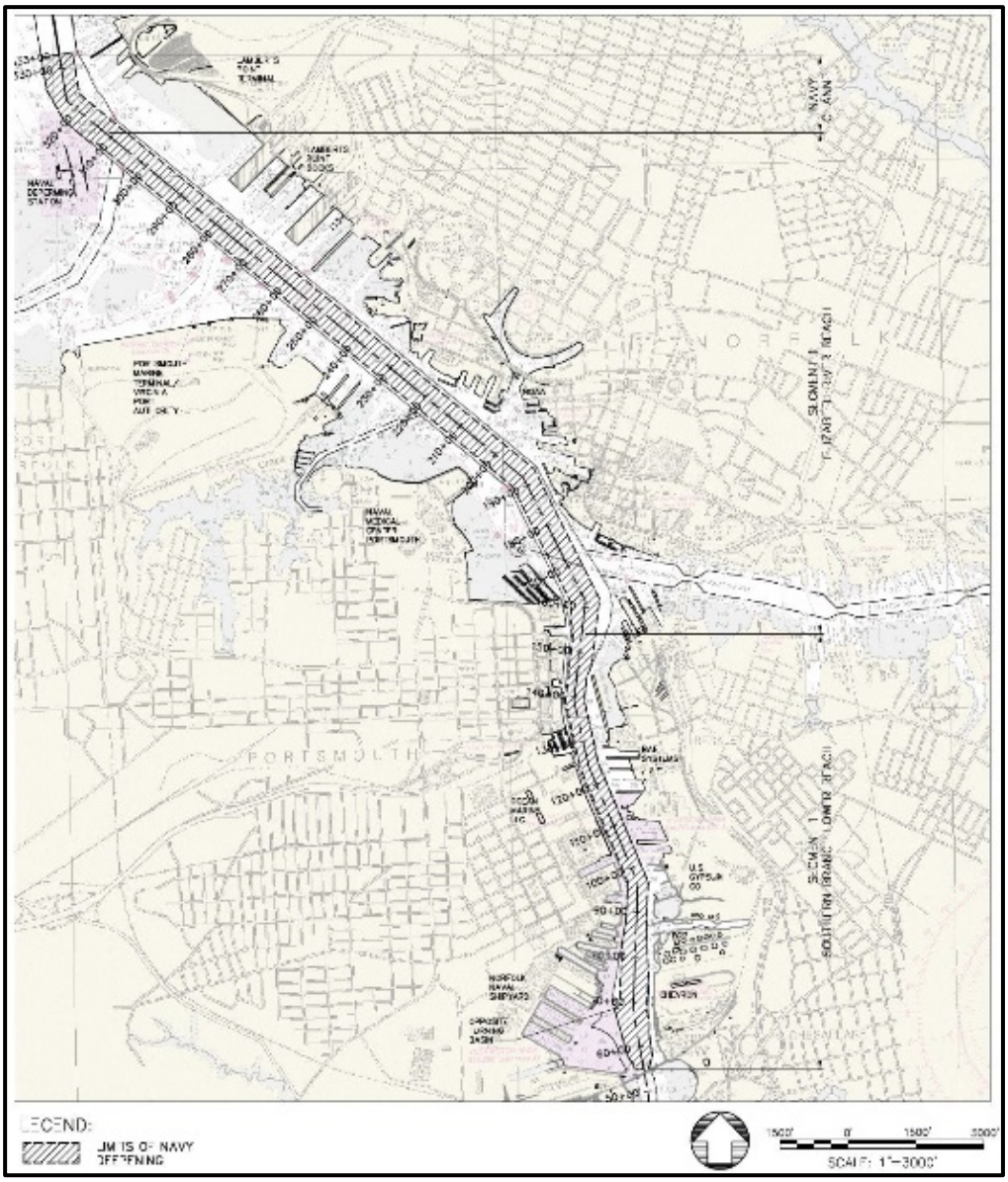

Figure 4-2. Navy Channel within the Federal Channel

Dredging in the Elizabeth River Reach and Southern Branch Lower Reach would be performed with a 24-inch cutter head with a typical production rate of approximately 1,400 to 2,000 cubic yards per hour. Using up to two 3,600 horsepower, diesel-driven, booster pumps mounted on barges, the dredged material would be pumped to the Craney Island Dredged Material Disposal Material Management Area (CIDMMA) through submerged pipelines placed outside of the Federal navigation channel for a distance of approximately 38,000 feet from the Elizabeth River branch and approximately 45,000 feet from the Southern Branch's Lower reach, respectively.

The cutterhead dredge would be assumed to operate 24/7, with personnel shifts assumed to be eight hours/day, seven days a week. A total of 55 personnel would be assumed to operate the cutterhead dredge including personnel for three shifts, support staff, and all of the required shore crews. The cutterhead dredge would be assumed to be actively dredging for 340 hours/month; as such, the time to dredge the five mile length of the Elizabeth River Reach and the Southern Branch Lower Reach within Segment 1 is estimated to be three months.

The pipelines would discharge upland of the main dikes on the east side of CIDMMA where routine operation has excess water sampled and tested, and then decanted through the manually operated spill boxes on the west side of CIDMMA.

Southern Branch Middle Reach. The Southern Branch's Middle reach will be dredged using a barge-mounted mechanical dredge equipped with a 10 cubic yard bucket. The crew size for a bucket dredge with barge and tug support would be 25 people inclusive of captain, engineers, mates, deckhands, tug operations, etc. Dredge operations would be 10 hours per day, six days a week, with an effective 220 hours per month (55 hours per week) of dredging, and would produce approximately 3,500 cubic yards per day.

Because of concerns regarding material suitability for placement, the construction assumptions conservatively assume that all the dredged material from the Southern Branch Middle Reach--as well as all other areas dredged upriver--would be disposed of at an upland disposal facility. For the analysis, two 3,000 cubic yard capacity barges are assumed to be transported together approximately 70 nautical miles from the dredging site to a permitted facility at Port Weanack on the James River or an alternative approved facility for re-handling. The USACE's CEDEP tool estimates that the round trip fuel usage from the ERSB to Port Weanack and back would be 3,508 gallons of diesel.

At Port Weanack or an alternative approved facility, a cement mixture would be added to the material while it remains in the barge and the material would be mixed with a large paddle wheel or rake. The purpose of the add-mixture is to solidify the consistency of the dredged material so that it can be moved with an excavator and loaded onto trucks for driving to the ultimate placement location. Production at Port Weanack would typically be in the range of 2,000 cubic yards per day, but could match 3,500 cubic yards per day expected to be produced by the dredge.

After a short curing time (typically not more than 24 hours), excavators would unload the material from the barges, transfer the material onto 12 CY dump trucks for transportation to, and disposal at, one or both of the nearby landfills. Local landfills that could accept the dredged material include the Charles City landfill and the CFS, Tri-City Regional Landfill & Recycling Center in Petersburg. Depending on the route utilized, one-way truck haul distances to these facilities would be approximately 13 and 17 miles, respectively. Port Weanack receives, mixes, and unloads barges 24/7, but receipt at the landfills is limited to 5:30 AM - 10:30 PM weekdays and 6:00 AM - 6:00 PM on Saturdays.

Within the Southern Branch Middle Reach, the volume of material to be dredged includes two feet of additional overdredge in order to avoid leaving exposed sediment with high levels of contaminants (e.g., PAHs). Additional sediment sampling to better define and verify the volume of material that could be required for overdredge will be performed during the PED phase, but the volumes to be removed include this quantity as a conservative assumption.

The following table shows assumed quantities of material that would be removed and the assumed destinations (Table 4-5). Within Segment 1, the largest volume of material to be dredged for the action alternatives being assessed in detail would result in approximately 1,650,000 CY being removed to establish the new channel dimensions. Of that total, 1,082,000 CY would be pumped to CIDMMA from the Elizabeth River Reach and Southern Branch Lower Reach. The remaining approximately 600,000 CYs would originate in the Southern Branch Middle Reach and be disposed of at either the Charles City County Landfill[9] or the CFS Tri-City Regional Landfill & Recycling Center after having been barged to Port Weanack[10], stabilized, and driven by dump truck to the landfill.

Table 4-5. Range of Volumes and Placement (CY)

	Pay & non-Pay		CIDMMA		Upland	
	Current depths +2	Current depths +6	Current depths +2	Current depths +6	Current depths +2	Current depths +6
Segment 1	565,000	1,641,000	346,000	1,082,000	220,000	560,000
Segment 2	594,000	1,470,000	0	0	594,000	1,470,000
Totals	1,159,000	3,111,000	346,000	1,082,000	814,000	2,030,000

As shown in the following table 4-6 , upland disposal of the material from Segment 1 would require up to a total of 93 tug trips (two 3,000 CY barges per tug trip) and 13,100 nautical miles traveled by tug to Port Weanack, and a total of 46,600 truck trips and 1.21 million truck-miles traveled to the landfill for placement.

Table 4-6. Upland Disposal Actions - Current Depths + 6 feet (CY)

Segment	Upland Disposal (CY)	Tug Trips (Two 3,000 CY barges /tug)	Tug Nautical Miles(141NM round trip)	Truck Trips (12 CY/truck)	Truck Miles Driven (26-mi round trip)
Segment 1	560,000	93	13,100	46,600	1,211,000
Segment 2	1,470,000	245	34,500	122,500	3,185,000
Total	2,030,000	338	47,600	169,100	4,396,000

As shown in the following table 4-7, the footprint of dredging required to maintain the existing navigation channel in Segment 1 is 493 acres. The action alternative being evaluated with the largest depth increase would result in a total future footprint of 529 acres, or an increase of approximately 36 acres in the channel footprint compared to maintaining the existing channel. Because a large portion of Segment 1 was previously deepened by the U.S. Navy, only 226 acres of the 529 acres would need to have material removed to achieve the necessary channel depth. Deepening the channel to the greatest depth being evaluated in the action alternatives (+ 6 feet) would be expected to take nine months to complete.

[9] Charles City County Landfill in Providence, Virginia (VDEQ Permit No. SWP531)
[10] Port Weanack Land, LLC soil processing facility in Charles City, Virginia (Virginia Pollutant Abatement Permit No. VPA00579)

Table 4-7. Range of Disturbances

Segment	Channel Footprint (Acres)			Acres Dredged			Months Dredging	
	Current depths	Current depths +2	Current depths +6	Current depths	Current depths +2	Current depths +6	Current depths +2	Current depths +6
Segment 1	493	506	529	37	93	226	5	9
Segment 2	115	122	135	2	74	130	6	14
Total	608	628	664	39	167	356	11	23

Segment 2 – Construction Methods, Schedule, Dredging Equipment, and Material Placement.

Segment 2 is approximately 2.4 miles long extending from the Norfolk Southern Lift Bridge to the Gilmerton Bridge and is limited to the Southern Branch of the Elizabeth River's Upper Channel Reach A (Table 4-1 and Figure 4-1).

Upper Channel Reach A. As shown in Table 4-5, within Segment 2, the largest volume of material to be dredged for the alternatives being assessed in detail (+ 6 feet) would result in approximately 1.5 million CY being removed from the channel. Dredging would be performed mechanically, as described for the Southern Branch's Middle Reach of Segment 1. As described previously for the Southern Branch Middle Reach in Segment 1, the volume of material to be dredged includes two feet of additional overdredge as a conservative assumption in order to be able to remove exposed sediments with unacceptable levels of contaminants (e.g., PAHs) that could be identified during the PED phase of the study.

The entire quantity of material removed would be disposed of at one or both of the landfills, described above, after being barged to Port Weanack, solidified, and trucked to the landfill. As shown in Table 4-6, upland disposal of the material in Segment 2 would require a total of up to 245 tug trips (two barges per tug trip), 34,500 nautical miles traveled by tug to Port Weanack, 122,500 truck trips to move the material to the landfills, and 3.2 million truck-miles traveled to the landfills for placement.

As shown in Table 4-7, dredging would be assumed to be completed in approximately 14 months and the footprint of dredging required for maintenance of the existing navigation channel in Segment 2 would be 115 acres. The action alternative being evaluated with the largest depth increase (+ 6 feet) would result in a total footprint of disturbance of approximately 135 acres in Segment 2, or an increase of approximately 20 acres in the channel footprint compared to maintaining the existing channel.

Maintenance Dredging Assumptions.

Without Project Maintenance Dredging Assumptions. The Southern Branch Project's constructed depth and width has been maintained with periodic dredging to maintain the depth. Table 4-8 shows the historical dredging quantities removed from the Southern Branch Project between 1980 and 2016. Over that 36-year period, Segment 1 has had almost 1.2 million cubic yards of material removed and Segment 2 has had almost 620,000 cubic yards with the most recent maintenance dredging in these segments being completed in 2003 and 2004,

respectively. The 1.5 mile long, upstream most reach of Segment 3 (Upper Channel Reach C) has never had maintenance dredging performed.

Table 4-8. ERSB Historical Maintenance Dredging

Segment	Dredging Volume (CY)	Year	Placement Location
Segment 1	538,611	1991	CIDMMA
	341,707	1993	CIDMMA
	100,577	1997	CIDMMA
	201,675	2003	CIDMMA
Total	1,182,570		
Segment 2	239,271	1981	CIDMMA
	172,894	1989	CIDMMA
	74,118	1993	CIDMMA
	29,243	1995	CIDMMA
	21,800	1999	CIDMMA
	82,049	2004	CIDMMA
Total	619,375		
Segment 3	13,128	1999	CIDMMA
	45,234	2004	CIDMMA
Total	58,362		
Source: (USACE, 1994; USACE, 2016)			

Under the future Without Project condition, there would be no channel modifications to the Elizabeth River and Southern Branch of the Elizabeth River. However, routine USACE maintenance of the existing Federal channel are assumed to require dredging a portion of the Elizabeth River and Southern Branch of the Elizabeth River during 17 of the 50 years in the period of analysis (2023-2073). As shown in Table 4-9, dredging actions would remove approximately 2,820,000 cubic yards of dredged material over the 50-year period of analysis.

The frequency of dredging actions in the future is projected for analysis, but is not reliably predicted; the frequency and extent of maintenance dredging that occurs on a Federal project is typically strongly influenced by budget availability. Although Table 4-7 shows 23 dredging events over the 50-year period of analysis, some years are assumed to have multiple segments dredged during the same cycle, so the total number of dredge events is assumed to be 17.

Table 4-9. Without Project Maintenance Dredging Quantities

Segment	Volume per Dredge Event (CY)	Number of Dredging Events in 50 YRS	TOTALS (CY)
Segment 1			
Eliz River Reach	235,000	7	1,650,000
Lower Reach	50,000	2	100,000
Middle Reach	25,000	2	50,000
Segment 2			
Upper Channel Reach A	90,000	10	900,000
Segment 3			
Upper Channel Reach B	60,000	2	120,000
Upper Channel Reach C	0	0	0
Totals		17	2,820,000

Under the Without Project condition, material would be placed into the CIDMMA, NODS, or in landfills, depending on source of the material being generated and whether the CIDMMA has been filled. Current estimates are that the CIDMMA will be filled in 2038. Until 2038, all maintenance-generated dredge material placement would be placed into CIDMMA. Once filled, the continued maintenance of the ER/SBER Project would require the use of offshored disposal at NODS. This would require use of a split hull dump barge to haul the material to NODS for placement at NODS.

With--Project Maintenance Dredging Assumptions.

Segment 1 Maintenance Dredging. A desktop analysis has been conducted for a first-order estimate of the maintenance dredging rate to be expected in the navigation channels following deepening. Historic maintenance dredging records were provided by the USACE for the period 1980 to 2014, and reviewed to inform the desktop analysis (USACE 1994, USACE 2016). The available maintenance dredging records were used to develop an estimate of the annual sedimentation rate within the navigation channels in the study area. Historical (from 1980 onwards) and recent data were examined and used for developing the sedimentation rate (see Engineering Appendix Section 5 Future Maintenance Quantities.

Based on historic dredging frequency and the estimated sedimentation rates, the following future maintenance frequency, volumes, and placement areas are assumed for Segment 1.

As shown in Table 4-10, the current averaged annual maintenance dredging from Segment 1 is approximately 33,800 cubic yards of material, but maintenance dredging in the reaches of Segment 1 is not required annually. Constructing the largest channel improvements being evaluated in detail is estimated to result in an increase in the annual maintenance dredging to approximately 37,500 cubic yards, or an additional 3,700 cubic yards per year.

Table 4-10. Estimated Annual Maintenance Volumes (CY/YR)

	Current Depths	Current Depths +6	Difference
Segment 1	33,800	37,500	3,700
Segment 2	17,700	19,600	1,900
Total	51,500	57,100	5,600

The Elizabeth River Reach would be assumed to be dredged approximately every seven years, using 24-inch hydraulic pipeline cutterhead dredge, to remove an accumulation of approximately 275,000 CYs. The material would be pumped to and placed in CIDMMA. For long term considerations, once CIDMMA capacity is reached, the material would be mechanically dredged and barged for placement in the NODS.

For the Lower Reach the frequency of maintenance dredging has historically been significantly lower and only expected to occur once every 30 years, when an assumed shoaled volume of 50,000 CYs would be removed. This material would also be assumed to be placed in the CIDMMA. Dredging this reach would be similar to the Elizabeth River Reach.

For the Middle Reach, the frequency of maintenance dredging has historically been low and only expected to be needed once every 30 years, when an assumed shoaled volume of 25,000 CYs would be removed. Material dredged from the Middle Reach for maintenance is assumed to be accomplished with mechanical dredging, barging to Port Weanack on the James River or an alternative approved facility, and placement in an upland landfill as described for the channel improvements. After the initial maintenance dredging cycle, the material would continue to be assumed to be mechanically dredged, but would be suitable for placement in CIDMMA.

Segment 2 Maintenance Dredging. Maintenance dredging assumptions for Segment 2 have been based on historic dredging frequency and the estimated sedimentation rates. As shown in Table 4-10, the current averaged annual maintenance dredging from Segment 2 is approximately 17,700 cubic yards of material; the largest channel improvements being evaluated in detail would result in annual maintenance dredging of approximately 19,600 cubic yards. Therefore, the maximum incremental increase in annual maintenance dredging from implementing the action alternative with the largest depth increase (+ 6 feet) would be an additional 1,900 cubic yards per year.

The Upper Channel Reach A has been assumed to be dredged approximately once every five years, when the assumed shoaled volume of 100,000 CYs would be removed. Material dredged from the Upper Channel Reach A for maintenance is assumed to be accomplished with mechanical dredging, barging to Port Weanack on the James River, and placement in an upland landfill as described for the channel improvements. After the initial maintenance dredging cycle, the material would continue to be assumed to be mechanically dredged, but would be suitable for placement in CIDMMA. Once the CIDMMA capacity is reached, the material would be placed at NODS.

With-Project Maintenance Dredging Summary. As described previously, the incremental increase in material to be removed for maintenance dredging because the channel had been deepened largest depth increase being assessed (+ 6 feet) would be an additional 3,700 CY/yr for Segment 1 and an additional 1,900 CY/yr for Segment 2 or a total of 5,600 CY/yr over and above the quantity accumulating under the Without Project condition.

Under the action alternative being evaluated with the largest depth increase (+ 6 feet), maintenance dredging would be assumed to be performed on approximately the same frequency as the Without Project conditions with a very nominal increase (+5,600 CY/yr) in the material being removed. Over the 50-year period of analysis, the increase in maintenance dredging volumes under the with-project condition are shown in the following table and would result in an additional 400,000 CY of material (3,220,000–2,820,000 = 400,000) being removed from the channel and placed for disposal when compared to the quantity of material that would need to be removed to maintain the channel under the Without Project condition, over the same 50-year period of analysis (Table 4-11).

Table 4-11. With Project Maintenance Dredging Quantities

	Volume per Dredge Event	Number of Dredging Events in 50 Years	TOTALS
Segment 1			
Eliz River Reach	278,000	7	1,950,000
Lower Reach	50,000	2	100,000
Middle Reach	25,000	2	50,000
Segment 2			
Upper Channel Reach A	100,000	10	1,000,000
Segment 3			
Upper Channel Reach B	60,000	2	120,000
Upper Channel Reach C	0	0	0
Totals		17	3,220,000

Construction Assumptions Summary

In total, the largest action alternative (+ 6 feet) being evaluated for Segments 1 and 2 of the Elizabeth River and Southern Branch of the Elizabeth River would require:

- Dredging 356 acres within the 608-acre channel footprint (Table 4-7);
- Disturbing 56 acres outside the current channel due to side-slope adjustments (as shown in Figure 4-2) that would occur because of the greater channel depth (36 acres within Segment 1 and 20 acres in Segment 2) (Table 4-11);
- Removing approximately 3.15 million CY (1.65 million CY from Segment 1 and 1.5 million CY from Segment 2) of material to deepen the existing channel (Table 4-5);
- Cutter head dredging and pumping approximately 1.1 million CY of material for placement in the CIDMMA (Table 4-5);
- Bucket dredging approximately 2.03 million CY of material for upland disposal in a landfill (Table 4-6);
- Transporting 2.03 million CY of material in approximately 340 two-barge tug trips covering approximately 48,000 nautical miles (Table 4-6);
- Dredging Segment 1 would be completed in approximately nine months and Segment 2 in 14 months for a total project construction of approximately two years (Table 4-7);

- Removing and disposing of an additional 400,000 CY of material to maintain the deeper project over the 50-year period of analysis.

Construction and Investment Costs.

Dredging quantities were developed based on the latest condition surveys provided by the USACE. Dates of the surveys are noted in the Engineering Appendix. Quantities include 1 Vertical to 3 Horizontal side slopes, to match existing channel width. No channel widening is considered in plan formulation. Volume calculations were completed for each channel reach at 1 foot increments to inform plan formulation. AutoCAD® Civil 3D® software was used to perform the volume calculations. Volumes are broken into "dredging zones", to clarify the calculated volumes, as identified in the following figure (Figure 4-3).

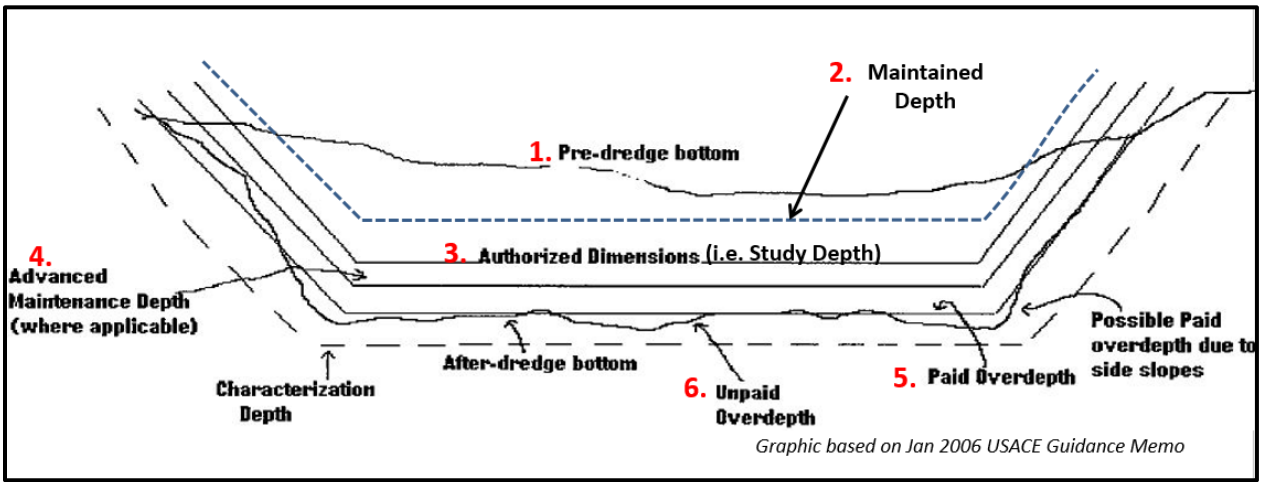

Figure 4-3. Typical Channel Cross Section with Dredging Zones and Channel Nomenclature, based on USACE Guidance Memo (USACE, 2006)

Notes:

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 dredging required to dredge from the existing condition (based on the latest condition survey of the channel) to the currently maintained channel dimensions. This volume to restore the channel to the District's historically maintained depth is included for inclusion in the Dredged Material management Plan.
3. Authorized Dimensions / Project Depth / Grade – Plan Formulation Increments
4. Advanced Maintenance – 0-foot per District's historic dredging activities in the subject reaches.
5. Allowable (Paid) Overdepth – 1-foot in Segment 1 and 2 feet in Segment 2 per District historical records in these reaches.
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. For cost estimates, the volume of non-pay dredged is based on the dredging area. For hydraulic (cutterhead) dredges, this equates to about ½-foot of non-pay depth, while the hopper dredges average less non-pay volume with about 3 inches. 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. For NEPA documentation non-pay volume is considered a contingency allowance to be included in the total for new work improvements. Note 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).
7. Additional Required Dredging for Contamination Mitigation - in Middle Reach (Segment 1) and Upper Channel Reach A (Segment 2) - as described in the Engineering Appendix, these reaches have higher potential for contaminated material. Because of that, volumes are shown for overdredging 1 ft. Additional cost to overdredge is considered in abbreviate Cost and Schedule Risk Analysis for comparing alternatives.

Dredging costs are developed using the Corps of Engineers 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. All costs associated for the contractor including overhead, profit, and bonds are included in the unit price calculated. The CEDEP spreadsheet also calculates costs for mobilization and demobilization, which are provided separately from the unit costs. It was assumed that the USACE would provide the post construction survey, so no cost was estimated with regard to surveys (note: the contractor is assumed to have a surveyor of their own, but no surveys were included for the owner). For the initial deepening scenarios, it is assumed that the initial mobilization is included in the maintenance dredging (where applicable).

Local service facility construction costs, which consist entirely of berth dredging, were estimated in a manner similar to channel dredging costs.

There were no lands, easements, rights-of-way, or relocations identified for this project. There are numerous submerged and overhead utilities that cross the project area, but none have been found to require relocation for the alternatives evaluated (see Engineering Appendix Section 8 Constraints).

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

Cultural Resources, sediment sampling and testing, engineering and surveys to assemble bid documents, as well construction management and support through construction.

An Abbreviated Risk Analysis was performed to evaluate uncertainties associated with each major construction cost item or feature in coordination with input with other members of the project development team. The Abbreviated Risk Analysis was developed via Cost Planning Center of Expertise guidelines.

The following two tables (Tables 4-12 & 4-13) present the estimated initial dredging costs for the range of channel depths considered in Segment 1 and Segment 2, respectively.

Table 4-12. Initial Dredging Costs for Segment 1 (a/b) – Elizabeth River Reach, Lower Reach, Middle Reach

Nominal Depth	**41/41**	**42/42**	**43/42**	**44/42**	**45/42**
Mob and Demobilization	$3,666,759	$3,666,759	$3,666,759	$3,666,759	$3,666,759
Dredging Cost	$4,200,307	$8,670,926	$12,675,222	$18,536,214	$25,294,291
Local Service Facility Construction Costs	$4,272,685	$6,956,482	$9,151,389	$11,346,296	$13,541,204
Environmental Mitigation	$-	$-	$-	$-	$-
Monitoring	$-	$-	$-	$-	$-
Construction Management	$442,500	$442,500	$442,500	$442,500	$442,500
PED	$4,686,250	$4,686,250	$4,686,250	$4,686,250	$4,686,250
Lands & Damages	$-	$-	$-	$-	$-
Relocating Aids to Navigation	$-	$-	$-	$-	$-
Contingency (14.8%)	$2,555,738	$3,614,592	$4,532,074	$5,724,347	$7,049,389
Construction Duration (months)	4.49	5.38	5.57	6.08	6.69
PED Duration (months)	24	24	24	24	24
Total GNF Costs	$14,920,496	$20,053,214	$24,650,547	**$31,379,551**	$39,138,500
Total Construction Costs	$19,824,239	$28,037,509	$35,154,194	$44,402,366	$54,680,393
Additional Annual Maintenance Costs	$12,366	$26,996	$44,752	$66,484	$91,872

Table 4-13. Initial Dredging Costs for Segment 2 - Upper Reach A

Nominal Depth	**36**	**37**	**38**	**39**	**40**
Mob and Demobilization	$836,436	$836,436	$836,436	$836,436	$836,436
Dredging Cost	$22,394,379	$37,061,135	$54,818,532	$73,719,000	$93,766,008
Local Service Facility Construction Costs	$9,370,370	$11,712,963	$14,055,556	$16,398,148	$18,740,741
Environmental Mitigation	$-	$-	$-	$-	$-
Monitoring	$-	$-	$-	$-	$-
Construction Management	$315,500	$315,500	$315,500	$315,500	$315,500
PED	$3,258,750	$3,258,750	$3,258,750	$3,258,750	$3,258,750
Lands & Damages	$-	$-	$-	$-	$-
Relocating Aids to Navigation	$-	$-	$-	$-	$-
Contingency (14.8%)	$5,353,964	$7,871,348	$10,846,147	$13,990,119	$17,303,780
Construction Duration (months)	5.65	7.30	8.13	9.45	11.73
PED Duration	24	24	24	24	24
Total GNF Costs	$30,774,895	$47,613,798	$68,001,065	$89,700,692	$112,716,663
Total Construction Costs	$41,529,399	$61,056,132	$84,130,920	$108,517,953	$134,221,216
Additional Annual Maintenance Costs	$70,489	$117,389	$174,844	$237,973	$304,871

National Economic Development (NED) Benefits

The focused array was evaluated in HarborSym considering the cost for dredging each segment to the range of depths under consideration and the benefits generated for those depths. The effort is conducted in four phases as originally outlined in Section 4.2.7--Plan Formulation and Evaluation Strategy, which will lead to the designation of the National Economic Development (NED) Plan.

The National Economic Development (NED) plan is the plan that reasonably maximizes net NED benefits. In order to identify the NED plan, economic analysis of alternatives was completed using HarborSym, the Corps-certified economic model for completion of deep draft navigation projects. Deepening alternatives were analyzed for Planning Segments-1 and -2 separately and then combined into a comprehensive plan covering both segments of the ERSB.

Increase in channel depth allows a portion of the ERSB fleet to sail deeper and use more of their cargo capacity. Because carrying more cargo per vessel call is more efficient, the

anticipated fleet response is that more cargo will be moved on this portion of the fleet. This means less cargo is anticipated to be moved on smaller vessels. The result is a reduction in the number of voyages moving cargo between the FWOP and the FWP condition. This causes a reduction in the cost of commodity movement between the FWOP and FWP condition, which equates to project benefits (transportation cost savings).

The economic parameters used in calculation the average annual (AAEQ) NED benefits, AAEQ costs, and AAEQ net NED benefits presented in subsequent sections are outlined below:

- Price Levels – FY 17
- Discount Rate – 2.75%
- Period of Analysis – 50yrs
- Base Year – 2023

Phase 1

Planning Segment-1 measures were analyzed using HarborSym. Only the vessel calls within this planning segment were imported into the model to better isolate the benefits of deepening in this segment. The measures analyzed for Planning Segment-1 are as follows:

- M0 – (FWOP) channel depth of 40'
- M1 – 41' channel depth
- M2 – 42' channel depth
- M3 – 43' channel depth
- M4 – 44' channel depth
- M5 – 45' channel depth

Table 4-14 and Figure 4-4 provide tabular and graphical illustrations, respectively, of life cycle NED benefits, costs, net NED benefits and BCRs expressed in AAEQ dollars for the alternatives considered for Segment 1. As indicated, the alternative that maximizes net remaining benefits is the 45-foot channel depth with a BCR of 3.33 and net benefits of $4,872,000, followed closely by the 44-foot channel with a BCR of 3.83 and net benefits of $4,758,000.

Table 4-14. Planning Segment 1 Economic Summary

	Measure	Depth	Benefits	Cost	Net Benefits	BCR
Step-I: Planning Segment-1 Measures	Seg1-M1	41 + 41	$2,872,500	$758,400	$2,114,100	3.79
	Seg1-M2	42 + 42	$3,727,600	$1,081,000	$2,646,600	3.45
	Seg1-M3	43 + 42	$5,017,600	$1,364,800	$3,652,800	3.68
	Seg1-M4	**44 + 42**	**$6,442,500**	**$1,734,300**	**$4,708,200**	**3.71**
	Seg1-M5	**45 + 42**	**$6,966,400**	**$2,144,300**	**$4,822,100**	**3.25**

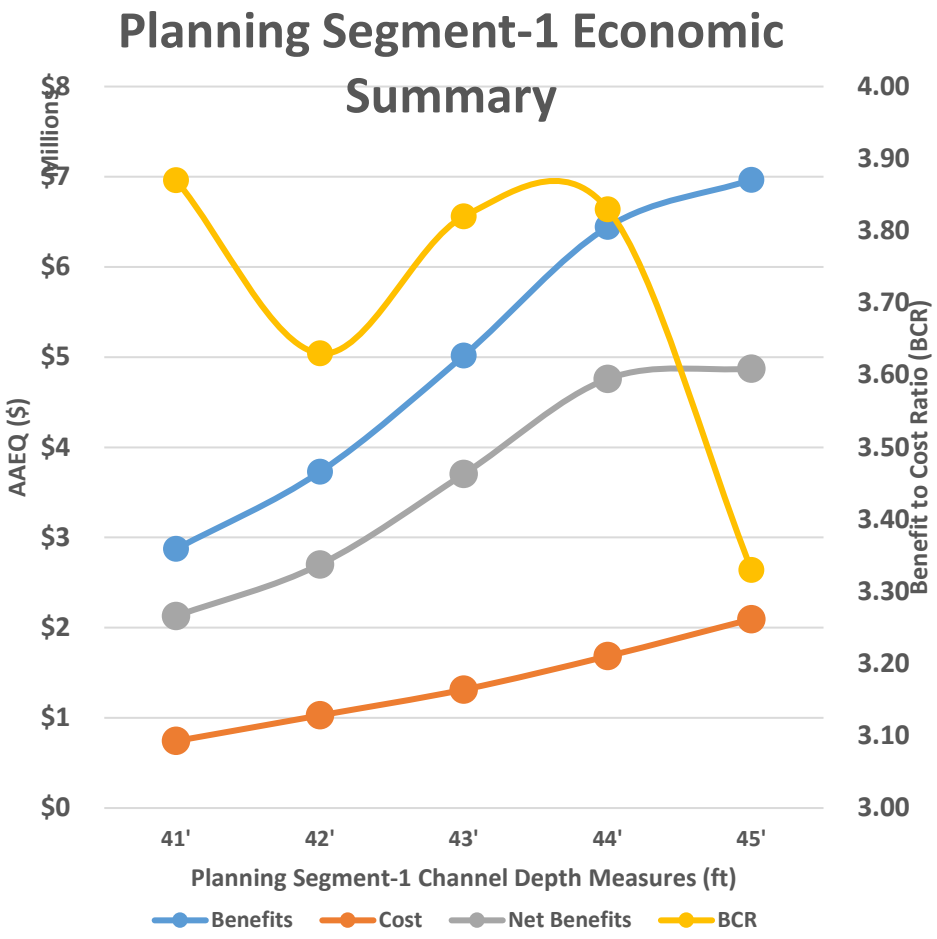

Figure 4-4. Planning Segment 1 Economic Summary (AAEQS)

Phase 2

Planning Segment-2 measures were also analyzed using HarborSym. Only the vessel calls within Planning Segment-2 and Planning Segment-3 were imported into the model to better isolate the benefits of deepening in this Segment-2. The measures analyzed for Planning Segment-2 are as follows:

- M0 – (FWOP) channel depth of 35'
- M1 – 36' channel depth
- M2 –37' channel depth
- M3 – 38' channel depth
- M4 – 39' channel depth
- M5 – 40' channel depth

Table 4-15 and Figure 4-5 provide tabular and graphical illustrations, respectively, of life cycle NED benefits, costs, net NED benefits and BCRs expressed in AAEQ dollars for Planning Segment 2. As indicated, the alternative that maximizes net remaining benefits is the 40-foot channel depth with a BCR of 1.83 and net benefits of $4,357,000 followed closely by the 39-foot channel with a BCR of 2.00 and net benefits of $4,243,000.

Table 4-15. Planning Segment 2 Economic Summary

	Measure	Depth	Benefits	Cost	Net Benefits	BCR
Step-II: Planning Segment-2 Measures	Seg2-M1	36 + 35	$4,428,000	$1,627,000	$2,801,000	2.72
	Seg2-M2	37 + 35	$4,711,500	$2,409,200	$2,302,300	1.96
	Seg2-M3	**38 + 35**	**$7,055,000**	**$3,334,800**	**$3,720,200**	**2.12**
	Seg2-M4	**39 + 35**	**$8,476,700**	**$4,317,400**	**$4,159,300**	**1.96**
	Seg2-M5	**40 + 35**	**$9,615,400**	**$5,361,100**	**$4,254,300**	**1.79**

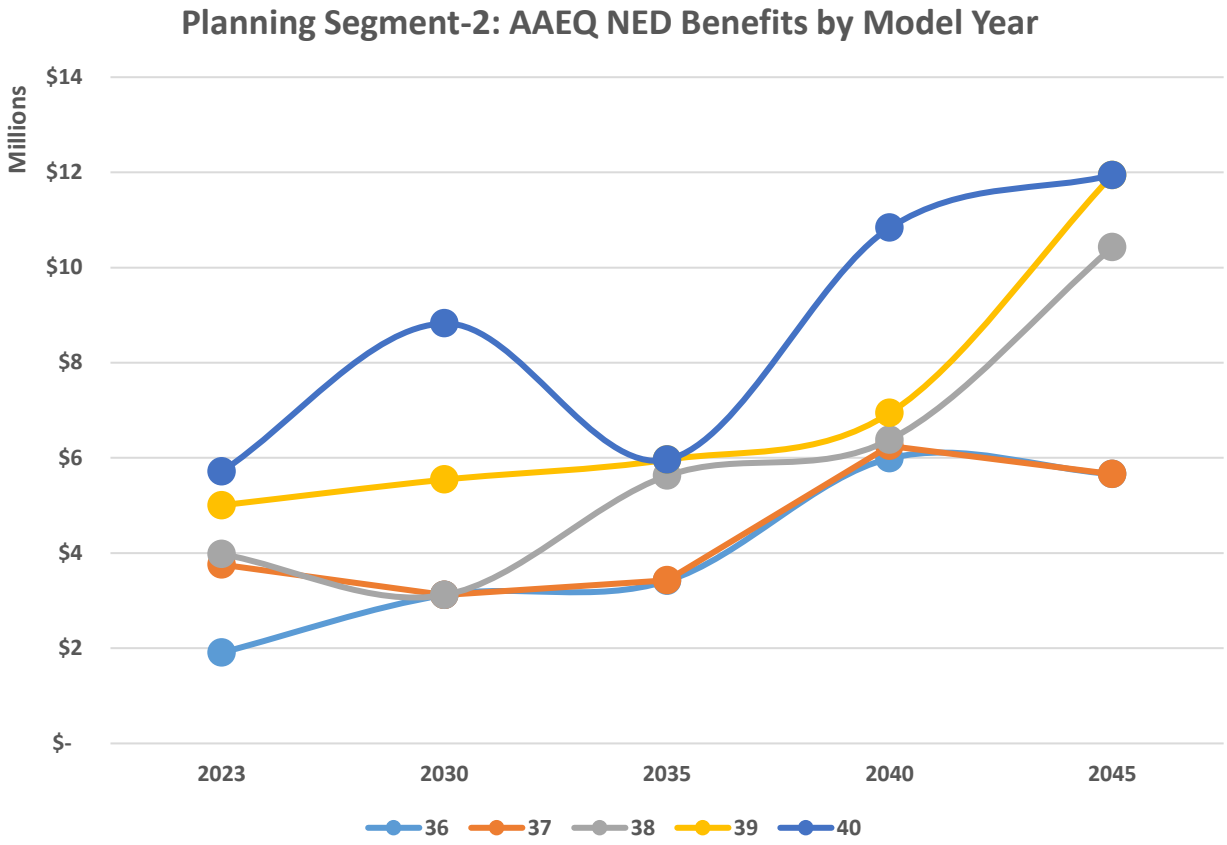

Figure 4-5. Planning Segment 2 Economic Summary (AAEQS)

Phase 3.

The analysis of Segment 3 showed that there is not enough vessel traffic to generate sufficient economic benefits in support of any deepening in this segment. Segment 3 currently has only a single terminal that services fuel barges typically drafting in the 20-foot range. Existing and Without Project future conditions are sufficient for full utilization of that facility and there would be no transportation cost saving benefits that would result from a deeper Federal channel in Segment 3. Segment 3 will continue to be maintained, as needed, at the current depth of 35 feet.

Phase 4.

Refinement of Segment 1. As presented earlier, Phase 4 involves the combination of Segments 1, 2, and 3 to form alternative Plans. The decision was made to subdivide Segment 1 to better capture the benefits for the section of channel up to the Perdue Terminal, designated Segment 1a, and the section from the Perdue Terminal to the end of Segment 1, designated Segment 1b (See Figure 4-6). The load factor analysis demonstrated that there were no benefits at depths greater than 42 feet for the section of Segment 1 upstream of the Perdue Terminal. More specifically, the load factor analysis demonstrated that:

- The Perdue Terminal, in Segment 1a, had vessels calling that utilize over 44 feet of depth and it has the ability for vessels to call at that depth in Segment 1a.

- The Transmontaigne Terminal, also located in Segment 1a, has vessels calling at a depth just under 43 feet and that is the next depth utilized before taking into account the vessels anticipated to call on the Perdue Terminal.

- The increment between 43 and 44 feet in Segment 1a is not disproportionate. Uncertainty in the variable inputs included in the load factor analysis does not allow for a definitive indication that only the Purdue Terminal will benefit from a 44-foot channel depth.

- The Enviva Wood Pellet Terminal, in Segment 1b, only had vessels calling that utilize depths up to 42 feet. In addition, Enviva has no plans to modify their terminal in the future to accommodate vessels larger than those that currently call.

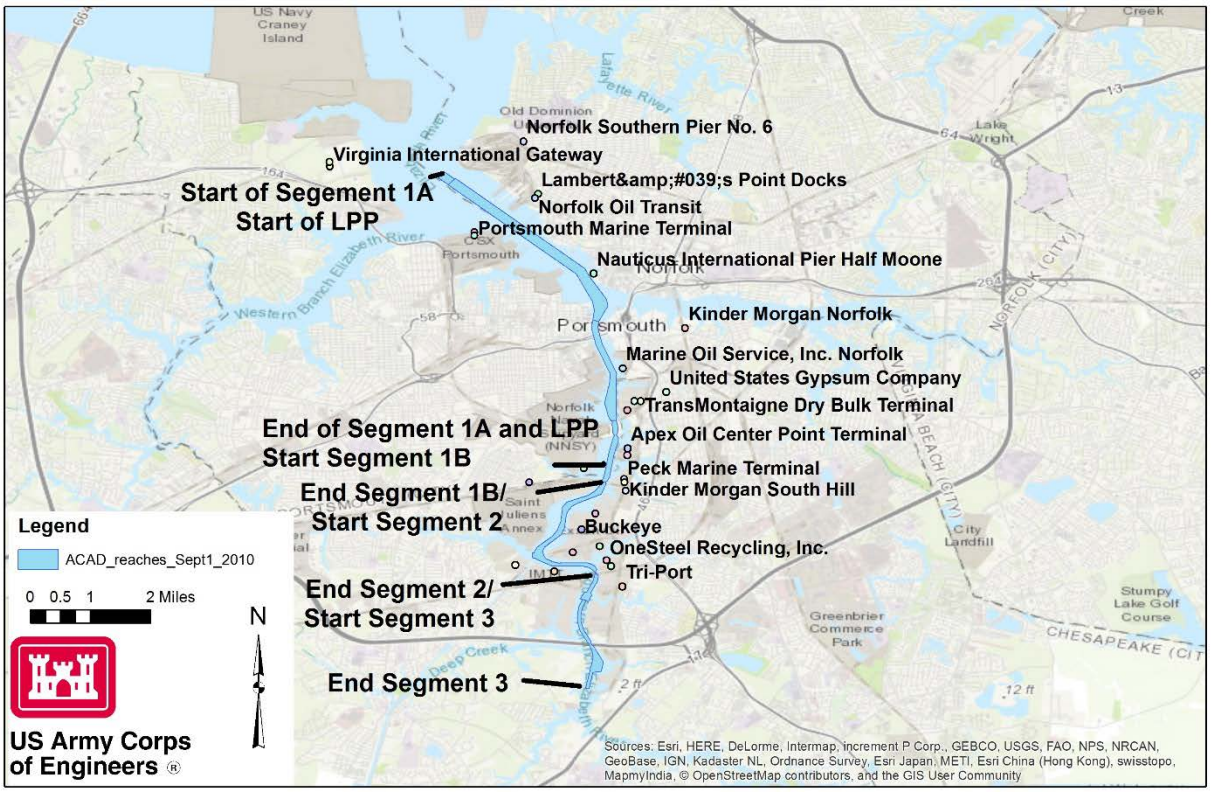

Figure 4-6. Segments 1a and 1b

Economic Analysis. It is possible to carry forward the results of the analyses of Segment 1 (44-foot and 45-foot depths); Planning Segment 2 (38-, 39-, and 40-foot depths); and Segment 3 (35-foot depth); and the refinement of Segment 1 (Segments 1a and 1b) and combine them to form the final array of alternatives shown in the following table (Table 4-16). This table presents the life cycle NED benefits, costs, net NED benefits and BCRs for the final array of alternatives, expressed in AAEQ dollars.

Table 4-16. Final Array of Alternatives Economic Summary

	Segment-1 Measures	Segment-2 Measures	Seg1a + Seg1b + Seg2 + Seg3 Depth	Benefits	Costs	BCR	Net Benefits
Step-III Final Array of Alternatives	Seg1-M4	Seg2-M3	44 + 42 + 38 + 35	$13,497,500	$5,069,100	$8,428,400	2.66
	Seg1-M4	**Seg2-M4**	**44 + 42 + 39 + 35**	**$14,919,200**	**$6,051,700**	**$8,867,500**	**2.47**
	Seg1-M4	Seg2-M5	44 + 42 + 40 + 35	$16,057,900	$7,095,400	$8,962,500	2.26
	Seg1-M5	Seg2-M3	45 + 42 + 38 + 35	$14,021,400	$5,479,100	$8,542,300	2.56
	Seg1-M5	**Seg2-M4**	**45 + 42 + 39 + 35**	**$15,443,100**	**$6,461,700**	**$8,981,400**	**2.39**
	Seg1-M5	Seg2-M5	45 + 42 + 40 + 35	$16,581,800	$7,505,400	$9,076,400	2.21

4.9.3 National Economic Development Plan

By definition, the NED Plan is the plan that reasonably maximizes the increases in the net economic value of the national output of goods and services based on the comparison of the differences in the value (benefits) produced by the plan to the value of the resources (costs) required to construct the plan. This plan also becomes the Tentatively Selected Plan. Based on the results presented in Table 4-16, it would appear that the NED Plan is Plan Seg1-M5/Seg2-M5 with net benefits of $9,076,400.

The difference in net benefits for each plan in comparison to Plan Seg1-M5/Seg2-M5 is less than three percent which suggests that the interpretation of the term "reasonably maximizes" is a significant factor in selecting the NED Plan. Engineering Regulation 1105-2-100 (Appendix G, Exhibit G-1) provides the following guidance on this subject: "Identification of the NED plan is to be based on consideration of the most effective plans for providing different levels of output or service. Where two cost-effective plans produce no significantly different levels of net benefits, the less costly plan is to be the National Economic Development (NED) plan, even though the level of outputs may be less." Based on this guidance, Plan Seg1-M4/Seg2-M4, the least costly of the four plans that maximize net benefits, is selected as the NED Plan and also as the Tentatively Selected Plan.

In summary, the NED Plan is made up of the following components:

- Deepen Seg1a from 40' to 44'. Seg1a extends from Lamberts Bend to just south of the Perdue Farms Terminal.
- Deepen Seg1b from 40' to 42'. Seg1b extends from Seg1a to the end of Planning Segment-1.
- Deepen Planning Segment-2 from 35' to 39'.
- Planning Segment-3 remains at 35'.

Transportation cost savings associated with the TSP are produced by carrying the same total commodity tonnage in the FWP as is carried in the FWOP but by doing so using fewer annual vessel calls in the FWP than are needed in the FWOP, which reduces total annual voyage costs associated with that level of throughput. The following table displays a comparison of the FWOP and FWP number of vessel calls per model year by vessel class for the TSP (Table 4-17). Note that bulkers are expected see the greatest reduction in vessel calls due to the implementation of the TSP across all model years. This is due to several factors including grain exports being the primary driver of growth in traffic for Segment-1 and the ability of the large bulker vessels to load deeper and therefore take advantage of increased channel depth.

Table 4-17. FWOP and FWP Calls by Vessel Class and Model Year

Vessel Class Name	2023		2030		2035		2040		2045	
	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP
10K DWT Bulker	10	9	11	10	13	11	15	11	15	12
20K DWT Bulker	20	19	22	21	24	24	26	24	28	27
30K DWT Bulker	63	57	75	70	84	79	91	84	99	92
40K DWT Bulker	23	20	25	24	28	26	30	26	33	30
50K DWT Bulker	17	16	20	18	23	20	27	24	30	27
60K DWT Bulker	20	20	25	23	28	27	32	31	38	35
70K DWT Bulker	7	6	8	8	9	9	10	10	10	10

Vessel Class Name	2023		2030		2035		2040		2045	
	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP
80K DWT Bulker	3	3	3	3	3	3	4	4	4	4
10K DWT Tanker	16	16	18	18	19	19	20	20	21	21
20K DWT Tanker	14	12	16	14	19	16	20	18	21	17
30K DWT Tanker	7	6	7	6	8	6	8	6	9	7
40K DWT Tanker	11	11	13	13	14	14	15	15	16	16
50K DWT Tanker	9	9	10	10	10	10	10	10	11	11
60K DWT Tanker	2	1	2	1	2	1	2	1	2	1
70K DWT Tanker	4	3	4	3	4	3	4	4	4	4
80K DWT Tanker	1	1	1	1	1	1	1	1	1	1
10K DWT Gas Carrier	4	3	4	3	4	3	4	3	4	3
20K DWT Gas Carrier	2	2	2	2	2	2	2	2	2	2
40K DWT Gas Carrier	2	2	2	2	2	2	2	2	2	2
50K DWT Gas Carrier	2	2	2	2	2	2	2	2	2	2
60K DWT Gas Carrier	2	2	2	2	2	2	2	2	2	2
80K DWT Gas Carrier	1	1	1	1	1	1	1	1	1	1
10K DWT Gen Cargo	84	82	98	97	109	107	118	115	127	123
20K DWT Gen Cargo	23	22	27	27	30	29	33	31	36	34
30K DWT Gen Cargo	11	10	13	12	14	13	15	14	16	15
40K DWT Gen Cargo	2	2	3	2	3	2	3	2	3	2
50K DWT Gen Cargo	2	2	2	2	2	2	2	2	2	2
Tank Barges	1082	1082	1135	1135	1179	1179	1225	1225	1277	1277
Dry Barges	1252	1252	1385	1385	1463	1463	1535	1535	1599	1599
Cruise Ships	22	22	22	22	22	22	22	22	22	22
Navy & Other	1344	1344	1344	1344	1344	1344	1344	1344	1344	1344
Total Calls	**4062**	**4039**	**4302**	**4281**	**4468**	**4442**	**4625**	**4591**	**4781**	**4745**

4.9.4 Locally Preferred Plan

The NED Plan is the Tentatively Selected Plan that was presented to the Corps Vertical Team during the TSP Milestone Meeting that was held in August 2017 and is the plan that received the concurrence of the Vertical Team at that time. Soon after the TSP Milestone Meeting, the Non-Federal Sponsor confirmed its support for a Locally Preferred Plan (LPP).

In accordance with ER-1105-2-100, study recommendations may deviate from the NED plan if requested by the non-Federal Sponsor and approved by the ASA (CW). If the sponsor prefers a plan more costly than the NED plan and the increased scope of the plan is not sufficient to warrant full Federal participation, the ASA (CW) may grant a waiver from the requirement to

recommend the NED Plan as long as the sponsor agrees to pay the difference in costs between the NED Plan and what is known as the Locally Preferred Plan (LPP). In this case, the LPP must have outputs similar in kind, and equal to or greater than the outputs of the NED Plan. It may also have other outputs. The incremental benefits, impacts, and costs of the LPP, beyond the NED Plan, must be analyzed and documented in the report.

The results of the plan formulation effort leading to the designation of the NED Plan has been presented and discussed with the Non-Federal Sponsor. After careful consideration and upon coordination with the Port Community, the Non-Federal Sponsor has indicated its support for a LPP. The LPP supported by the Non-Federal Sponsor is essentially the NED Plan with the deepening of the channel in Segment 1a to a depth of 45 feet. The LPP is designated as Plan Seg1-M5/Seg2-M4 (45'+42'+39'+35'). The Non-Federal Sponsor believes that the additional one foot of channel depth in Segment 1a that would be provided by the LPP would best serve the needs of the waterway users.

4.10 COMPARISON OF THE NED AND LPP PLANS

The NED Plan and LPP are shown in Table 4-18. The BCR's for the two plans are very close at 2.52 and 2.44 respectively. Th net benefits for each plan are also very similar, but the cost is higher for the LPP.

Table 4-18. NED and LPP Plans

Plan	Depths	AAEQ Costs	Net Benefits	Benefit-to-Cost Ratio
NED Plan (Alternative Action Plan 1)	44+42+39+35	$6,052,000	$8,867,000	2.47
Locally Preferred Plan (Alternative Action Plan 2)	45+42+39+35	$6,462,000	$8,981,000	2.39

4.10.1 System of Accounts

The Federal process incorporates four accounts to facilitate evaluation and display of the effects of the alternative plans. The four accounts are National Economic Development, Environmental Quality, Regional Economic Development, and Other Social Effects. While the National Economic Development account is required, the other accounts are considered with the intent to identify factors that could exhibit meaningful differences between alternative and that could significantly influence plan selection.

National Economic Development. As discussed earlier, the NED account displays changes in the economic value of the national output of goods and services. Under this account, the NED Plan/TSP Plan generates average annual equivalent (AAEQ) net benefits of $9,001,000, with a BCR of 2.52.

Regional Economic Development. The Regional Economic Development (RED) Account was established by the Economic and Environmental Guidelines for Water and Related Land Resources Implementation Studies (U.S. Water Resources Council, 1983). The RED account

measures changes in the distribution of regional economic activity that would result from each alternative plan. Evaluations of regional effects are measured using nationally consistent projections of income, employment, output, and population. The effects on the RED account for each of the alternatives considered are expected to be minor and do not have a material bearing on the plan selection process.

Changes to the RED account for the selected plan will be assessed using the USACE Online Regional Economic System (RECONS). This modeling system provides estimates of regional, state, and national economic impacts of construction spending associated with a USACE Civil Works Navigation Project. Economic impacts are measured in terms of economic output, jobs, earnings, and/or value added. The RECONS assessment of the RED account will be performed for the final draft GRR/EA.

The Port of Virginia is one of the major drivers of the regional economy. An analysis by the Mason School of Business, College of William and Mary (Pearson and Swan, 2014) identified the economic impact of the Port of Virginia on the State of Virginia. The total direct and indirect economic impact was $60.3 billion in Fiscal Year 2013. The estimated value added to the Gross State Product was $30.5 billion, which was 6.8% of the entire Gross State Product. The economic impact on wages was estimated as $17.5 billion paid to 374,000 Virginia employees, which generated $1.44 billion in state corporate and individual income taxes, general sales taxes, and real property taxes within the state.

Environmental Quality. The Environmental Quality Account considers non-monetary effects on ecological, cultural, and aesthetic resources. Under this account, the preferred plan should avoid or minimize environmental impacts and maximize environmental quality in the project area to the extent practicable considering other criteria and planning objectives.

The possible consequences of the Tentatively Selected Plan were considered in terms of probable environmental impact, social well-being, and economic factors. Endangered Species Act, Section 7 consultation was concluded with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. Species Determinations were concluded based on anticipated impacts of the Action Alternative. Impacts to these species and any designated Critical habitat are not anticipated to be "significant," as defined by the significance thresholds in National Environmental Policy Act guidelines (40 CFR Parts 1500-1508). Best Management Practices and standard USACE protocols will 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.

Environmental quality account information is presented in Section 6 of the integrated report and summarized in the FONSI in Section 10.

Other Social Effects. The Other Social Effects (OSE) Account registers the effects resulting from the implementation of the final deepening alternative plans from other perspectives that are relevant to the planning process, but are not reflected in the other three accounts. The OSE are anticipated to result from channel construction and maintenance activities and the level of cargo movement through the waterway. It is projected that the amount of cargo moving through the waterway will increase over time with or without navigation improvements; however, the implementation of the final deepening alternative plans would reduce the total number of vessels transiting the waterway when compared with without project conditions. The OSE are summarized as follows with specific details presented in Section 6.0:

- Overall, based on the absence of adverse impacts to human health, environmental health risks, and safety risk, this project would not have disproportionately high and adverse impacts to any communities, including environmental justice communities or children.

- The increase in noise and vibration would be temporary and negligible, even when considered in combination with other larger-scale navigation projects that could take place at or about the same time.

- The impacts to the visual and aesthetic environment would be temporary and negligible.

- The adverse impacts to the recreational resources would be a temporary and negligible construction-related disturbance during the period of initial construction and maintenance activities.

- There would be no adverse impacts upon adjacent land use and development.

- Impacts on land transportation are expected to be negligible as the Port of Virginia continues efforts, in coordination with local municipalities, to identify and implement means of decreasing truck traffic associated with routine Port operations.

4.10.2 The Recommended Plan/Proposed Action

Based on the information presented in the previous paragraphs, the LPP is designated as the Recommended Plan. This plan is supported by the Non-Federal Sponsor as the plan that would best meet the needs of the waterway users. The LPP, while a request from the project sponsor, was still formulated according to the four criteria within the P&G and is a direct result of such formulation. The LPP represents a greater depth but yet still contains both the formulation requirements and the four accounts identified within the NED plan. The LPP meets the requirements of ER-1105-2-100 in that it has similar outputs in kind, and greater than the NED Plan and the Non-Federal Sponsor has indicated its intent to pay the difference in costs between the NED Plan and the LPP. The LPP must be approved by and receive a waiver from the ASA (CW). It is the intent of the Project Delivery Team to submit an approval and waiver request to the ASA (CW) for the LPP.

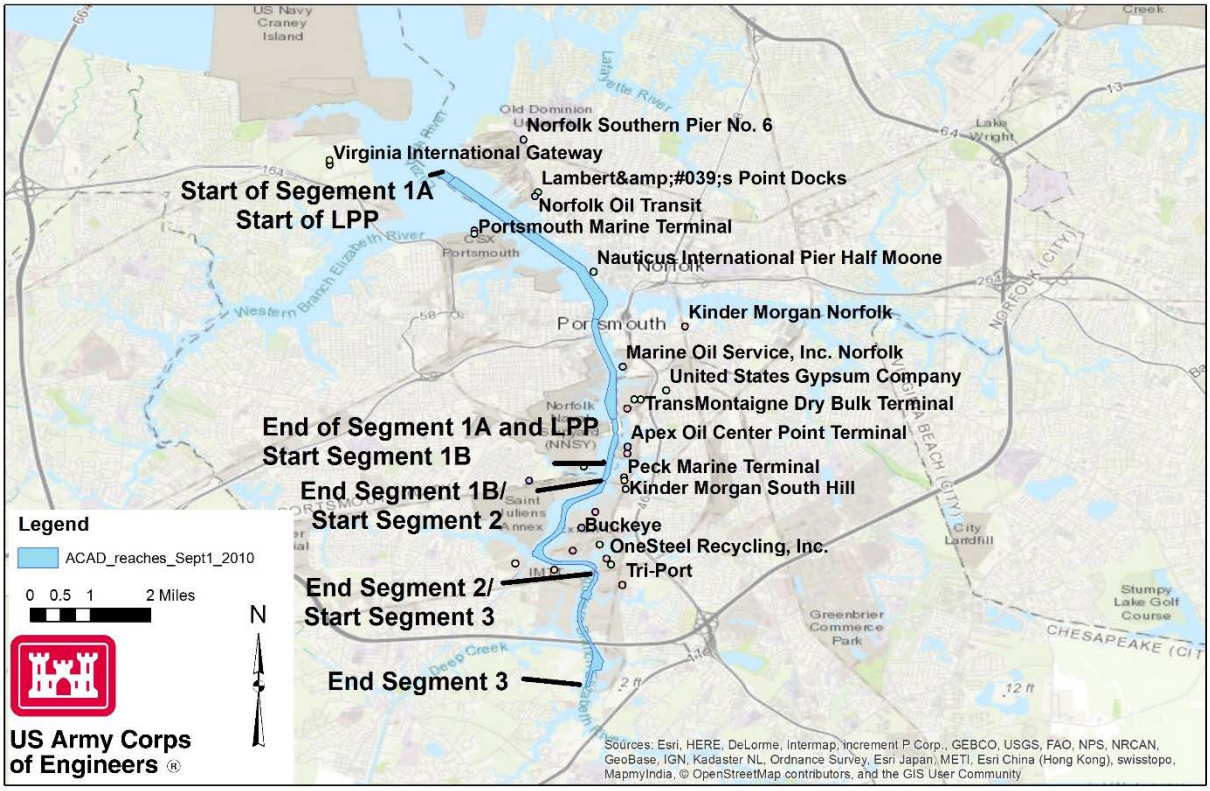

Figure 4-7. Segments 1a and 1b

Economic Analysis. It is possible to carry forward the results of the analyses of Segment 1 (44-foot and 45-foot depths); Planning Segment 2 (38-, 39-, and 40-foot depths); and Segment 3 (35-foot depth); and the refinement of Segment 1 (Segments 1a and 1b) and combine them to form the final array of alternatives shown in the following table (Table 4-16). This table presents the life cycle NED benefits, costs, net NED benefits and BCRs for the final array of alternatives, expressed in AAEQ dollars.

Table 4-19. Final Array of Alternatives Economic Summary (AAEQ) (1)

Segment-1 Measures	Segment-2 Measures	Seg1a + Seg1b + Seg2 + Seg3 Depth	AAEQ Benefits	AAEQ Costs	Net Benefits	BCR
Seg1-M0	Seg2-MO	40+40+35+35	(2)	(2)	(2)	(2)
Seg1-M4	Seg2-M3	44 + 42 + 38 + 35	$13,497,000	$4,954,000	$8,543,000	2.72
Seg1-M4	Seg2-M4	44 + 42 + 39 + 35	$14,919,000	$5,918,000	$9,001,000	2.52
Seg1-M4	Seg2-M5	44 + 42 + 40 + 35	$16,058,000	$6,942,000	$9,116,000	2.31
Seg1-M5	Seg2-M3	45 + 42 + 38 + 35	$14,021,000	$5,364,000	$8,657,000	2.61
Seg1-M5	Seg2-M4	45 + 42 + 39 + 35	$15,443,000	$6,328,000	$9,115,000	2.44
Seg1-M5	Seg2-M5	45 + 42 + 40 + 35	$16,582,000	$7,352,000	$9,230,000	2.26

(1) Dollar values rounded to nearest 1000s.
(2) No Action Alternative.

4.10.3 National Economic Development Plan

By definition, the NED Plan is the plan that reasonably maximizes the increases in the net economic value of the national output of goods and services based on the comparison of the differences in the value (benefits) produced by the plan to the value of the resources (costs) required to construct the plan. This plan also becomes the Tentatively Selected Plan. Based on the results presented in Table 4-16, it would appear that the NED Plan is Plan Seg1-M5/Seg2-M5 with net benefits of $9,230,000. However, there are three other plans that have net remaining benefits that fall within a very small percentage of those generated by Plan Seg1-M5/Seg2-M5 and are less costly, as shown in the following table (Table 4-17).

Table 4-20. Comparisons of Alternative Plans Considered for Selection as the NED Plan

Plan	Depth (Feet)	AAEQ Costs	Net Benefits	Incremental Net Benefits (1)	Incremental Net Benefits (%) (1)
Seg1M5/ Seg2-M5	45+42+40+35	$7,352,000	$9,230,000	0	0
Seg1-M4/ Seg2-M5	44+42+40+35	$6,942,000	$9,116,000	-$114,000	-1.23
Seg1-M5/ Seg2-M4	45+42+39+35	$6,328,000	$9,115,000	-$115,000	-1.25
Seg1-M4/ Seg2-M4	44+42+39+35	$5,918,000	$9,001,000	-$229,000	-2.48

(1) As compared to Plan Seg1-M5/Seg2-M5.

The difference in net benefits for each plan in comparison to Plan Seg1-M5/Seg2-M5 is less than three percent which suggests that the interpretation of the term “reasonably maximizes” is a significant factor in selecting the NED Plan. Engineering Regulation 1105-2-100 (Appendix G, Exhibit G-1) provides the following guidance on this subject: “Identification of the NED plan is to be based on consideration of the most effective plans for providing different levels of output or service. Where two cost-effective plans produce no significantly different levels of net benefits, the less costly plan is to be the National Economic Development (NED) plan, even though the level of outputs may be less.” Based on this guidance, Plan Seg1-M4/Seg2-M4, the least costly of the four plans that maximize net benefits, is selected as the NED Plan and also as the Tentatively Selected Plan.

In summary, the NED Plan is made up of the following components:

- Deepen Seg1a from 40’ to 44’. Seg1a extends from Lamberts Bend to just south of the Perdue Farms Terminal.
- Deepen Seg1b from 40’ to 42’. Seg1b extends from Seg1a to the end of Planning Segment-1.
- Deepen Planning Segment-2 from 35’ to 39’.
- Planning Segment-3 remains at 35’.

Transportation cost savings associated with the TSP are produced by carrying the same total commodity tonnage in the FWP as is carried in the FWOP but by doing so using fewer annual vessel calls in the FWP than are needed in the FWOP, which reduces total annual voyage costs associated with that level of throughput. The following table displays a comparison of the

FWOP and FWP number of vessel calls per model year by vessel class for the TSP (Table 4-18). Note that bulkers are expected see the greatest reduction in vessel calls due to the implementation of the TSP across all model years. This is due to several factors including grain exports being the primary driver of growth in traffic for Segment-1 and the ability of the large bulker vessels to load deeper and therefore take advantage of increased channel depth.

Table 4-21. FWOP and FWP Calls by Vessel Class and Model Year

Vessel Class Name	2023		2030		2035		2040		2045	
	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP
10K DWT Bulker	10	9	11	10	13	11	15	11	15	12
20K DWT Bulker	20	19	22	21	24	24	26	24	28	27
30K DWT Bulker	63	57	75	70	84	79	91	84	99	92
40K DWT Bulker	23	20	25	24	28	26	30	26	33	30
50K DWT Bulker	17	16	20	18	23	20	27	24	30	27
60K DWT Bulker	20	20	25	23	28	27	32	31	38	35
70K DWT Bulker	7	6	8	8	9	9	10	10	10	10
80K DWT Bulker	3	3	3	3	3	3	4	4	4	4
10K DWT Tanker	16	16	18	18	19	19	20	20	21	21
20K DWT Tanker	14	12	16	14	19	16	20	18	21	17
30K DWT Tanker	7	6	7	6	8	6	8	6	9	7
40K DWT Tanker	11	11	13	13	14	14	15	15	16	16
50K DWT Tanker	9	9	10	10	10	10	10	10	11	11
60K DWT Tanker	2	1	2	1	2	1	2	1	2	1
70K DWT Tanker	4	3	4	3	4	3	4	4	4	4
80K DWT Tanker	1	1	1	1	1	1	1	1	1	1
10K DWT Gas Carrier	4	3	4	3	4	3	4	3	4	3
20K DWT Gas Carrier	2	2	2	2	2	2	2	2	2	2
40K DWT Gas Carrier	2	2	2	2	2	2	2	2	2	2
50K DWT Gas Carrier	2	2	2	2	2	2	2	2	2	2
60K DWT Gas Carrier	2	2	2	2	2	2	2	2	2	2
80K DWT Gas Carrier	1	1	1	1	1	1	1	1	1	1
10K DWT Gen Cargo	84	82	98	97	109	107	118	115	127	123
20K DWT Gen Cargo	23	22	27	27	30	29	33	31	36	34
30K DWT Gen Cargo	11	10	13	12	14	13	15	14	16	15
40K DWT Gen Cargo	2	2	3	2	3	2	3	2	3	2
50K DWT Gen Cargo	2	2	2	2	2	2	2	2	2	2
Tank Barges	1082	1082	1135	1135	1179	1179	1225	1225	1277	1277

Vessel Class Name	2023		2030		2035		2040		2045	
	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP
Dry Barges	1252	1252	1385	1385	1463	1463	1535	1535	1599	1599
Cruise Ships	22	22	22	22	22	22	22	22	22	22
Navy & Other	1344	1344	1344	1344	1344	1344	1344	1344	1344	1344
Total Calls	**4062**	**4039**	**4302**	**4281**	**4468**	**4442**	**4625**	**4591**	**4781**	**4745**

4.10.4 Locally Preferred Plan

The NED Plan is the Tentatively Selected Plan that was presented to the Corps Vertical Team during the TSP Milestone Meeting that was held in August 2017 and is the plan that received the concurrence of the Vertical Team at that time. Soon after the TSP Milestone Meeting, the Non-Federal Sponsor confirmed its support for a Locally Preferred Plan (LPP).

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4.11 COMPARISON OF THE NED AND LPP PLANS

The NED Plan and LPP are shown in table 4-19. The BCR's for the two plans are very close at 2.52 and 2.44 respectively. Th net benefits for each plan are also very similar, but the cost is higher for the LPP.

Table 4-22. NED and LPP Plans

Plan	Depths	AAEQ Costs	Net Benefits	Benefit-to-Cost Ratio
NED Plan (Alternative Action Plan 1)	44+42+39+35	$5,918,000	$9,001,000	2.52
Locally Preferred Plan (Alternative Action Plan 2)	45+42+39+35	$6,328,000	$9,115,000	2.44

4.11.1 System of Accounts

The Federal process incorporates four accounts to facilitate evaluation and display of the effects of the alternative plans. The four accounts are National Economic Development, Environmental Quality, Regional Economic Development, and Other Social Effects. While the National Economic Development account is required, the other accounts are considered with the intent to identify factors that could exhibit meaningful differences between alternative and that could significantly influence plan selection.

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- Impacts on land transportation are expected to be negligible as the Port of Virginia continues efforts, in coordination with local municipalities, to identify and implement means of decreasing truck traffic associated with routine Port operations.

4.11.2 The Recommended Plan/Proposed Action

Based on the information presented in the previous paragraphs, the LPP is designated as the Recommended Plan. This plan is supported by the Non-Federal Sponsor as the plan that would best meet the needs of the waterway users. The LPP, while a request from the project sponsor, was still formulated according to the four criteria within the P&G and is a direct result of such formulation. The LPP represents a greater depth but yet still contains both the formulation requirements and the four accounts identified within the NED plan. The LPP meets the requirements of ER-1105-2-100 in that it has similar outputs in kind, and greater than the NED Plan and the Non-Federal Sponsor has indicated its intent to pay the difference in costs between the NED Plan and the LPP. The LPP must be approved by and receive a waiver from the ASA (CW). It is the intent of the Project Delivery Team to submit an approval and waiver request to the ASA (CW) for the LPP.

5 DRAFT RECOMMENDED PLAN/PROPOSED ACTION

5.1 DESCRIPTION OF THE DRAFT RECOMMENDED PLAN

The Draft Recommended Plan (DRP) includes the deepening of the Federal navigation channels from the Lamberts Point to the Gilmerton Bridge and the maintenance of the existing channel from the Gilmerton Bridge to the Chesapeake Extension. The DRP is the LPP, which is one-foot deeper than the required depth in the NED Plan in the reach from Lamberts Point to the Perdue Terminal. For the purpose of this study and to conform to NEPA requirements and Corps planning regulations the Draft Recommended Plan may also be referred to as the Tentatively Selected Plan (TSP) or the Preferred Alternative (PA).

5.1.1 Channel Dimensions

The Draft Recommended Plan (or Preferred Alternative) is the Locally Preferred Alternative, which includes the following features:

- Deepening the channel from Lamberts Bend to Perdue Farms (Segment 1a) from a required depth of 40 feet to 45 feet deep in Segment 1a, and deepening the channel from Perdue Farms to the Norfolk Southern Lift Bridge (Segment 1b) from a required depth of 40 feet to 42 feet.
- Deepening the channel from the Norfolk Southern Lift Bridge to the Gilmerton Bridge (Segment 2), from a required depth of 35 feet to 39 feet deep; and
- Continuing to maintain the channel from the Gilmerton Bridge to the Chesapeake Extension to a required depth of 35 feet (Segment 3).

Table 5-1 summarizes the features of the Draft Recommended Plan. The Draft Recommended Plan does not recommend a change in the existing, authorized channel depths or widths for any channel segment.

Table 5-1. Authorized, Existing, and Recommended Required Depths for the Elizabeth River and Southern Branch Navigation Improvements Project

Channel Segment	Channel Depth (feet below MLLW)		
	Authorized Depth	Existing Required Depth	Recommended Plan Required Depth
Segment 1a	45	40	45
Segment 1b	45	40	42
Segment 2	40	35	39
Segment 3	35	35	35

For the environmental impact analysis we evaluated dredging depths impacts (and associated dredging volume and durations) that are deeper than the required (or target) dredging depth. This is because dredging beyond the required depth sometimes may be allowed for advanced maintenance and allowable paid and nonpaid overdepth and also because dredging to an exact depth out in the field is not practical. Therefore, the dredging depths, volumes, and durations vary between the economic analysis and the environmental impact analysis in our study. For

more information on the assumptions used in the environmental analysis pertaining to dredging depths, volumes, and durations, please refer to Section 6.0, Environmental Consequences.

5.1.2 Dredging and Dredged Material Management

Dredged material would be placed/disposed at the CIDMMA or at an approved, upland disposal site. Dredged material meeting sediment testing requirements for placement at the CIDMMA would be placed in the Craney Island Rehandling Basin or directly in one of the containment cells at the CIDMMA. Material would be transported to the placement site by hydraulic pipeline if hydraulically dredged or by barge/scow if mechanically dredged to be bottom dumped in Craney Island Rehandling Basin or directly pumped out into a containment cell at CIDMMA. In the future, after the completion of the construction of the CIEE, some of the dredged material may be placed in this site as well.

Sediment testing for contaminants of concern and the extent of contamination would be conducted during the Preconstruction, Engineering, and Design Phase of the project. Dredging within the Elizabeth River Southern Branch Navigation Improvements Project is anticipated to generate dredged material with contamination from Segment 1 and within Segment 2 that exceeds the acceptance criteria of the CIDMMA. Contaminated dredged material may be brought to Port Weanack on the James River or an alternate approved facility for re-handling and would be ultimately disposed of at an approved upland site(s). Potential upland disposal sites for contaminated material may include, but are not limited to, the following:

- Charles City County Landfill
- CFS, Tri-City Regional Landfill & Recycling Center
- John C. Holland Enterprises Landfill
- Southeastern Public Service Authority (SPSA) Regional Landfill
- Portsmouth City Craney Island Landfill
- Bethel Landfill
- King and Queen Sanitary Landfill

Additionally, the following soil processing services could include but would not be limited to the following:

- Port Tobacco/Weanack Land, LLC (also can accept some dredged material)
- Clearfield MMG, Inc. Soil Recycling

5.1.3 Disposal Area Modifications

Placement of dredged material at CIDMMA is limited to users within the geographical 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. The 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 mean lower low water (MLLW), with the interior dike heights currently ranging from 33 to 36 feet above MLLW, which maintains 3 to 4 feet of freeboard. Under the current management program, a nominal 2-foot increase in dike height is scheduled for 2017. The dikes at CIDMMA will continue to be raised as appropriate for future capacity needs.

5.1.4 Beneficial Use of Dredged Material

Due the dredged material in the Elizabeth River being predominately fine grained sediments (Fugro 2016), there is no known opportunity for beneficial use of the dredged material. If a beneficial use is identified in the future, the project would be coordinated separately from this project.

5.2 Environmental Mitigation

No compensatory environmental mitigation is anticipated to be required with implementation of the Recommended Plan. For a summary of avoidance and minimization measures to reduce any potential impacts to environmental resources please see Chapter 7: Summary of Proposed management Actions, Best Management Practices, and Compensatory Mitigation.

5.3 OPERATION AND MAINTENANCE CONSIDERATIONS

Operation and maintenance of the Recommended Plan will be a continuation of existing operation and maintenance practices. Maintenance dredging of the Draft Recommended Plan will occur on a less than annual basis, with 17 dredging events projected over the 50-year planning period. Suitable dredged material would be placed at the CIDMMA and dredged material not suitable for placement at the CIDMMA would be barged to an approved transfer facility for re-handling and disposal.

The Recommended Plan will increase historical maintenance dredging volumes, with increases in the Elizabeth River Reach and Upper Reach A (Table 5-2).

Table 5-2. Estimated Maintenance Dredging Volume for ERSB Channels

Reach	Current Annualized Maint. Volume (CY)	Future With Project, Annualized Volume (CY)	No. of Dredging Events in 50 Years	% Increase Over Without Project Conditions
Elizabeth River Reach	31,600	33,510	6	6.0%
Southern Branch Lower Reach	1,430	1,510	2	5.6%
Southern Branch Middle Reach - Segment of 1A	670	720	2	7.5%
Southern Branch Middle Reach - Segment of 1B	100	110	2	10.0%

Upper Reach A	17,700	19,650	10	11.0%
Upper Reach B	1,670	1,860	2	11.4%
Upper Reach C	-	-	n/a	

5.4 LANDS, EASEMENTS, RIGHTS OF WAY, AND RELOCATION CONSIDERATIONS

There are no lands, easements, rights of way, or relocation considerations associated with the Draft Recommended Plan.

5.5 REAL ESTATE CONSIDERATIONS

The implementation of the recommended project does not require the transaction/acquisition of real estate as the bottoms/bottomlands needed for the project are owned by the Non-Federal Sponsor in fee simple. Additionally, the project does not require any rights-of-entry or temporary easements or the relocation of any residence, business, farm, or public or private utility or facility. The intended effects of this project are not expected to cause flooding in the surrounding area or involve known future mineral activities or other subsurface minerals or timber activities. Navigational Servitude, the Constitutional right of the Federal Government to use, control, and regulate the navigable waters of the United States for various commerce-related purposes, including the entry and construction on lands below the mean high water level, is available for this project. Specific information on the real estate considerations are presented in the Real Estate Plan which is found in Appendix C.

5.6 IMPLEMENTATION REQUIREMENTS

This section defines implementation responsibilities necessary to insure that the Draft Recommended Plan's goals and objectives are achieved. Included are discussions of the division of plan responsibilities between Federal and non-Federal interests, institutional requirements, cost sharing, analysis of non-Federal financial capability, a discussion of the Project Cost Agreement (PCA), and views of the non-Federal sponsor.

5.6.1 Cost Sharing

Cost sharing for the Recommended Plan will be done in accordance with Section 101 of the WRDA 1986, as amended, and cost shared as a General Navigation Feature. The NED Plan cost shares are based on all NED channel depths being greater than 21 feet and less than 50 feet. Channel depths greater 21 feet and less than 50 feet are cost shared 25 percent non-Federal and 75 percent Federal (Table 5-5). The locally preferred incremental addition to the NED Plan is cost shared 100% non-Federal (Table 5-6). Cost shares for the Locally Preferred Plan, which is the Recommended Plan, are presented in Table 5-7. The non-Federal sponsor will provide all Lands, Easements, Right-of-ways, and Relocations (LERR). 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 LERR, are credited against the additional cash contribution. A summary of cost shares is presented in Tables 5-5 through 5-7.

Table 5-3. NED Plan Cost Shares

	Total Cost	Federal	Non-Federal
Mob and Demobilization	$4,503,000	$3,377,000	$1,126,000
Dredging Cost (Including Mob / Demob)	$92,255,000	$69,191,000	$23,064,000
Environmental Mitigation	$0	$0	$0
Monitoring	$0	$0	$0
Construction Management	$758,000	$569,000	$190,000
PED	$7,945,000	$5,959,000	$1,986,000
Contingency (14.81%)	$15,619,000	$11,714,000	$3,905,000
Total Construction of GNF	$121,080,000	$90,810,000	$30,270,000
LERR	$0	$0	$0
Total Project First Costs	$121,080,000	$90,810,000	$30,270,000
Non-Federal Berth Dredging Costs	$31,853,000	$-	$31,853,000
Relocating Aids to Navigation	$0	$0	$0
10% GNF Non-Federal	$0	$(12,108,000)	$12,108,000
Total Cost	$152,934,000	$78,702,000	$74,231,000

Table 5-4. Locally Preferred Increment Cost Shares

	Total Cost	Federal	Non-Federal
Mob and Demobilization	$0	$0	$0
Dredging Cost (Including Mob / Demob)	$6,758,000	$0	$6,758,000
Environmental Mitigation	$0	$0	$0
Monitoring	$0	$0	$0
Construction Management	$0	$0	$0
PED	$0	$0	$0
Contingency (14.81%)	$1,001,000	$0	$1,001,000
Total Construction of GNF	$7,759,000	$0	$7,759,000
LERR	$0	$0	$0
Total Project First Costs	$7,759,000	$0	$7,759,000
Non-Federal Berth Dredging Costs	$2,520,000	$0	$2,520,000
Relocating Aids to Navigation	$0	$0	$0
10% GNF Non-Federal	$0	$0	$0
Total Cost	$10,279,000	$0	$10,279,000

Table 5-5. Locally Preferred (Draft Recommended) Plan Cost Shares

	Total Cost	Federal	Non-Federal
Mob and Demobilization	$4,503,000	$3,377,000	$1,126,000
Dredging Cost (Including Mob / Demob)	$99,013,000	$69,191,000	$29,822,000
Environmental Mitigation	$0	$0	$0
Monitoring	$0	$0	$0
Construction Management	$758,000	$569,000	$190,000
PED	$7,945,000	$5,959,000	$1,986,000
Contingency (14.81%)	$16,620,000	$11,714,000	$4,906,000
Total Construction of GNF	$128,839,000	$90,810,000	$38,029,000
LERR	$0	$0	$0
Total Project First Costs	$128,839,000	$90,810,000	$38,029,000
Non-Federal Berth Dredging Costs	$34,373,000	$-	$34,373,000
Relocating Aids to Navigation	$0	$0	$0
10% GNF Non-Federal	$0	$(12,108,000)	$12,108,000
Total Cost	$163,213,000	$78,702,000	$84,510,000

5.7 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 5.4, above. 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 GNF consisting of breakwaters and jetties, entrance and primary access channels, widened channels, turning basins, anchorage areas, locks, and dredged material disposal areas with retaining dikes.

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 12 June 2007. For the final report Appendix L, Correspondence, will contain this certification.

5.8 VIEW OF THE NON-FEDERAL SPONSOR

The Port of Virginia fully supports the DRP and has agreed to the cost sharing as outlined above. Appendix L, Correspondence, contains the sponsor's letter of intent for the final report. The letter of intent contains the Port of Virginia'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.

5.9 RISK AND UNCERTAINTY

Risk and uncertainty exists 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 Appendix B. Cost contingencies, incremental costs, and estimates for the dredging costs are discussed in Appendices A (Engineering). There are also risks which were addressed during the study using a Risk Register. The purpose of the register is to apply a risk-based decision making approach throughout the study. The register was used to highlight areas of study risks and identify ways to address those risks, such as reducing the schedule, optimizing the study area, and identifying the optimum amount of modeling to make a risk-based decision.

Several assumptions applied to analyses during the study result in conservative cost and impact estimates and reduce cost risks. Ship Simulation investigations to be conducted during the Preconstruction Engineering and Design (PED) phase will reduce this risk.

6 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVE PLANS

This chapter describes the existing and projected future conditions for each of the resources that could reasonably be expected to be impacted by the project. Existing and projected future condition descriptions include physical, chemical, biological and sociological conditions. These conditions are described without implementation of the alternative actions and with implementation of the alternative actions. The comparison of Without Project and with-project conditions defines the impacts of the alternatives. Table 6-1 provides a summary of the impacts for the resources that could be potentially affected by implementation of the project alternatives. Because of the similarity of the Action Project Alternatives (Alternative 1 (NED plan) and Alternative 2 (LPP/DRP)), we would expect the same threshold level of impacts although the relative impact of Alternative 2 would be slightly greater than Alternative 1 because of the increased dredging depths and duration of dredging.

Table 6-1. Environmental Consequences of the Project Alternatives Summary Table

Resource	No Action Alternative/Future Without Project Alternative	Action Project Alternatives
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. Continued maintenance of the channel system should have 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), but topography may change at a slightly higher rate at the CIDMMA and upland disposal sites because of increased dredging volumes placed/disposed at these facilities.
Bathymetry, Hydrology, and Tidal Processes	No would be no anticipated effects to bathymetry, hydrology or tidal processes.	The additional channel dredging and widening 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 area of the channel. This bathymetric alteration may influence effects of the tides. These impacts would be adverse, permanent and minor.
Hazardous, Toxic, and Radioactive Waste (HTRW)	No releases of HTRW exceeding regulatory limits are anticipated with maintenance dredging or dredged material disposal/placement operations. Maintenance dredging would continue to have an adverse, temporary, negligible level of impact and will remain within dredged material placement/disposal limits at the CIDMMA and upland containment sites when CIDMMA limits on contaminants are exceeded.	Impacts would be at the same threshold level of impact as the NAA/FWO (adverse, temporary, and negligible). Any potential redistribution of contaminants resulting from dredging and dredged placement/disposal would be 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 either of the Action Project Alternatives would be slightly higher due to the increased duration of dredging and dredged material placement/disposal. Adverse salinity and dissolved oxygen changes will be permanent, but negligible to minor and not significant. Implementation of either of the Action Project Alternatives would result in adverse impacts to water quality that would be temporary to permanent and negligible to minor.

Resource	No Action Alternative/Future Without Project Alternative	Action Project Alternatives
Vegetation, Wetlands, and Submerged Aquatic Vegetation	There would be no effect to Submerged Aquatic Vegetation (SAV) or jurisdictional 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.	There would be no effect to Submerged Aquatic Vegetation (SAV) or jurisdictional 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 either of the Action Project Alternatives would be slightly higher due to the increased duration of dredging and dredged material placement/disposal.
Plankton Community	Adverse, temporary and negligible impacts to the local plankton community that result from current 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 either of the Action Project Alternatives would be slightly higher due to the increased duration of dredging and dredged material placement/disposal.
Fish and Fish Habitat	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 temporary and negligible. While impacts to Essential Fish Habitat (EFH) would be adverse, they would not be substantive.	Similar to the NAA/FWO, impacts to fish and fish habitat would result in negligible to minor and temporary 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.
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 either of the Action Project Alternatives would be slightly higher due to the increased duration of dredging and dredged material placement/disposal.
Special Status Species	The affect finding for the Federally listed northern long-eared bat (*Myotis septentrionalis*) would be No Affect as this species would not be anticipated to occur in the Action Area. Affect findings for all other Federally listed species with the potential to occur in the Action Area would be May Affect, Not Likely to Adversely Affect because of potential temporary, minor disturbance effects. Only temporary, minor disturbances to marine mammals would be anticipated to occur from disturbance related impacts. No Level A or Level B harassment to marine mammals would be anticipated. Temporary to permanent impacts to migratory birds would be negligible to minor resulting from temporary disturbance impacts and temporary to permanent creation of wildlife habitat at the CIDMMA.	Impacts would be at the same threshold level of impact as the NAA/FWO, however, the relative level of impact with either of the Action Project Alternatives 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 Alternatives
Air Quality	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). There would be adverse, temporary, negligible to minor impacts to air quality.	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 either of the Action Project Alternatives would be slightly higher due to the increased duration of dredging and dredged material placement/disposal.
Climate Change	Current 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 either of the Action Project Alternatives would be slightly higher due to the increased duration of dredging and dredged material placement/disposal. In future conditions with implementation of either of the Action Alternatives we would anticipate fewer greenhouse gas emissions resulting from deep draft vessels as compared to future conditions without implementation of the Action Project Alternative.
Floodplains	Potential adverse impacts to floodplains from material placement/disposal operations would be adverse, temporary, and negligible. A CIDMMA dike breach/failure would be unlikely.	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.	Impacts would be at the same threshold level of impact as the NAA/FWO, however, the relative level of impact with either of the Action Project Alternatives would be slightly higher due to the increased duration of dredging and dredged material placement/disposal.
Occupational Safety and Health	Maintenance dredging and dredged material placement operations would continue and existing, adverse, temporary, safety risks that are at a negligible to minor level of impact would continue.	The duration of exposure to occupational safety and health risks would increase with implementation of either of the Action Project Alternatives. Although the Action Project Alternatives have slightly higher durations of exposures to occupational safety and health hazards, entailing slightly more risk than the NAA/FWO, the occupational safety and health risks would be very similar and remain at an adverse, temporary and negligible to minor level of impact.
Cultural Resources	There would be no anticipated direct, indirect, or cumulative effects to cultural resources. Unidentified sites could still be at slight risk to effects from maintenance dredging, although that potential is less than with implementation of the Action Project Alternative. The future without project could subject unidentified submerged archaeological sites to damage from ship strikes, groundings, and prop wash.	Effects to terrestrial architectural cultural resources would be adverse, temporary, and negligible. No submerged archaeological resources have been recorded within the Area of Potential Effect (APE) for dredging. Archaeological sites may exist within unsurveyed parts of the APE. Surveys will be conducted for these areas during the PED Stage of the project. A Programmatic Agreement with the State Historic Preservation Office has been concluded that sets forth procedures for mitigating adverse effects to historic properties if any are identified. Avoidance and minimization of impacts would be attempted where feasible, and mitigation of adverse effects (if applicable) would be evaluated and determined during the PED Stage.
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 NAA/FWO but temporary impacts to the viewshed would increase because of increased dredging and dredged material placement/disposal durations and dredging locations. Implementation of either of the Action Project Alternatives would result in adverse, temporary and negligible impacts to the aesthetic environment.

Resource	No Action Alternative/Future Without Project Alternative	Action Project Alternatives
Recreation	While maintenance 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), 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.
Socioeconomics and Environmental Justice	There would not be substantive changes to demographic, socioeconomic, or Environmental Justice community trends. The effect on the socioeconomic character would be beneficial, temporary, and minor from existing dredging maintenance and dredged material placement/disposal operations.	The improved navigation channel 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. Implementation of either 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. Either of the Action Project Alternatives would result in a temporary, beneficial increase in the local economy. Regional Economic Development benefits would be anticipated to be beneficial and temporary and in relation to the dredging cycle.
Land Use and Induced Development	There would be no temporary or permanent predicted changes to the existing land use or patterns of land use change.	There would be no effect on land use or patterns of land use change.
Transportation	There would be no anticipated changes to the regional traffic or surface road congestion.	Expected impacts to transportation would be similar to the NAA/FWO. Neither of the Action Project Alternatives would 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.

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

One important 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). Please see Table 6-2 for an approximate estimate of estimated maximum, potential dredging depths that account for the overdepth and advanced maintenance dredging with implementation of the Preferred Alternative. For the purpose 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, though it is unlikely the non-pay overdepth volume will be dredged. The maximum potential estimated dredging depths, durations, and volumes are provided in table 6-2. 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.

Table 6-2. Lifecycle Dredging Actions and Volumes of the FWOP and Preferred Alternative (Alternative 2)

				Estimated Construction Maximum				Estimated Maintenance - 50 Years		Summary - Construction Maximum and Maintainance	
Alternative	Required Depth - feet (ft)	Current Volume above Existing Maintained Depth (cubic yards)	Estimated Maximum Depth (ft) = Required Depth + 1 ft Advanced Maintenance + 2 ft Paid Allowable Depth + 2 ft Non-Pay Allowable Overdepth + 1 ft Contamination Removal (select segments only)	Estimated Maximum Volume (cubic yards)	Estimated Maximum Dredging Duration (Months)	Estimated Maximum Total Bottom Disturbance (square feet)	Estimated Maximum Change/Delta (increase) in Bottom Disturbance - (square feet)	Estimated 50 Year Maintenance Volume (cubic yards)	Estimated 50 Year Maintenance Dredging Duration (months)	Estimated Maximum Volume - Volume Above Existing + Allowable Pay + Non-Pay + Maintenance Volume (cubic yards)	Estimated Maximum Construction + 50 Year Maintenance Dredging Duration (months)
No Action Alternative/Future Without Project (NAA/FWOP)- Segment 1 Elizabeth River Reach	40	55,804	46	480,234	0.70	14,345,062	-	1,579,750	3.44	2,115,788.73	4.15
NAA/FWOP - Segment 1 Lower Reach	40	3,818	46	64,783	0.09	5,209,099	-	71,300	0.21	139,901.58	0.31
NAA/FWOP - Segment 1 Middle Reach	40	10,050	46	197,351	2.18	2,064,875	-	38,250	0.29	245,650.50	2.47
NAA/FWOP - Segment 2	35	1,938	40	359,206	4.48	5,020,273	-	884,800	6.27	1,245,944.38	10.75
NAA/FWOP - Segment 3	35	495,977	40	1,222,383	15.25	4,269,028	-	83,350	0.59	1,801,710.10	15.84
Total										**5,548,995.29**	**33.52**
Alternative 2 - Segment 1A	45	63,969	up to 50, 51 in MR	2,499,984	3.65	20,737,337	976,689	1,826,389	3.98	4,390,341.61	7.63
Alternative 2- Segment 1B	42	5,704	up to 48	71,877	0.79	2,039,347	180,960	5,144	0.04	82,724.58	0.83
Alternative 2 - Segment 2	39	1,938	up to 45	1,590,006	19.84	5,729,763	709,490	982,128	6.96	2,574,072.50	26.80
Alternative 2 - Segment 3	35	495,977	40	1,222,383	15.25	4,269,028	-	83,350	0.59	1,801,710.10	15.84
Total										**8,848,848.79**	**51.11**

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

6.1 GEOLOGY, PHYSIOGRAPHY, AND TOPOGRAPHY

6.1.1 No Action/Future Without Project Alternative

Existing maintenance dredging operations, dredged material placement, and navigation within the ROI would continue. Continued placement for maintenance dredging would occur in CIDMMA. 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.

Placement of dredged material may alter the topography at the CIDMMA, through a very slight permanent elevation increase. This project is one of many dredging projects within the Norfolk Harbor that would utilize the CIDMMA; and over time, they may fill with dredged material. However, continued use of those sites as placement areas will have a negligible 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. Also, additional development, including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel, is planned in the future. New development within the ROI could increase impacts to geology, physiography, or topography by changing land uses, and altering or elevations and/or geologic landforms.

Climatic changes such as sea level rise and increasing global temperatures are predicted to continue in the future. Climate change impacts such as increased 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.

Erosion and loss of estuarine and ocean beaches is anticipated to occur with sea level rise. Over the course of time, more landforms may become submerged, and other areas may become lower-lying and flood more frequently, particularly within the coastal physiographic province in which this project is located.

The No Action/Future Without Project Alternative Plan is not predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects. Therefore, effects to the geology, physiography, seismicity, and topography from implementation of the No Action/Future Without Project Alternative Plan are predicted to be negligible and permanent.

6.1.2 Action Project Alternatives

Impacts to geology, physiography, seismicity, and topography with implementation of either of the action alternative plans (Alternative Plan 1 or 2), would be similar to those described for the No Action/Future Without Project Alternative Plan. Much of Segment 1 has already been deepened by the Navy; that portion only requires periodic maintenance dredging to maintain depth, as does Segment 3, which is not proposed for additional channel deepening.

For either action alternative, the channel will be permanently deepened, and generally maintained to those depths. The existing sediment within the dredging footprint in the channel would be removed, most of which, from a geologic perspective, is recently deposited fine sands, silts, mud, and unconsolidated clay. Some thin, marine sands of the Quaternary and possibly Tertiary ages may be present in the lower depths to be dredged. 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 necessary to achieve the proposed depths.

Compared to current operations, there would be increased material placement/disposal at the CIDMMA, with implementation of either of the action alternatives as compared to the No Action/Future Without Project Alternative Plan. Alternative Plan 2, with its additional dredging in Segment 1a, would result in very slightly more dredged material placement than Alternative Plan 1. For either alternative, there will be minor topographic increases in elevation in CIDMMA over the next 50 years, due to the project. Over time, the CIDMMA may fill with dredged material. However, as CIDMMA is a manmade facility, and used as such, topographic changes as a result of dredged material placement will not affect any natural geologic landforms. Placement of the dredged material at the CIDMMA is expected to have no adverse impact on seismology; no adverse impacts on geology and physiography; and permanent, negligible to minor, adverse impacts on topography.

Any contaminated materials dredged from the ROI would be carefully handled, and would be transported to lined landfills that currently exist and are functioning. For either alternative, there will be minor adverse effects in the form of topographic increases in elevation at the upland disposal site, due to the project. However, removing contaminated material from the ROI would have a beneficial effect from a geologic and physiographic perspective, as they are unnaturally occurring materials.

As described in the No Action/Future Without Project Alternative Plan Section, potential cumulative impacts include increased development such as port growth, increased shipping traffic, and climate change. Implementation of either of the action alternatives is not anticipated

to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects, including port growth.

6.2 BATHYMETRY, HYDROLOGY, AND TIDAL PROCESSES

6.2.1 No Action/Future Without Project Alternative

The present channel will remain at current depths throughout its various segments. The navigation channel may still require periodic maintenance dredging to maintain present depth into the future. This maintenance dredging will remove material from the channel, mainly fines and silts deposited from the water column, not any new material. While rising seas due to climate change are expected to increase the depth slowly over time, such change will not be rapid enough to ameliorate the need for the continued maintenance dredging. There will be continuing, minor impacts to the hydrology, tidal processes or bathymetry under the No Action/Future Without Project Condition Alternative. Temporary, negligible impacts to the bathymetry are expected.

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. Also, additional development, including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel, is planned in the future. None of these changes should alter the bathymetry any further in the project ROI.

Climatic changes such as sea level rise and increasing global temperatures are predicted to continue in the future. Climate change impacts such as increased 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. These impacts, should not alter the bathymetry with one exception, sea level rise will act to increase water levels in the ROI. It is possible that rising waters will lessen the frequency of duration for maintenance dredging.

The No Action/Future Without Project Alternative Plan is not predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects, including port growth. Therefore, with implementation of the No Action/Future Without Project Alternative Plan, adverse impacts are temporary and negligible to minor.

6.2.2 Action Project Alternatives

The additional proposed dredging with either implementation of Alternative Plan 1 or Alternative Plan 2 has the potential to alter local hydrology, in particular the location of any salt wedge (the region where heavier, saltier water mixes with lighter, fresher water) and/or currents. The EFDC/HEM3D hydraulic/water quality model (VIMS 2016) was performed assuming that dredging in Segments 1, 2, and 3 would be an additional seven feet in Segment 1 and 2 (five feet to get to the full authorized depth with two feet of advanced maintenance dredging) and 2 feet in Segment 3, indicates that with implementation of the action alternatives, there will be minor changes to transport times (freshwater age, saltwater age, and renewal time) in the middle of the Elizabeth River and Lafayette River. The saltwater age increases slightly in the middle of the Elizabeth River (less than 1% increase). The freshwater and saltwater ages decrease approximately 1.5% in the Lafayette River at the maximum depth they modeled, indicating flushing improves with the proposed dredging. Less will occur under any of the action alternatives. Overall renewal time decreased approximately 2.0% in the Lafayette River

according to the VIMS model, with a small change (less than 1% decrease) at the confluence of the Elizabeth and Lafayette Rivers. These simulated depths are not expected to result in substantive changes to hydrology and tidal processes of the Elizabeth River. Overall, minor changes in hydrology and tidal processes (the horizontal tide) of the Elizabeth River and its tributaries are expected as a result of project implementation.

This action will cause a small increase in the tidal prism of the Elizabeth River, though this volume increase is minor compared to the entire tidal prism of the River. Local tides will not be impacted by the proposed deepening, as this will not alter the ability of water to enter or exit the Elizabeth River relative to current tides. High and low tides will remain the same, as the activity does not result in any restrictions on incoming or outgoing tides. No alteration to the vertical tide is expected. Due to the deepening, there is a possibility of minor alterations to horizontal tides, which could alter local currents in the River. Based on the results of the VIMS hydrodynamic modeling simulations (VIMS 2016), these alterations appear to be minor.

Maintenance dredging will be needed to maintain the channel. This dredging will be similar in volume relative to the dredging that would be needed to maintain the channel if the deepening were not done. No additional changes to bathymetry, hydrology or tidal processes would occur during routine maintenance dredging. No substantive impacts to the tidal processes, bathymetry and hydrology of the Elizabeth River system are expected from routine maintenance dredging.

As described in the No Action/Future Without Project Alternative Plan Section, potential cumulative impacts include increased development such as port growth, increased shipping traffic, and climate change. Although increased development and climate change have the potential to increase water levels in the project ROI, implementation of either of the action alternatives is not anticipated to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects, including port growth.

Therefore, implementation of either Alternative Plan 1 or Alternative Plan 2 is anticipated to result in adverse impacts that would be temporary to permanent, negligible to minor to the bathymetry in the ROI. Although impacts would be slightly greater for Alternative Plan 2 than for Alternative Plan 1 (because of the deeper dredging depths in Segment 1a), it would not reach a threshold level of difference in the impact findings for the bathymetry of the Elizabeth River.

6.3 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

6.3.1 No Action/Future Without Project Alternative

With implementation of the No Action/Future Without Project Condition, the existing channels would be maintained to their required depths. Dredged material would be tested in accordance with *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual, Inland 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* (2003) to determine suitability for placement at the CIDMMA or at an upland disposal site(s). Ongoing efforts to remediate contaminated sediment issues in the Elizabeth River and Southern Branch of the Elizabeth River (e.g., Atlantic Wood Industries, Republic Creosoting, Money Point's Phase 3, and Eppinger and Russel Creosoting) would continue. Two of the former creosote sites (Atlantic Wood Industries and Eppinger and Russell) are undergoing active remediation, and remediation of the third (Republic Creosoting), is planned (Di Giulio and Clark 2015). As a result of these ongoing efforts, it would be reasonable to

expect the No Action/Future Without Project Alternative Plan would have a reduction in the concentration of contaminants in the sediments within the Elizabeth River and Southern Branch of the Elizabeth River. No adverse impacts to the public or the environment from release of Hazardous, Toxic, and Radioactive Waste (HTRW) are anticipated from implementation of the No Action/Future Without Project Alternative Plan. Continued dredging maintenance of the channel would have an adverse, temporary and minor impact to the sediment profile.

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. Also, additional development, including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel, is planned in the future.

Climatic changes such as sea level rise and increasing global temperatures are predicted to continue in the future. Climate change impacts such as increased 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. While rising seas due to climate change are expected to increase the depth slowly over time, such change will not be rapid enough to ameliorate the need for continued maintenance dredging.

The No Action/Future Without Project Alternative Plan is not predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects. Therefore, with implementation of the No Action/Future Without Project Alternative Plan, adverse impacts to the sediment profile would be temporary and minor.

6.3.2 Action Project Alternatives

With implementation of either Alternative Plan 1 or Alternative Plan 2, additional channel deepening, and therefore, removal of sediments in the channels would occur in Segment 1 and Segment 2 while the existing channel depth in Segment 3 would be maintained. Detailed sediment testing to determine the composition, extent and level of any potential contaminants in the sediments will not be completed until the Preconstruction, Engineering, and Design Phase of the project. However, based on existing sediment data and previous industrial activities that occurred in the ROI, it is possible that additional dredging beyond the required depth of either alternative (approximately two feet) and placement of an engineered cap or complete removal of contaminated material to depth if economically justified based on savings in future operation and maintenance costs in accordance with USACE policy (PGL No 49, Section 312 WRDA of 1990) may be implemented in Segment 1 and Segment 2.

Dredged material will be tested in accordance with *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual, Inland 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* (2003) to determine suitability for placement at the CIDMMA or at an upland disposal site(s).

Dredging with implementation of either of the action alternatives is anticipated to generate some dredged material containing contamination within the ROI that exceed the acceptance criteria of the CIDMMA. Contaminated sediments may need to be dewatered prior to disposal. Contaminated dredged material will need to be disposed of at an approved upland site(s). Potential upland disposal sites that could be used are described in the Affected Environment

portion of this section. No adverse impacts to the public or the environment from release of HTRW are anticipated from implementation of either of the action alternatives.

The dredging would result in a removal of mostly soft silts and clay sediments, which are in some areas likely contaminated, from the bottom of the navigation channel. The removal of sediments would result in minor impacts to the sediment profile of the Elizabeth River. The potential removal of contaminated sediments may assist in the ecological recovery of the Elizabeth River resulting in permanent and minor to moderate benefits to sediments.

It is expected that, over time, new sediments will be transported from the Chesapeake Bay, upper reaches of the River, and the side slopes of the Elizabeth River outside of the channel into the channel, which will require periodic maintenance dredging to maintain the required channel depth. No substantive impacts to sediments other than their removal are expected from routine maintenance dredging.

As described in the No Action/Future Without Project Alternative Plan Section, potential cumulative impacts include increased development such as port growth, increased shipping traffic, and climate change. Implementation of either of the action alternatives is not anticipated to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

Therefore, implementation of either Alternative Plan 1 or Alternative Plan 2 is anticipated to result in impacts that would be adverse to beneficial, temporary to permanent and negligible to moderate to sediments. Although impacts would be relatively greater for Alternative Plan 2 than for Alternative Plan 1 (because of the deeper dredging depths in Segment 1a), it would not reach a threshold level of difference in the impact findings for sediments and HTRW.

6.4 WATER QUALITY

6.4.1 No Action/Future Without Project Alternative

Existing dredging operations, dredged material placement at the CIDMA, effluent discharges from the CIDMMA, and navigation within the ROI would continue. Dredging operations result in a temporary increase in Total Suspended Solids and turbidity in the water column.

Sediment testing conducted 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 the commencement of dredging ensures that only dredged material that meets suitability criteria would be placed at the CIDMMA. Dredged material that meets sediment testing requirements would continue to be placed in the Craney Island Re-Handling Basin (CIRB) or directly in one of the containment cells at the 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 in CIRB or directly hydraulically off-loaded and pumped into a containment cell at CIDMMA. Effluent discharge from the CIDMMA would continue to be discharged to the Hampton Roads 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.

Where environmental contaminants occur in the sediment, specialized mechanical, clamshell buckets designed to contain the dredged material would be used to prevent dispersion of any contaminated dredged material. Dredging within portions of the channels has the potential to generate dredged material with contamination that exceeds the acceptance criteria of CIDMMA. If encountered, contaminated dredged material would be disposed of at an approved upland site(s).

Continued development, shipping and other navigation operations, and stormwater discharges will continue to negatively impact water quality within the ROI and adjacent areas. 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 Elizabeth River Channels. Also, additional development including construction of a fourth new cell at CIDMMA, the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel is planned in the future which has the potential to impact water quality.

Restoration of wetlands, implementation of stormwater Best Management Practices, and restoration of oyster reefs (which can reduce Total Suspended Solid levels in the water due to the oysters' filtering capabilities, and others) have the potential to improve water quality in the future. Fecal coliform levels are likely to decrease in the future, mainly due to decreasing numbers of homes on septic systems, better sewage treatment, and better containment and treatment of stormwater runoff. The DEQ has a TMDL for the Elizabeth River that, as it is required to be implemented, should result in a decline in bacteria in the water. Current trends for Nitrogen (N) are declining, which is likely to continue, though pressures in the Bay watershed remain high – agriculture and the human population will always make it a challenge to keep N levels declining. Phosphorus (P) levels are locally on the increase, in contrast to overall trends in Chesapeake Bay (Chesapeake Bay Program 2016). It is uncertain what is driving the local increase in P, though it may be related to the generally poor flushing conditions in the Elizabeth River. Therefore, future trends in P are relatively uncertain but may increase if the current trends continue.

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 of the river 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 Bay may result in increases in harmful algal blooms (Najjar et al. 2010). Within the 50-year timeframe of the proposed project, rising seas will induce minor changes to water quality, as it is expected that salinity will increase slightly due to increased Atlantic Ocean water input. This could cause an increase in stratification, which has the potential to reduce DO levels in deep bottom waters. The exact intensity and threshold to water quality resulting from climatic change is relatively uncertain but has the potential to substantially alter water quality in the ROI. Implementation of the No Action/Future Without Project Alternative Plan is not anticipated to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects, including port growth to negatively impact water quality.

6.4.2 Action Project Alternatives

Implementation of either Alternative Plan 1 or Alternative Plan 2 would result in a temporary increase in Total Suspended Solids and turbidity in the dredging footprint and adjacent areas following dredging activities resulting in an adverse, temporary impact to water quality that results in a negligible to minor level of impact.

Changes in salinity and decreases in DO, and flushing rates are anticipated to cause permanent, adverse impacts to water quality that are negligible to minor in nature. Implementation of either Alternative Plan 1, or Alternative Plan 2 has the potential to alter the location of the salt wedge (the region where heavier, saltier water mixes with lighter, fresher water) and/or currents. The simulation modeling conducted by Shen et al. (2017) and Wang et al. (2017) indicated that salinity in the river would experience a minor increase, approximately less than one PSU on average in both surface and bottom waters. Implementation of an action alternative is anticipated to cause less than a 0.5 mg/L change in average DO levels (Wang et al. 2017) compared to the without project condition, and is not anticipated to result in ecological impacts in the ROI. Freshwater age is defined as the movement of fresh water in the waterbody. The modeling analyses indicated that with implementation of an action alternative, age increases slightly in the lower James while decreasing in tributaries to the Elizabeth River. Slightly improved flushing rates (decreases in age of the water) may result in lower bacterial levels in portions of the ROI. Saltwater age indicates the change of movement of saltwater in a waterbody. With implementation of an action alternative, the modeling indicated that saltwater age decreases in the lower James River and Elizabeth River slightly. Renewal time is the measure of the overall change in flushing time. Overall, with implementation of an action alternative, the modeling analyses indicated there is a decrease in flushing time in the lower James River.

Sediment testing conducted 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 the commencement of dredging would ensure that only dredged material that meets suitability criteria would be placed at the CIDMMA.

Dredged material which meets sediment testing requirements for placement at the CIDMMA will continue to be placed in the Craney Island Re-Handling Basin (CIRB) or directly in one of the containment cells at the 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 in CIRB or directly hydraulically off-loaded and pumped into a containment cell at CIDMMA. Effluent discharge from the CIDMMA would continue to be discharged to the Hampton Roads via spillways. Effluent discharges would be visually monitored and regularly tested for Total Suspended Solids. The discharge of effluent from the CIDMMA may result in a temporary, negligible to minor increase in Total Suspended Solids and turbidity in the water column. The discharge of effluent from the CIDMMA may result in a temporary, negligible to minor increase in Total Suspended Solids and turbidity in the water column.

Where environmental contaminants occur in the sediment, specialized mechanical, clamshell buckets designed to contain the dredged material would be used to prevent dispersion of any contaminated dredged material. Dredging within the Elizabeth River Southern Branch Navigation Improvements Project Area has the potential to generate material with contamination

within portions of Segment 1 and within Segment 2 of the ROI that exceed the acceptance criteria of CIDMMA. Contaminated dredged material will need to be disposed of at an approved upland site(s). For a listing of potential disposal sites, please refer to the Sediments and Hazardous, Toxic, and Radioactive Waste Section.

As described in the No Action/Future Without Project Alternative Plan Section, potential cumulative impacts include increased development such as port growth, increased shipping traffic, and climate change. Although increased development and climate change have the potential to increase water levels in the project ROI, implementation of either of the action alternatives is not anticipated to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects, including port growth. Continued development, shipping and other navigation operations, and stormwater discharges will continue to negatively impact water quality within the ROI and adjacent areas. 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 Elizabeth River Channels. Additional development including construction of the CIEE and associated, proposed port facility, as was a proposed Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel planned in the future have has the potential to impact water quality (Sisson et al. 2005; Boon et al. 1999).

Implementation of either Alternative Plan 1 or Alternative Plan 2 is anticipated to result in adverse impacts that would be temporary to permanent and negligible to minor to water quality. Although impacts would be slightly greater for Alternative Plan 2 than for Alternative Plan 1 (because of the deeper dredging depths in Segment 1a), it would not reach a threshold level of difference in the impact findings for water quality. Implementation of either of the action alternatives is not anticipated to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects. Climate change impacts are expected to be much larger in magnitude than any impacts due to the proposed dredging.

6.5 VEGETATION, WETLANDS, AND SUBMERGED AQUATIC VEGETATION

6.5.1 No Action/Future Without Project Alternative

Existing maintenance dredging operations, dredged material placement, and navigation within the ROI would continue. These operations can cause minor turbidity and siltation in the ROI. However, because there is no SAV in the ROI, and because of the substantial distance from the current dredging and dredged material placement sites from any shoreline wetlands, no existing or future impacts to these resources resulting from dredging and dredged material placement operations are anticipated.

Placement of dredged material may alter the topography, and consequently alter any existing vegetation colonizing the CIDMMA. This is typical of the normal operations of the CIDMMA. Over time, the CIDMMA may fill completely with dredged material, at which time, the site may become too dry to support wetland vegetation and may eventually become solely colonized with upland vegetation. Vegetation at CIDMMA may transition from early successional stages to habitats containing permanent vegetation cover in later successional stages. Therefore, placement of dredged material at the CIDMMA is anticipated to create both temporary and permanent, negligible, adverse impacts to vegetation at 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 and mitigated in an Environmental Impact Statement (EIS) for that project (2006).

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. Also, additional development, including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel, is planned in the future. Additional development could increase impacts to wetlands along the shorelines or further inland, or to riparian vegetation. Wetlands along shorelines may be permanently filled or converted to create new docking facilities and/or shoreline stabilization measures. Continued development, shipping and navigation operations, and stormwater discharges will also continue to impact wetlands and vegetation within the ROI through boat wake erosion and nutrient inputs.

Climatic changes such as sea level rise and increasing global temperatures are predicted to continue in the future. Climate change impacts such as increased 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. In general, wetlands both inside and outside of ROI as well as SAV are at increased risk of damage and loss from potential increases in sea level rise and salinity shifts. The locations of these resources may shift in response to climate change and the ensuing sea level rise. Wetlands may erode further, or be at increased risk of becoming too inundated to support vegetation. As a result, they may transition into mudflats and/or subaqueous bottom. Alternatively, sea level rise may cause estuarine wetlands to retreat inland. In addition, higher salinity levels in waterways in combination with increased sea level may result in inundation of freshwater wetlands further inland, and conversion to estuarine wetlands. Therefore, if additional wetlands colonize the Southern Branch in the future, they would likely colonize areas slightly higher in topography, and thus, further away from the dredging, in response to sea level rise. With respect to SAV, the lack of existing shallow water habitat as well as the lack of water clarity in the Southern Branch of the Elizabeth River, makes it unlikely that SAV would ever recolonize there in the future.

The ROI itself is already a highly developed port with substantial navigation and shipping operations, with relatively few wetland areas and relatively modest vegetative cover. Therefore, continuing maintenance dredging operations would not likely cause substantial shifts to these community types in future conditions.

The No Action/Future Without Project Alternative Plan is not predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects, including port growth. Therefore, with implementation of the No Action/Future Without Project Alternative Plan, adverse impacts to vegetation are temporary to permanent, and negligible. There would be no impacts to jurisdictional wetlands.

6.5.2 Action Project Alternatives

Compared to current operations, impacts to the vegetation, wetlands, and SAVs with implementation of the action alternatives would be similar to those described for the No Action/Future Without Project Alternative Plan. As described earlier in this report, much of Segment 1 has already been deepened by the Navy. Therefore, this portion requires less initial dredging, and only periodic maintenance dredging to maintain depth. No new dredging will occur in Segment 3 for either alternative; it will continue to require only maintenance dredging.

There would be no impacts to jurisdictional wetlands or Submerged Aquatic Vegetation with implementation of either of the action alternatives. This is because, measured from Google Earth imagery (2017), the closest wetlands along the shoreline are located near the northern limits of Segment 2, on the western bank, south of the Norfolk Southern Lift Bridge; and these wetlands are at least 160 feet from the edge of the channel to be deepened. In addition, the hydraulic modeling (Wang et al. 2017) conducted to simulate conditions of the Action Alternative indicate that any potential changes to water quality parameters (salinity and dissolved oxygen) would be negligible to minor. These water quality impacts would not be anticipated to affect any jurisdictional wetlands; any potential water quality effects would not cause a change in the composition or function of wetlands adjacent to the ROI.

As with the No Action/Future Without Project Alternative, the Action Alternatives are anticipated to have a temporary, negligible, adverse impact to vegetation, and no impact to SAVs. Temporary increases in turbidity and total suspended solids may occur, and temporary changes in water circulation are possible during dredging within the ROI. However, because of the already disturbed nature of the majority of the ROI as described, neither Action Alternative is anticipated to have any substantial impact on wetlands or vegetation.

Placement of dredged material may alter the topography and consequently any wetland and vegetation cover at the CIDMMA. Compared to the No Action Alternative, (current dredging operations), there would be increased material placement/disposal at the CIDMMA with implementation of either of the Action Alternatives. However, as with the No Action Alternative, placement of the dredged material may result in temporary to permanent, negligible, adverse impacts to wetlands and vegetation at the CIDMMA. The dredged material placement site would transition over time as the material dries and vegetation inhabits the site. Over time, the CIDMMA may fill with dredged material slightly faster, but that would be difficult to predict, as the CIDMMA and CIEE will also accept dredged material from many other future dredging projects within the Norfolk Harbor boundaries.

As described in the No Action/Future Without Project Alternative Plan Section, potential cumulative impacts include increased development such as port growth, increased shipping traffic, and climate change. Although increased development and climate change have the potential to adversely impact vegetation in the ROI, implementation of either of the action alternatives is not anticipated to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects, including port growth.

Therefore, implementation of either Alternative Plan 1 or Alternative Plan 2 is anticipated to result in no direct impact to natural wetlands; and in adverse wetland and upland vegetation impacts within CIDMMA that would be temporary to permanent, and negligible. Although impacts would be slightly greater for Alternative Plan 2 than for Alternative Plan 1 (because of the deeper dredging depths in Segment 1a), it would not reach a threshold level of difference in the impact findings for wetlands or vegetation. There would be no impacts to jurisdictional wetlands or SAV with implementation of either of the action alternatives.

6.6 BENTHIC FAUNA

6.6.1 No Action/Future Without Project Alternative

Existing maintenance dredging operations, dredged material placement, and navigation within the ROI would continue under existing authorizations. The existing and projected future adverse impacts to the benthic community are temporary to permanent 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 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 TSS 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 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 to permanent.

No impacts to oyster reefs, the Newport News Middle Ground Artificial Reef, the Middle Ground Light Broodstock Sanctuary, Hampton Flats Hard Clam Harvest Area, or the Newport News Shellfish Management Area occur from existing dredging and dredged material placement operations. These resources are located far enough from existing operations that no significant direct or indirect impacts to these resources occur from existing dredging operations.

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. Also, additional development including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel is planned in the future. Additional development could increase impacts to the benthic community and associated habitat. Continued development, shipping and navigation operations, and stormwater discharges/nutrient inputs will continue to impact the benthic community within the ROI and adjacent coastal and estuarine waters.

Climatic changes such as sea level rise and increasing global temperatures are predicted to continue as a result of burning of fossil fuels and deforestation in the ROI over the next 50 years. 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. Due to impacts from climate change, it is possible the extent of waters high enough in salinity to

support estuarine life will extend further up the tributaries of the Bay, including the Elizabeth River. Climate change is anticipated to potentially increase winter and spring nutrient loading into the Chesapeake Bay and may result in increased phytoplankton production (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) which could impact benthic populations. The anticipated higher temperatures and carbon dioxide levels in the Bay may result in increases in harmful algal blooms (Najjar et al. 2010). Although the eastern oyster is fairly resilient to small changes in temperature and salinity, other benthic resources such as blue crabs, horseshoe crabs and clams could be more sensitive to these shifts in the estuarine system.

The No Action/Future Without Project Alternative is not predicted to substantially cumulatively interact with climate change and/or other cumulative effects. Therefore, effects to the benthic community from implementation of the No Action/Future Without Project Alternative are predicted to be temporary to permanent and minor in nature.

6.6.2 Action Project Alternative

Impacts to the benthic community with implementation of the Action Project Alternative would be similar to those described for the No Action/Future Without Project Alternative. Following implementation of the Action Alternative, there would be little change in the composition and abundance of the benthic community, as the channels are already subject to recurring dredging and dredged material placement activities. Additional areas would be dredged including the meeting areas (200-400 feet adjacent to the channel footprint) and Anchorage F which would increase impacts to the benthic community. Also, impacts to the benthic community would slightly increase as open ocean disposal would increase with the Action Alternative.

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 (VIMS unpublished 2016) 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, with implementation of the Action Alternative we would anticipate impacts would remain to be adverse and minor, but would range from temporary to permanent.

No impacts to oyster reefs, the Newport News Middle Ground Artificial Reef, the Middle Ground Light Broodstock Sanctuary, Hampton Flats Hard Clam Harvest Area, or the Newport News Shellfish Management Area would occur from implementation of the Action Alternative. These resources are located an acceptable distance (.3 - .8 miles) from proposed dredging operations and dredged material placement/disposal sites that no impacts to these resources are anticipated.

With implementation of any of the action alternatives, there would be little change in the long-term composition and abundance of the benthic community within the channel, as such areas within the ROI are already subject to recurring dredging impacts. The hydraulic modeling (Virginia Institute of Marine Science 2016) conducted to simulate conditions of the action alternatives indicated that changes to water quality parameters (salinity, DO) would be negligible to minor and therefore would not result in a long-term composition change in the benthic community.

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. Also, additional development including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel is planned in the future. Additional development could increase impacts to the benthic community and associated habitat. Continued development, shipping and navigation operations, and stormwater discharges/nutrient inputs will continue to impact the benthic community within the ROI and adjacent coastal and estuarine waters.

Climatic changes such as sea level rise and increasing global temperatures are predicted to continue as a result of burning of fossil fuels and deforestation in the ROI over the next 50 years. 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. Due to impacts from climate change, it is possible the extent of waters high enough in salinity to support estuarine life will extend further up the tributaries of the Bay, including the Elizabeth River. Climate change is anticipated to potentially increase winter and spring nutrient loading into the Chesapeake Bay and may result in increased phytoplankton production (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) which could impact benthic populations. The anticipated higher temperatures and carbon dioxide levels in the Bay may result in increases in harmful algal blooms (Najjar et al. 2010). Although the eastern oyster is fairly resilient to small changes in temperature and salinity, other benthic resources such as blue crabs, horseshoe crabs and clams could be more sensitive to these shifts in the estuarine system.

The implementation of the Action Alternative is not predicted to substantially cumulatively interact with climate change and/or other cumulative effects. Therefore, effects to the benthic community from implementation of the Action Alternative are predicted to be temporary to permanent and minor in nature.

6.7 PLANKTON

6.7.1 No Action/Future Without Project Alternative

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 operations include entrainment, burial/siltation, and reduced light levels that may affect phytoplankton productivity.

Continued development, shipping and other navigation operations, and stormwater discharges will continue to negatively impact plankton species composition and populations within the ROI. 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 channels. Also, additional development including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel is planned in the future.

Climatic changes such as sea level rise and increasing global temperatures are predicted to continue as a result of burning of fossil fuels and deforestation. 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. Climate change is anticipated to

potentially increase winter and spring nutrient loading into the Chesapeake Bay and may result in increased phytoplankton production (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 Bay may result in increases in harmful algal blooms (Najjar et al. 2010). Climatic change has the potential to affect the plankton species composition and abundance of plankton populations within the ROI which in turn can affect higher level food chain composition and dynamics. The exact intensity and threshold to plankton populations resulting from climatic change is relatively uncertain but has the potential to substantially alter plankton populations in the ROI.

Although climate change has the potential to alter the plankton community composition as well as abundance, implementation of any of the No Action Alternative/Future Without Project Alternative is not predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

6.7.2 Action Project Alternatives

Dredging construction and maintenance is anticipated to cause additional entrainment and burial/siltation of the local plankton community as compared to current operations. For both Alternative 1 and Alternative 2, dredging construction 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. 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 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 plankton community to rapidly recover. While adverse impacts to the plankton community may be slightly less with implementation of Alterative 1 rather than Alternative 2, the impact threshold would not range higher than the negligible level for either of the action alternatives.

Continued development, shipping and other navigation operations, and stormwater discharges will continue to negatively impact plankton species composition and populations within the ROI and adjacent areas. 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 channels. Also, additional development, including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel, is planned in the future.

Climate change may lead to increased ocean temperatures, ocean acidification, sea level rise, and changes in currents, upwelling and weather patterns and has the potential to cause changes in the nature and character of the estuarine ecosystem in the ROI. Climate change is anticipated to potentially increase winter and spring nutrient loading into the Chesapeake Bay and may result in increased phytoplankton production (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). The anticipated higher temperatures and carbon dioxide levels in the Bay may result in increases in harmful algal blooms (Najjar et al. 2010).

Climatic change has the potential to affect the plankton species composition and abundance of plankton populations within the ROI, which in turn can affect higher level food chain composition and dynamics. The exact intensity and threshold to plankton populations resulting from climatic change is relatively uncertain but has the potential to substantially alter plankton populations in the ROI.

Although climate change has the potential to shift the plankton community composition as well abundance, implementation of any of either Alternative 1 or Alternative 2, the Draft Recommended Plan, is not predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects. Therefore, adverse impacts to plankton populations from implementation of the action alternatives are predicted to be temporary and negligible.

6.8 FISH AND FISH HABITAT

6.8.1 No Action/Future Without Project Alternative

Existing maintenance dredging operations and navigation within the ROI would continue. Current dredging and navigation operations that may affect egg, larval, juvenile, and adult life stages of fishes within the ROI include direct removal or burial, turbidity/siltation effects, shifts in dissolved oxygen and salinity, entrainment, visual and noise disturbances, and alteration of habitat. With implementation of the No Action/Future Without Project Alternative, the impacts to fish resources would continue to be negligible and temporary.

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. Also, additional development including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel is planned in the future. Additional development could increase impacts to fish and fishery resources and associated habitat in the project area. Continued development, shipping and navigation operations, and stormwater discharges/nutrient inputs will continue to impact fish resources and fish habitat within the ROI and adjacent coastal and estuarine waters.

As a result of climate change, global temperatures and sea level are expected to rise in the foreseeable future. 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 affect the nature and character of the estuarine and coastal ecosystem in the ROI.

Sea level rise may result in an increase in salinity in upstream areas that could affect breeding sites and survival of early life stages (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. However, implementation of the No Action/Future Without Project Alternative is not predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects. Therefore, effects to fish resources from implementation of the No Action/Future Without Project Alternative are predicted to be negligible and temporary in duration.

6.8.2 Action Project Alternatives

Similar to the No Action/Future Without Project Alternative, potential impacts to fish and fish habitat from Alternative 1 and Alternative 2 include the transit of dredging vessels to dredging locations and dredging, which affects water quality by increasing TSS turbidity. Increased depths from dredging in estuarine environments have the potential to alter salinity levels within the ROI and also can potentially result in changes to dissolved oxygen (DO) levels. Dredging has the potential to release nutrients and/or contaminants from sediments, which can impact fishes, prey, and their habitat. Fishes can be impacted by strikes from dredging vessels/equipment. They may also be impacted by noise disturbances, which may cause species to flee the ROI and/or potentially alter other behaviors, such as foraging success. Fishes and their habitat could be impacted by releases of unexploded ordinance (UXO), although this would be highly unlikely. The extent of impact depends on hydraulic processes, sediment texture, composition and chemical content, and the behavior and life stage of the fish species.

The temporary increase in total suspended solids (TSS) and turbidity in the water column at dredging sites can directly impact fishes and their habitat. The impacts to fish species from TSS and turbidity are directly related to: the species tolerance, exposure, duration of exposure, and life stage. Deposition of suspended sediments may induce impacts to fish eggs and larvae through abrasion, and/or smothering, especially in the dredging areas (Wilbur and Clarke 2001). Additionally, non-motile, sessile benthic prey species have the potential to be buried and smothered during dredging. Increases in TSS and turbidity can impact prey species' predator avoidance response due to visual impairments caused by decreased water clarity (Gregory and Northcote 1993; Wilbur and Clarke 2001). Turbid waters can also visually impair predator species that rely on sight to forage. Increased TSS and turbidity alters the ability for light to penetrate the water column, which impairs both physical and biological processes in the ROI (Johnston 1981; Wilbur and Clarke 2001). Increased turbidity can impact primary productivity and respiration of organisms within the ROI. By limiting light availability in the water column, the rate of primary productivity has the potential to drop, and as an effect of the reduction in primary productivity, there is an overall reduction in DO availability. If DO levels drop significantly, anoxic conditions may ensue, which can result in stress induced illness or mortality. However, dredging operations have occurred within the ROI and adjacent areas for more than 30 years, and no dredging operation has been recorded to result in an anoxic fish kill or harmful algal bloom. Therefore, anoxic or hypoxic conditions, or harmful algal blooms following dredging operations seems extremely unlikely with implementation of either Alternative 1 or Alternative 2.

While dredging operations will temporarily increase TSS and turbidity, these impacts will be minor when compared to background levels. The flushing of water (due to the water exchange and tidal fluctuations) from within the ROI will minimize potential TSS/turbidity plumes and cause them to disperse quickly, minimizing long term impacts to water quality. These factors combined with operational controls on the dredge will help to minimize impact to non-motile, demersal species (Wilbur and Clarke 2001). Overall, adverse impacts to fishes and their habitat would be temporary in duration, and based on hydraulic and water quality modeling conducted, to date (Shen et al. 2017; Wang and Sisson 2017), for the project, we would anticipate salinity and DO impacts to range from negligible to minor in intensity.

Dredging can potentially release nutrients and contaminants from sediments to the water column. Contaminant dispersal and release may negatively impact managed fish species and their prey by causing illness or mortality by uptake of contaminants into tissue.

Dredging will alter benthic habitats by direct removal of sediments, making benthic habitats disturbed and temporarily unsuitable for some sessile and/or benthic organisms. Removal of sediment will temporarily disturb ecological successional processes in the ROI, and may indirectly effect fishes that utilize these benthic habitats. Indirect effects to fishes utilizing benthic habitats include avoidance and decreased foraging success.

Direct removal of suitable benthic substrate by dredging may impact fish habitat by removing important prey species (i.e. benthic organisms), food species (i.e. macroalgae), or by alteration of nursery and spawning areas. Re-colonization of the newly exposed substrate after dredging is not only a function of site-specific characteristics (i.e. bathymetry, tidal energy), but also of substrate requirements of the larvae of re-colonizing species (Rhoads and Germano 1982). Any deviation from the existing benthic floor changes the complexion for smaller species that utilize the area for foraging and living space. Therefore, dredging will likely result in the temporary loss of some fish habitat, including foraging grounds.

The dredging vessels used in the Elizabeth River Navigation improvement project may include hydraulic cutterhead and mechanical dredges. The entrainment of various fish species during dredging operations can lead to direct injury and/or death to the fish. During dredging, a possible impact to fish species is the entrainment of eggs, larvae, juveniles, and adult life stages. Life stages with limited or no swimming ability, especially eggs and larvae, have a higher potential to be entrained. Active dredging operations have a higher potential to entrain demersal fish species, such as flounder, or species that spawn in or near the dredging area. Foraging, rearing, and spawning habitat preferences impact the potential for various species to be entrained.

With the implementation of the action alternatives, Alternative 1 or Alternative 2, entrainment impacts to fish resources are anticipated to range from negligible to minor and be temporary in duration.

In the Elizabeth River, dredging vessel strikes to fish resources 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. Eggs, larvae, and species with limited swimming ability are at highest risk of strike impacts. Effects from dredging vessel equipment/strikes are anticipated to be negligible to minor and temporary in duration.

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. The influence of noise pollution on aquatic organisms, including fishes, is poorly understood.

Of the marine fish species studied, nearly all fall within the spectrum of auditory sensitivity from 20 – 1000 Hz (outliers can sense up to 4000 Hz); there is a considerable amount of spectral overlap between the noise produced from dredging activities and fish auditory sensitivity (Kasumyan 2005; Nichols et al. 2015). Results from a study conducted by Nichols et al. (2015), provide evidence suggesting that random, intermittent noise, rather than continuous noise, produced by water craft raised the levels of cortisol – a stress hormone - in a coastal fish species. Elevated cortisol levels in fishes, and especially in juvenile fishes, are correlated with a variety of negative effects, including increased susceptibility to infection, decreased growth rates, and reduced predator avoidance (Nichols et al. 2015; McCormick et al. 1998). Implementation of the Elizabeth River and Southern Branch Deepening Project is not

anticipated to substantially increase noise levels as they relate to impacts to fish resources. Impacts are predicted to be temporary in duration for both Alternative 1 and Alternative 2.

Best management practices can be implemented to minimize dredging disturbances. For example, agitation and operation of the cutterhead of a dredge will not begin until the cutterhead is in immediate contact with the substrate. The dredge operator will not begin dredging until the draghead is in direct contact with the substrate, effectively reducing impacts to fish resources within the vicinity of the dredge. Another measure taken by the USACE to minimize environmental disturbances is deployment of UXO screening devices on dredges where there is risk of UXO detonation.

Adverse impacts to fish and fishery resources generally increases as the volume and duration of dredging increases. Therefore, Alternative 1 would have less relative adverse impacts than Alternative 2. However, overall we would not expect there to be a different threshold of impacts with implementation of any of the action alternatives and impacts to fish and fishery resources is anticipated to be negligible to minor and temporary in duration.

Virginia Port growth is anticipated to increase throughout the next 50 years. Additionally, a new port facility is planned, which may increase the number of vessels transiting the Elizabeth River. Additional development, including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel is planned for the future. Further development could increase impacts to the managed species occurring in the project area. However, implementation of either of the action alternatives, along with other past, present, and future actions, is not anticipated to significantly contribute to those increased impacts.

Potential cumulative threats to managed species include entrainment and exposure to contaminants such as PAHs and PCBs. Another potential cumulative impact to consider is impacts that occur from fishery entanglement. While some of these threats have the potential to impact fish resources, implementation of either of the action alternatives is not anticipated to significantly contribute cumulatively to injuries and mortalities resulting from these impacts.

Global climate change has the potential to affect fish populations in the project area in the future. Sea level rise may cause an increase in salinity in upstream areas that could affect breeding sites and survival of early life stages (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 may also cause detrimental effects to fish populations. While continued development and climate change has the potential to impact fishes, implementation of either Alternative 1 or Alternative 2 is not anticipated to substantially contribute cumulatively to injuries and/or mortalities resulting from these impacts.

Although climate change and continued use of the Elizabeth River has the potential to adversely affect fish resources in the ROI, implementation of either of the action alternatives is not predicted to substantially cumulatively interact with climate change, development, or other possible cumulative effects. No substantial adverse impacts to fish resources are anticipated and no impacts to the population level of any fish species or any associated prey species are anticipated.

6.9 WILDLIFE

6.9.1 No Action/Future Without Project Alternative

Existing maintenance dredging operations, dredged material placement, and navigation within the ROI would continue. Operation of vessels and dredging equipment may flush wildlife, such as birds, out of the area. 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 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 has a temporary, negligible to minor, adverse impact to invertebrates and fish.

Placement of dredged material may alter the topography and consequently the habitat and wildlife at the CIDMMA. Placement of the dredged material may flush wildlife out of the area resulting in temporary, negligible to minor, adverse impacts. The dredged material placement site would transition over time as the material dries and vegetation inhabits the site. Over time, the CIDMMA may fill with dredged material. The lack of replacement of sandy material over time at the CIDMMA may negatively impact some avian species that utilize the sandy material for nesting and foraging habitat. However, increased upland habitat may provide greater foraging habitat for other types of avian species and mammals. Placement of dredged material at the CIDMMA is anticipated to create additional wildlife habitat, which will create permanent, minor, beneficial impacts to wildlife at the CIDMMA.

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. Also, additional development, including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel, is planned in the future. Additional development could increase impacts to wildlife and their habitats. Continued development, shipping and navigation operations, and stormwater discharges/nutrient inputs will continue to impact wildlife within the ROI.

Climatic changes such as sea level rise and increasing global temperatures are predicted to continue in the future. Climate change impacts such as increased 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. These impacts have the potential to affect the distribution and abundance of wildlife within the ROI. Loss of estuarine and ocean beaches is anticipated to occur with sea level rise; therefore, the importance and use of wildlife habitat at the CIDMMA will likely increase in future conditions. The negative impacts to wildlife from continued development, continuance of storm water discharges, and navigation and shipping operations will have some negative impacts to wildlife. However, because the ROI is already a highly developed port with substantial navigation and shipping operations, these increased pressures would not likely cause substantial shifts to wildlife in future conditions. Shifts in salinity, temperature, and sea level all have the potential to result in shifts in prey species availability, which could also detrimentally impact wildlife. The potential loss of tidal wetlands and marsh islands with sea level rise may result in the general loss of nesting and foraging habitats for wildlife along the Atlantic seaboard.

The No Action/Future Without Project Alternative Plan is not predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects, including port growth. Therefore, with implementation of the No Action/Future Without Project Alternative Plan, impacts are temporary to permanent, negligible to minor, and beneficial to adverse.

6.9.2 Action Project Alternatives

Compared to current operations, operation of vessels and dredging equipment would increase and may temporarily flush additional wildlife, such as birds, out of the area. The increased Total Suspended Solids and turbidity resulting from additional dredging operations with implementation of either Alternative Plan 1 or Alternative Plan 2 may disrupt foraging abilities for some wildlife. This would result in temporary, negligible to minor, adverse impacts to wildlife.

The dredging is anticipated to have a temporary, negligible to minor, adverse impact to benthic invertebrates and fish. This 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 additional dredging is not anticipated to have any substantial impact on any prey invertebrate or fish populations.

Placement of dredged material may alter the topography and consequently the habitat and wildlife at the CIDMMA. Compared to current operations, there would be increased material placement/disposal at the CIDMMA with implementation of either of the action alternatives as compared to the No Action/Future Without Project Alternative Plan. Placement of the dredged material may result in temporary, negligible to minor, adverse impacts to wildlife at the CIDMMA. The dredged material placement site would transition over time as the material dries and vegetation inhabits the site. Over time, the CIDMMA may fill with dredged material. The lack of replacement of sandy material over time at CIDMMA may negatively impact some avian species that utilize the sandy material for nesting and foraging habitat. However, increased upland habitat may provide greater foraging habitat for other types of avian species and mammals. Placement of dredged material at the CIDMMA is anticipated to create additional permanent wildlife habitat, which will create permanent, minor, beneficial impacts to wildlife at the CIDMMA.

As described in the No Action/Future Without Project Alternative Plan Section, potential cumulative impacts include increased development such as port growth, increased shipping traffic, and climate change. Although increased development and climate change have the potential to adversely impact wildlife in the ROI, implementation of either of the action alternatives is not anticipated to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects, including port growth.

Therefore, implementation of either Alternative Plan 1 or Alternative Plan 2 is anticipated to result in wildlife impacts that would be temporary to permanent, negligible to minor, and adverse to beneficial. Although impacts would be slightly greater for Alternative Plan 2 than for Alternative Plan 1 (because of the deeper dredging depths in Segment 1a), it would not reach a threshold level of difference in the impact findings for wildlife.

6.10 SPECIAL STATUS SPECIES

6.10.1 No Action/Future Without Project Alternative

Federally Listed Endangered and Threatened Species
Existing dredging and dredged material placement/disposal operations and navigation within the ROI would continue and are anticipated to continue for the next 50 years. Adverse impacts to Federally listed species that range from no impact to minor, adverse impacts resulting from existing dredging operations will continue. Adverse impacts to Federally listed species that occur with the No Action/Future Without Project Alternative would be similar and at the same impact threshold to those that would occur with implementation of the Action Alternatives but most impacts would be relatively less due to the reduced dredging volumes and dredging frequencies. However, potential vessel collision risks for whales and sea turtles with deep draft vessels would be relatively less with the Action Alternatives as compared to the No Action/Future Without Project Alternative because of the anticipated reduced vessel calls. We would anticipate impacts to state listed bats to be similar to impacts to the northern long-eared bat as described in the Biological Assessment, Appendix E. Impacts to state listed birds would be at the same impact threshold as those described in the Action Alternatives Section but would be relatively less. Cumulative impacts of the No Action/Future Without Project Alternative would be similar to those described with implementation of one of the Action Alternatives. Substantial cumulative or synergistic impacts resulting from implementation of the No Action/Future Without Alternative with other cumulative impacts would not be not anticipated.

Marine Mammals
There are few studies on the effects of dredging on marine mammals due to dredging activities in isolation (Todd et al. 2014). In terms of direct effects, vessel collisions are possible, but improbable because dredges operate either in a stationary position or at low speeds. The risk of injury to marine mammals 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 dredging equipment. No marine mammal strikes with dredge-related vessels has ever been reported to occur in the Action Area.

Within a noisy harbor area such as the Elizabeth River and Southern Branch, 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). Marine mammals may 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). In addition, the noise of the dredging vessel/equipment and also the vessels in the harbor itself has an adverse effect to listed whales in the Action Area and may interfere with their ability to communicate and forage for prey in addition to the vessel strike risks. Todd et al. (2014) noted 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. In addition, effects of turbidity are often localized with minimal direct impact on marine mammals (Todd et al. 2014). No Level A or B harassment to marine mammals occurs with existing dredging and dredged material placement/disposal operations. Todd et al. (2014) note that the indirect effects of dredging 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).

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 move away from disturbance such as noise or equipment operations. The ROI is also limited relative to the surrounding area available for use; therefore the species are likely to move and forage elsewhere during the operation. Noise generated by bucket or cutterhead dredge activities would not be expected to affect migration, nursing, breeding, feeding, or sheltering.

Another potential threat to marine mammals is injury or incidental take resulting from UXO detonation or contact with contaminants leaching from UXO that occur in the ROI. However, we would not anticipate this to be a substantial threat as the USACE deploys UXO screening devices on dredges where there is risk of UXO detonation.

Overall, no Level A or Level B harassment to marine mammals from implementation of the Action Alternative is anticipated. Overall, no substantive disruption of behavioral patterns to migration, breathing, nursing, breeding, feeding or sheltering would be anticipated.

Potential cumulative threats to marine mammals include ship strikes and noise impacts from commercial and recreational vessels and exposure to contaminants such as oil spills. Another potential cumulative impact to consider is impacts that occur from fishery entanglement. While some of these threats have the potential to impact marine mammal populations, implementation of the No Action/Future Without Project Alternative is not anticipated to substantially contribute cumulatively to injuries and mortalities resulting from these impacts.

Virginia Port growth is anticipated to increase throughout the next 50 years and a new port facility is planned, which is anticipated to increase the number of vessels calls. Also, additional development including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel, and construction of the CIEE is planned in the future. Additional development could increase the risks of marine mammal impacts from noise impacts and ship strikes. Substantial cumulative or synergistic impacts resulting from implementation of the No Action/Future Without Project Alternative with other cumulative impacts would not be not anticipated.

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

The continued placement of dredged material at the CIDMMA is anticipated to increase foraging, nesting, and resting habitats for upland dependent avian species. Although piping plovers previously nested at the CIDMMA, the nesting habitat there has degraded and is not currently suitable for piping plover nesting. (The piping plover is a Federally listed species and is discussed further in the Biological Assessment located in Appendix E). No future plans to resume the nesting management program to improve the nesting habitat are anticipated. We would not anticipate bald eagle nesting at the CIDMMA in the future, due to the lack of riparian forests for nesting. Benefits to avian species would be negligible to minor and permanent.

Migratory birds (including all state listed avian species) have the potential to forage, rest, and/or migrate through the ROI. The noise and temporary turbidity plume caused by current dredging and dredged material placement actions may cause migratory birds to move away from the disturbance; however, this is a negligible to minor, and temporary impact that does not substantially impact their long-term foraging or breeding success. The dredging is anticipated to have a temporary, negligible to minor adverse impact to benthic invertebrates and fish. This

potentially impacts some of the prey species of migratory birds. Future 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, current dredging does not have any substantial impact on migratory birds.

Another potential threat to migratory birds from current operations is take resulting from unexploded ordinance (UXO) detonation or contact with contaminants leaching from UXO that occur in the ROI. However, this is not a substantial threat as the USACE deploys UXO screening devices on dredges where there is risk of UXO detonation. Contaminants from industry activity long ago may also be present in low concentrations on and under the river bottom in various locations within the ROI, as described in the Hazardous, Radioactive, and Toxic Waste (HRTW) section of this document. However, as this dredging would be maintenance dredging of more recent sediments, rather than new dredging, these layers would be unlikely to be disturbed. Before being accepted at CIDMMA, dredged material is tested for contaminants, and if contaminated, it cannot be accepted and must be transported to an appropriate landfill. At this time, dredged material from the ROI is generally acceptable at CIDMMA.

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 channels. Also, additional development including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel is planned in the future. Additional development could increase migratory bird disturbance impacts. However, implementation of the No Action Alternative/Future Without Project Alternative is not anticipated to substantially contribute to those increased impacts to migratory birds. The loss of barriers and beach nesting breeding and foraging habitat anticipated with sea level rise also has the potential to impact migratory birds although the level of impact is relatively uncertain.

In summary, the No Action/Future Without Project Alternative would have minor and temporary impacts to migratory birds. In addition, substantial synergistic impacts resulting from implementation of the No Action/Future Without Project Alternative with the impacts of climate change and other cumulative impacts would not be anticipated.

6.10.2 Action Project Alternatives

Federally Listed Endangered and Threatened Species
A detailed assessment of the potential impacts of implementation of Alternative 2 on Federally listed species, including a comprehensive cumulative impact assessment of past, present and future anticipated actions in association with Alternative 2, is provided in the Biological Assessment, Appendix E. There is no designated critical habitat in the Action Area. The results of the impacts assessment are summarized in Table 6-3. Please note that best management practices/mitigation measures for Federally listed species are described in the Biological Assessment, Appendix E. We would expect impacts to state listed bats to be similar to those described for the northern long-eared bat in the Biological Assessment, Appendix E. Potential impacts to state listed birds would be the same as those described in the migratory birds section. Because of the similarity of Alternative 1 and Alternative 2, we would expect the same conclusion for Federally listed species with implementation of either action alternative although the relative impact of Alternative 2 would be slightly greater because of the increased dredging depths and duration of dredging.

Table 6-3. Federally Listed Species Conclusions and Bald Eagle Determination

Species/Resource Name	Conclusion	Notes/Documentation
Piping plover and red knot	May Affect, Not Likely to Adversely Affect	The project may slightly impact flight and foraging behaviors but would have a negligible to minor impact.
Atlantic sturgeon	May Affect, Not Likely to Adversely Affect	Because of the slow speed of the dredging vessels and dredging equipment, collisions would be unlikely. Dredging may impact prey species and cause sturgeon to leave the Action Area from the dredging turbidity plume and noise. However, dredging is not anticipated to substantially affect any foraging behaviors.
Shortnose sturgeon	May Affect, Not Likely to Adversely Affect	Species would not likely occur in the Action Area. Effects would be discountable.
Blue whale, north Atlantic right whale, and sperm whale	May Affect, Not Likely to Adversely Affect	These species would not likely occur in the Action Area. Effects would be discountable.
Fin whale and sei whale	May Affect, Not Likely to Adversely Affect	Whales would be a rare occurrence in the Action Area. Because of the slow speed of the dredging vessels and dredging equipment, collisions would be unlikely. Dredging may temporarily impact prey species and cause whales to leave the Action Area from the dredging turbidity plume and noise disturbances. However, dredging is not anticipated to substantially affect any foraging behaviors.
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	No Effect	There no suitable foraging or roosting habitat in the Action Area. There is no hibernacula in the ROI. The project would not affect flights if they occur in this area.

Species/Resource Name	Conclusion	Notes/Documentation
Hawksbill sea turtle and leatherback sea turtle	May Affect, Not Likely to Adversely Affect	These species would not likely occur in the Action Area. Effects would be discountable.
Sea Turtles: green, Kemp's Ridley, leatherback, and loggerhead	May Affect, Not Likely to Adversely Affect	Because there is no hopper dredging in the Action Area, turtle entrainment would not be anticipated. Dredging may temporarily impact prey species and cause sea turtles, if present, to leave the Action Area from the dredging turbidity plume and disturbance. However, dredging would not substantively affect any foraging behaviors. Collisions with dredging vessels or dredging equipment would be unlikely. No nesting occurs in the Action Area.
Bald eagle	Unlikely to disturb nesting bald eagles. Does not intersect with eagle concentration area.	No bald eagle nests exist within the Action Area or within three miles of the CIDMMA.
Candidate species	No effect; No species present.	

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 are possible, but improbable because dredges operate either in a stationary position or at low speeds. The risk of injury to marine mammals 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 dredging equipment. No marine mammal strikes with dredge-related vessels has ever been reported to occur in the Action Area.

Within a noisy harbor area such as the Elizabeth River and Southern Branch, 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). Marine mammals may 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). In addition, the noise of the dredging vessel/equipment and also the vessels in the harbor itself has an adverse effect to listed whales in the Action Area and may interfere with their ability to communicate and forage for prey in addition to the vessel strike risks. Todd et al. (2014) noted 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. In addition, effects of turbidity are often localized with minimal direct impact on marine mammals (Todd et al. 2014). No Level A or B harassment

to marine mammals occurs with existing dredging and dredged material placement/disposal operations.

Todd et al. (2014) note that the indirect effects of dredging 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).

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 move away from disturbance such as noise or equipment operations. The ROI is also limited relative to the surrounding area available for use; therefore the species are likely to move and forage elsewhere during the operation. Noise generated by bucket or cutterhead dredge activities would not be expected to affect migration, nursing, breeding, feeding, or sheltering.

Another potential threat to marine mammals is injury or incidental take resulting from UXO detonation or contact with contaminants leaching from UXO that occur in the ROI. However, we would not anticipate this to be a substantial threat as the USACE deploys UXO screening devices on dredges where there is risk of UXO detonation.

Overall, no Level A or Level B harassment to marine mammals from implementation of either of the Action Alternatives is anticipated. Overall, no substantive disruption of behavioral patterns to migration, breathing, nursing, breeding, feeding or sheltering would be anticipated.

Potential cumulative threats to marine mammals include ship strikes and noise impacts from commercial and recreational vessels and exposure to contaminants such as oil spills. Another potential cumulative impact to consider is impacts that occur from fishery entanglement. While some of these threats have the potential to impact marine mammal populations, implementation of either of the Action Alternatives is not anticipated to substantially contribute cumulatively to injuries and mortalities resulting from these impacts.

Virginia Port growth is anticipated to increase throughout the next 50 years and a new port facility is planned, which is anticipated to increase the number of vessels calls. Also, additional development including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel, and construction of the CIEE is planned in the future. Additional development could increase the risks of marine mammal impacts from noise impacts and ship strikes. Substantial cumulative or synergistic impacts resulting from implementation of either of the action alternatives with other cumulative impacts would not be not anticipated.

In summary, implementation of either Alternative 1 or Alternative 2 is anticipated to result in adverse impacts to marine mammals that would be temporary, negligible to minor, and adverse. Although relative impacts would be slightly greater for Alternative 2 than for the other alternatives (because of the deeper dredging depths and duration of dredging), it would not reach a threshold level of difference in the impact findings for any marine mammals.

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

Compared to current operations, operation of vessels and dredging equipment would increase and may temporarily flush migratory birds out of the area for slightly longer periods of time. The

increased Total Suspended Solids and turbidity resulting from additional dredging operations with implementation of either Alternative 1 or Alternative 2 may disrupt foraging abilities for some species.

Placement/disposal of dredged material may alter the topography and consequently the habitat and wildlife at the CIDMMA. Compared to current operations, there would be increased material placement/disposal at the CIDMMA with implementation of either of the action alternatives as compared to the No Action/Future Without Project Alternative. Placement/disposal of the dredged material may result in temporary, negligible to minor, adverse impacts to wildlife at the CIDMMA. The dredged material placement/disposal site would transition over time as the material dries and vegetation inhabits the site. 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 provide greater foraging habitat for other types of avian species and mammals. Placement/disposal of dredged material at the CIDMMA may create additional permanent migratory bird habitat, which will create permanent, minor, beneficial impacts to migratory birds at the CIDMMA.

Impacts to migratory birds with implementation of either of the action alternatives would be at the same impact threshold level as those described for the No Action/Future Without Project Alternative, although relative affects would be slightly higher for Alternative 2 than the other alternatives. Either of the action alternatives would result in temporary, negligible to minor, adverse impacts to migratory birds and their prey. However, because of the already disturbed nature of the majority of the ROI and the amount of other available habitat for migratory birds and their prey species, additional dredging is not anticipated to have any substantial impact on migratory birds or their prey.

The cumulative impacts for the action alternatives would be those that are described in the No Action/Future Without Project Alternative Section. Implementation of any of the action alternatives is not anticipated to substantially cumulatively interact with other past, present, or future actions impacting migratory birds. Although increased development and climate change have the potential to adversely impact migratory birds in the ROI, implementation of either of the action alternatives is not anticipated to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

In summary, implementation of either Alternative 1 or Alternative 2 is anticipated to result in impacts to special status species that would be temporary to permanent, negligible to minor, and adverse to beneficial. Although relative impacts would be slightly greater for Alternative 2 than for the other alternatives (because of the deeper dredging depths and duration of dredging), it would not reach a threshold level of difference in the impact findings for any special status species.

6.11 AIR QUALITY

6.11.1 No Action/Future Without Project Alternative

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). Because of the similarity of the Action Project Alternatives (Alternative 1 and Alternative 2), we would expect the same

threshold level of impacts although the relative impact of Alternative 2 would be slightly greater than Alternative 1 because of the increased dredging depths and duration of dredging.

In addition, the existing emissions-producing activities within the ROI (e.g., transportation, industry, commerce, military, and recreation) would be expected to continue throughout the 50 year period of analysis. Emissions in the future either with or without implementation of the Action Alternative resulting from deep draft navigation would likely increase because of the anticipated increases in vessel calls. However, the long-term trends for all criteria air pollutants throughout the region have been decreasing slightly over time. Because the relative contribution to the regional trends is small from navigation in the ROI, these improving regional air quality trends would be predicted to continue under the No Action/Future Without Project alternative.

There are a number of large-scale construction projects within the ROI that would be expected to generate adverse, temporary, impacts to air quality from increased emissions including:

- Port growth including a new port facility;
- Construction of the Third Crossing;
- Expansion of the Chesapeake Bay Bridge Tunnel;
- Norfolk International Terminals Piers 1 and 2 removed, with area deepened to -50 feet;
- Construction of the CIEE;
- I-64 High Rise Bridge Corridor (City of Chesapeake 2014).

Implementation of the No Action/Future Without Project Alternative would result in adverse, temporary impacts to air quality that are negligible to minor. These temporary increases in emissions would not be predicted to result in measurable changes to the regional or global-climatic air quality. In addition, when considered in combination with other large-scale construction projects that may occur at the same time, the cumulative adverse effects to air quality in the ROI would be temporary and negligible to minor. Substantial cumulative or synergistic impacts resulting from implementation of the No Action/Future Without Project Alternative with the impacts of climate change and other cumulative impacts is not anticipated.

6.11.2 Action Project Alternatives

Air emissions resulting from combustion of fuel during construction and maintenance operations would increase with implementation of either of the Action Project Alternatives 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 one of the action project alternatives, the overall number of vessel calls is anticipated to increase over time. Therefore, fuel combustion emissions resulting from navigation in the ROI 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.

Existing emissions-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. Virginia Port growth is anticipated to increase throughout the next 50 years, and a new port facility is planned. Also, additional development is planned as is described in the No Action/Future Without Project Alternative. The increased development would also be linked with increases in air emissions from combustion of fuel associated with construction and maintenance of development projects.

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

The implementation of either of the action project alternatives is not predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects. Therefore, the cumulative adverse effects from implementation of the Action Project Alternative to air quality in the ROI would be adverse, temporary and negligible to minor.

6.12 CLIMATE CHANGE

6.12.1 No Action/Future Without Project Alternative

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).

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. The following regional projects are assumed to be implemented under the No Action/Future Without Project alternative and would be expected to result in temporary, construction-related, increases in greenhouse gas emissions within the ROI:

- Channel improvements in the Norfolk Harbor and Channels Project,
- Norfolk International Terminal Piers 1 and 2 removed, with area deepened to -50 feet
- Craney Island Eastward Expansion – full build-out (USACE, 2006)
- I-64 High Rise Bridge Corridor (City of Chesapeake, 2014).

The Center for Climate Strategies estimates that GHG emissions in Virginia will increase to 200 MMt by 2020, which is a 39-percent increase above 1990 levels and the transportation sector is projected to be the largest contributor to future emissions growth (CCS 2012).

With implementation of the No Action/Future Without Project alternative, 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 adverse, minor and temporary impacts to air quality but this would not substantively impact global-climatic air quality.

6.12.2 Action Project Alternatives

Greenhouse gas emissions resulting from combustion of fuel during construction and maintenance operations would increase with implementation of either of the action project alternatives as compared to the No Action/Future Without Project Alternative because of the increased duration of operations. Implementing either Action Alternative 1 or 2 would not be expected to result in measurable changes to the localized relative sea level change.

With implementation of either the No Action/Future Without Project Alternative or either of the action project alternatives, the overall number of vessel calls is anticipated to increase over time. Therefore, greenhouse gas emissions resulting from deep draft navigation would increase over time regardless of whether an action alternative is implemented. However, the anticipated number of vessel calls with implementation of either of the action alternatives would be less than future conditions without implementation of an 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 either of the action alternatives we would anticipate fewer greenhouse gas emissions resulting from deep draft vessels as compared to future conditions without implementation of an action alternative.

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. Virginia Port growth is anticipated to increase throughout the next 50 years, and a new port facility is planned. Also, additional development is planned as is described in the No Action/Future Without Project Alternative. The increased development would also be linked with increases in greenhouse gas emissions from combustion of fuel associated with construction and maintenance of development projects.

Overall, impacts of either of the action project alternatives would the same as those described in the Air Quality Section and would not substantively contribute to global-climatic air quality. Implementation of an action alternative would not be anticipated to substantively cumulatively or synergistically contribute to climate change-induced water quality effects as described in the Water Quality Section

6.13 FLOODPLAINS

6.13.1 No Action/Future Without Project Alternative

Flooding can occur during tidal storm events and/or from heavy rainfall, usually associated with tropical systems, nor'easters, and heavy rainfall events. Flooding can be short term in duration, such as hurricanes, or long term duration, such as nor'easters. Typically slow moving and large in size, nor'easters can produce large amounts of rainfall and high water levels caused by storm surge that can stay elevated above normal astronomical tide cycles for long periods of time. These types of storms can cause inland flooding and significant beach and shoreline erosion from persistent wave action.

Tidal Flooding
Historical tidal flood events for the study area have mainly been from tropical storms, weak Category 1 hurricanes, or nor'easters; the area has not experienced a major hurricane on record. At the nearby Sewells Point tide gage located in Norfolk, in more recent time, Hurricane Isabel produced one of the highest storm tide elevations at 6.3 feet, NAVD88, approximately a 4% annual chance (25-year) flood event.

The current effective (August 3, 2015) 1% (light blue color) and 0.2% (pink color) annual chance exceedance (ACE) floodplain boundaries established by the Federal Emergency Management Agency (FEMA) are shown on Figure 6-1 below. As shown, the interior containment areas of the dike are not impacted, noting the FEMA floodplains shown are based strictly on a tidal engineering analysis and do not account for impacts from rainfall. The 1% annual chance flood elevations range from 7.6 feet to 7.9 feet for stillwater conditions, and nine to 15 feet considering wave action, NAVD88. The 0.2% annual chance stillwater elevations range from 9.1 to 9.7 feet, NAVD88; wave height calculations were not completed for the 0.2% annual chance flood event. Note, some of the access roads to enter Craney Island, the lower road along the primary dike, staging areas, and docking facilities near and along the waterfront appear to be subject to flooding from the 1% and 0.2% annual chance flood events. Portions of the lower perimeter road and the main access entrance to enter the containment area have estimated top of road elevations at approximately five and six feet, NAVD88, respectively, using USACE topographic data. Portions of the perimeter road flooded during Hurricane Isabel.

Figure 6-1. FEMA, City of Portsmouth, VA, 1% and 0.2% ACE Floodplain Boundaries

Although no flood damages were reported for buildings with past events, Craney Island also includes buildings that could be impacted by tidal flooding. As shown on Figure 6-2 below, a close-up view of Figure 6-1 near the southwest corner at the entrance to Craney Island, Buildings A: oil tank container sheds, B: outdoor lube pit for maintenance, C: main office/maintenance bay, D: equipment shed, E: emergency management equipment shed, and F: oil filter/supplies shed are located near or within the 1% (light blue color) and 0.2% (pink color) annual chance floodplains. Note, Buildings A, B, C, and F have a field-surveyed finished floor elevation at or higher than 14 feet, NAVD88, where the ground is elevated from a retaining wall on the north side of the structures, thus protecting the buildings from the 1% and 0.2 % annual chance floods. Finished floor elevations are not available for Buildings D and E, but lowest adjacent grade elevations are estimated from USACE topographic data at approximately seven and eight feet, NAVD88, respectively. If sensitive/critical equipment are stored within these buildings, if necessary, the equipment may need to be elevated above or located outside the 0.2% annual chance floodplain. A copied portion of the FEMA Flood Insurance Rate Map

(FIRM), City of Portsmouth, Virginia, Panel 5155290019D, effective August 3, 2015 is also shown in Figure 6-3.

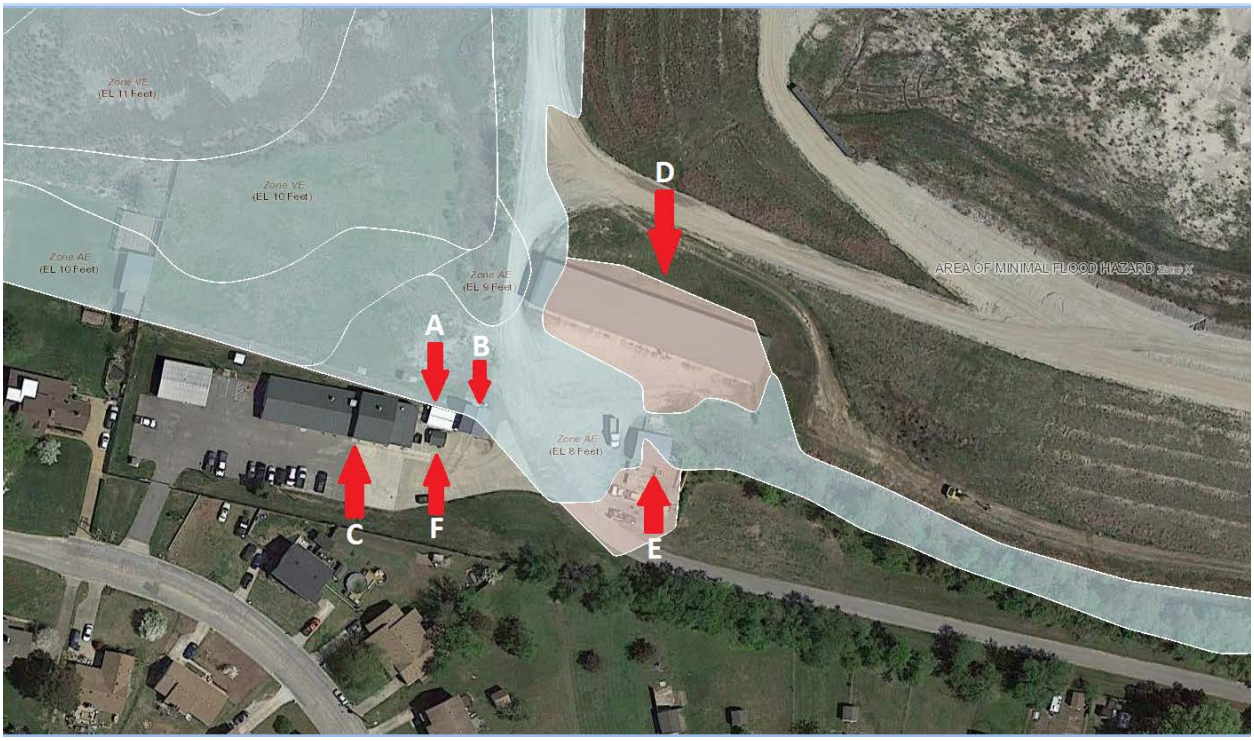

Figure 6-2. FEMA, City of Portsmouth, VA, 1% and 0.2% ACE Floodplain Boundaries at Craney Island Buildings

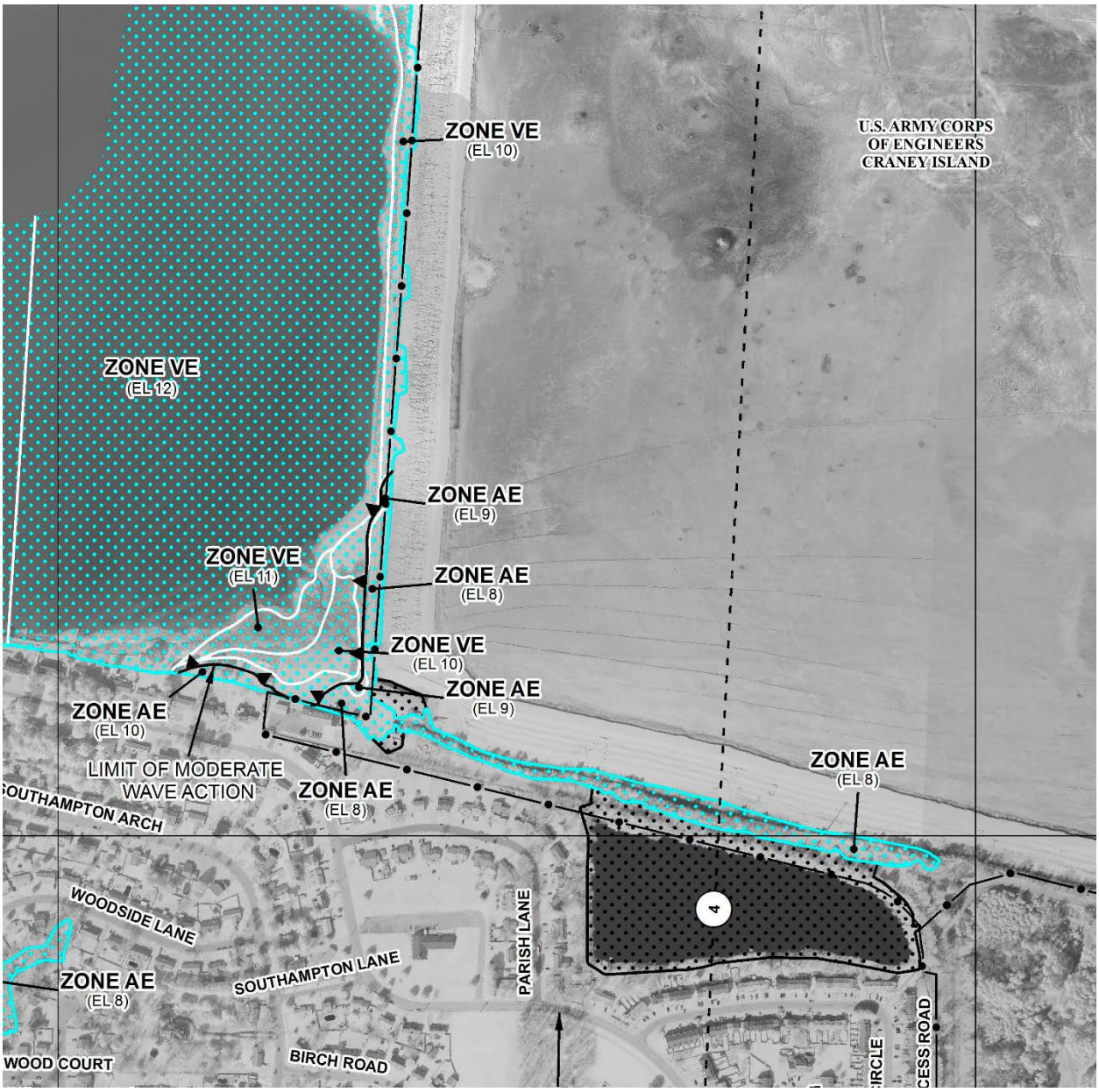

Figure 6-3. FEMA FIRM Panel 5155290019D

Wave Action

Being located along the waterfront, Craney Island can be exposed to the normal daily effects of wave action or from a severe tidal flood event. Looking at Figure 6-4 below and using more recent Google aerial imagery, to help protect Craney Island against wave action and coastal erosion, starting in 2012, there are currently 23 breakwater structures in place on the north and west sides. In addition, a stone revetment has been placed on the north shoreline.

Figure 6-4. Aerial View of Craney Island Breakwater Structure

Rainfall Impacts

Aside from tidal flooding, the containment cells within Craney Island could also be impacted by heavy rainfall, where if there is not enough available storage, then overtopping could occur. A hydrologic/hydraulic analysis has not been conducted to evaluate storage and overtopping for various hypothetical rainfall events, considering empty and full pond conditions. However, there have been several past storm events, such as Hurricane Floyd in 1999, Tropical Storm Ernesto in 2006, Nor'Ida in 2009, Hurricane Irene in 2011, Super Storm Sandy in 2012, and most recently Hurricane Mathew in 2016, that have produced significant rainfall amounts of nine inches or more in a 24 hour period, approximately equivalent to a 1% annual chance event, where overtopping has not occurred. In addition, as a best management practice, if large amounts of rainfall are in the weather forecast and pumping operations have been ongoing, if

possible, workers will draw down a working pond level using the two spillways (Figure 6-5 below) in a containment area to increase available storage. Considering the dike cross section/footprint size and scale relative to the interior containment areas, it appears a future dike breach/failure is considered unlikely.

Figure 6-5. Spillway Structure - Containment Area

A pond is shown near the entrance to Craney Island, adjacent to Parish Lane. It is unknown about the volume capacity of the lake, the type or condition of the outlet structure, and where it drains, but if rainfall conditions were such that overtopping occurred or failure of the outlet structure or embankment (road) occurred, there is a possibility that some of the Craney Island buildings or access road could be impacted.

As a waterfront facility built within the harbor, Craney Island is located near/within the 1% annual chance tidal floodplain. As shown above using the FEMA floodplain boundaries, the perimeter road around the dike, some of the buildings, and some of the access roads to enter Craney Island could be impacted by tidal flooding, which could affect operations at Craney Island. Additionally, equipment that is stored in buildings and is considered critical should be elevated above or located outside the 0.2% floodplain. Continued proactive measures using breakwater and revetment structures will help protect the shoreline against wave action.

Although not shown as a mapped floodplain by FEMA, dike overtopping 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 Matthew. 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 Craney Island, 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 the No Action/Future Without Project Alternative Plan, we would anticipate any potential adverse impacts to the floodplains to be negligible and temporary.

Existing navigational uses, such as industry, commerce, military, and recreation activities, will continue within the ROI, including existing dredging operations and dredged material placement. Virginia Port growth is anticipated to increase throughout the next 50 years, which may increase the number of vessels transiting the Norfolk Harbor and Channels. Craney Island will continue to function and operate as a dredged material management area due to its location and as a low cost option for placement of dredged material. Users of Craney Island include Federal, state, and local governments and private dredging projects.

Climatic changes, such as sea level rise and changes in weather patterns, have the potential to impact Craney Island. Over the 50 year horizon, the amount of dry land bordering Craney Island is anticipated to decrease with a projected increase in sea level rise. In addition, an increase in sea level also means the possibility of higher wave heights, shoreline erosion, and potential damage. The perimeter road may need to be eventually elevated and the shoreline further protected from wave action. If more rainfall or intense storms occur due to changes in weather patterns, then more attention will be needed for dike raising, release of water through the spillways, adequate freeboard, dewatering operations, etc.

We would not anticipate the No Action/Future Without Project Alternative Plan to substantively cumulatively or synergistically interact with other present, past, or future actions.

6.13.2 Action Project Alternatives

With respect to encouraging development in the floodplain, deepening of the existing navigation channel would allow more efficient use of the existing waterfront, but would not lead to changes in adjacent land use or allow development to occur that is not already planned or under construction.

As a waterfront facility built within the harbor, Craney Island is located near/within the 1% annual chance tidal floodplain. As shown above using the FEMA floodplain boundaries, the

perimeter road around the dike, some of the buildings, and some of the access roads to enter Craney Island could be impacted by tidal flooding, which could affect operations at Craney Island. Additionally, equipment that is stored in buildings and is considered critical should be elevated above or located outside the 0.2% floodplain. Continued proactive measures using breakwater and revetment structures will help protect the shoreline against wave action.

Although not shown as a mapped floodplain by FEMA, dike overtopping 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 Craney Island, 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 dredge material, operating the spillways, and maintaining adequate freeboard for normal pumping operations and also for rain and wind events.

Therefore, with implementation of Alternative Plan 1 or Alternative Plan 2, we would anticipate any potential adverse impacts to the floodplains to be negligible and temporary.

Existing navigational uses, such as industry, commerce, military, and recreation activities, will continue within the ROI, including existing dredging operations and dredged material placement. Virginia Port growth is anticipated to increase throughout the next 50 years, which may increase the number of vessels transiting the Norfolk Harbor and Channels. Craney Island will continue to function and operate as a dredged material management area due to its location and as a low cost option for placement of dredged material.

Climatic changes, such as sea level rise and changes in weather patterns, have the potential to impact Craney Island. Over the 50 year horizon, the amount of dry land bordering Craney Island is anticipated to decrease with a projected increase in sea level rise. In addition, an increase in sea level also means the possibility of higher wave heights, shoreline erosion, and potential damage. The perimeter road may need to be eventually elevated and the shoreline further protected from wave action. If more rainfall or intense storms occur due to changes in weather patterns, then more attention will be needed for dike raising, release of water through the spillways, adequate freeboard, dewatering operations, etc.

We would not anticipate either Alternative Plan 1 or Alternative Plan 2 to substantively cumulatively or synergistically interact with other present, past, or future actions.

6.14 NOISE AND VIBRATION

6.14.1 No Action/Future Without Project Alternative Plan

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. Therefore, adverse impacts with implementation of the No Action/Future Without Project Alternative would be considered to be temporary and minor.

In the future, with or without implementation of an action alternative, vessel calls are anticipated to increase as compared to current conditions, thus increasing noise and vibration within the ROI over time. Virginia Port growth is anticipated to expand throughout the next 50 years, and a new port facility is planned. The following regional projects are assumed to be constructed either with or without No Action/Future Without Project Alternative:

- Chesapeake Bay Bridge Tunnel – Parallel Thimble Shoal Tunnel (CBBT 2016);
- Hampton Roads Bridge Tunnel – Parallel Tunnel (VDOT 2012; VDOT 2016);
- Hampton Roads 3rd Crossing (Patriots Crossing) (VDOT 2001; VDOT 2016);
- I-664 Widening (ties to Patriots Crossing) (VDOT 2001; VDOT 2016);
- Norfolk International Terminals Piers 1 and 2 removed, with area deepened to -50 feet, and
- Craney Island Eastward Expansion – full build-out (USACE 2006).

The timing for completion of these projects is uncertain, and construction of these projects are anticipated to produce minor and temporary adverse impacts to ambient noise levels within the ROI, though these impacts are not likely to substantively synergistically or cumulatively interact.

No substantive cumulative or synergistic impacts would be anticipated. Implementation of the No Action/Future Without Project Alternative is predicted to result in temporary, minor adverse noise and vibration impacts within the ROI.

6.14.2 Action Project Alternative Plans

Compared to the No Action/Future Without Project Alternative, implementation of either of the Action Project Alternatives would result in an 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. It is anticipated that implementation of either of the Action Project Alternatives would result in temporary and minor adverse noise and vibration impacts within the ROI.

Vessel noise, both with and without implementation of either of the Action Project Alternatives Would increase over time because vessel calls are expected to rise in the coming years. However, overall noise and vibration impacts associated vessel calls would decrease with implementation of the Action Project Alternative; the same existing fleet of vessels would continue to call, but some of the smaller vessel size classes would be used less due to the fact

that larger vessel classes are more efficient. Virginia port growth is anticipated to expand throughout the next 50 years, and a new port facility is planned. The following regional projects are assumed to be constructed either with or without implementation of the Action Project Alternative:

- Chesapeake Bay Bridge Tunnel – Parallel Thimble Shoal Tunnel (CBBT 2016);
- Hampton Roads Bridge Tunnel – Parallel Tunnel (VDOT 2012; VDOT 2016);
- Hampton Roads 3rd Crossing (Patriots Crossing) (VDOT 2001; VDOT 2016);
- I-664 Widening (ties to Patriots Crossing) (VDOT 2001; VDOT 2016);
- Norfolk International Terminals Piers 1 and 2 removed, with area deepened to -50 feet, and
- Craney Island Eastward Expansion – full build-out (USACE 2006).

No substantive cumulative or synergistic impacts would be anticipated. Implementation of the Action Project Alternative is predicted to result in temporary, minor adverse noise and vibration impacts within the ROI.

6.15 OCCUPATIONAL SAFETY AND HEALTH

6.15.1 No Action/Future Without Project Alternative

With implementation of the No Action/Future Without Project Alternative Plan, maintenance dredging would continue and existing safety risks described in the Affected Environment Section that are at a negligible to minor level of impact would continue. 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 UXO, avoidance of slip and fall hazards, handling contaminated sediment, and wearing appropriate PPE. With implementation of the No Action/Future Without Project Alternative Plan, there would be continued maintenance dredging, but this would be at a lower level of duration than implementation of either of the action project Alternatives. Because maintenance dredging would be less disturbing to the sediment profile, there would be a lesser likelihood of encountering contaminated sediments or UXO than with implementation of either of the action alternatives.

6.15.2 Action Project Alternatives

Construction dredging is assumed to present a slightly higher occupational health and safety risk as maintenance dredging because of the likely potential to encounter contaminated sediments. In addition, the duration of exposure to occupational safety and health risks would increase with implementation of an action alternative as compared to the No Action/Future Without Project Alternative Plan. The increased level of dredging and dredged material disposal/handling activities, and 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. Hazards from 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. Dewatering of contaminated sediments will likely be required when handling dredged material from Segment 1 and Segment 2 with implementation of an action alternative. Effects to occupational health and safety would vary by alternative according to the dredging/dredged material disposal/handling durations and potential hazards in the areas. Implementation of an action alternative as compared to the No Action/Future Without Project Alternative Plan would have increased

exposure to potential chemical and ordnance hazards, but to date all contaminated sediments and ordnance encountered by dredging in the area has been safely handled. Although Alternative Plan 2 would have slightly higher durations of exposures to occupational safety and health hazards, entailing slightly more risk than Alternative Plan 1, the occupational safety and health risks or impacts would both be higher than the No Action/Future Without Project Alternative Plan and at a negligible to minor level of impact.

6.16 CULTURAL RESOURCES

6.16.1 No Action/Future Without Project Alternative Plan

Terrestrial archaeological and architectural historic properties would not be affected if the project is not constructed. No direct, indirect, or cumulative effects would be expected to these properties in either future without or future with project scenarios. Submerged archaeological properties would be less subject to effects without the project. Currently, no significant submerged archaeological resources have been identified in the APE of the project, but substantial areas remain unsurveyed. In the future Without Project condition, unidentified sites might still be subject to effects from maintenance dredging, however that potential is less than dredging for deeper or expanded channels. The Future Without Project could subject unidentified submerged archaeological sites to damage from ship strikes, groundings, and prop wash. This would be less likely if the Preferred Alternative is constructed.

6.16.2 Action Project Alternatives

Effects to terrestrial architectural cultural resources would be negligible for both of the Action Alternatives. Noise and visual effects from dredging would be transitory and distant from land areas. This and changes to navigation, the addition of larger vessels, would be a negligible effect. Terrestrial archaeological resources along shorelines and submerged archaeological resources away from the channels would not suffer from effects from increased wakes because vessels would not be travelling at wake producing speeds.

No submerged archaeological resources have been recorded within the APE for dredging. Archaeological sites may exist within unsurveyed parts of the APE. Surveys will be conducted for these areas during the Preliminary Engineering and Design after the appropriation of funds for this project through a Programmatic Agreement with the State Historic Preservation Office. Consequently, the impact intensity of the direct effects of construction on submerged archaeological resources are unknown at this time. Avoidance and minimization of effects would be attempted, and mitigation of adverse effects implemented for any NRHP eligible sites that may be identified in the APE.

Some survey exists for Segment 1, but only about 10% of it, on the west side of Segment 1b (Figure 6-3). Segment 2 has had full Phase I and Phase II survey, and although a shipwreck site (44CS0234) was identified in that reach, it is located about 200 feet outside of the dredging APE, and would not be affected by the project. Additional survey for deepening of the channel in other area should be needed only to the extent the channels would be widened to accommodate the deepening. This would be up to a 60 ft. expansion of dredged area, with an additional buffer needed to account for dredge anchoring. A 200 ft. wide survey area on either side of the channel is recommended for both Alternative Plan 1 and Alternative Plan 2. Although Alternative Plan 1, the NED plan, would affect a slightly reduced area due to the lesser depth compared with Alternative Plan 2, the LPP, the difference is on the order of a six-foot wider dredge area for each foot of added depth, although this ratio could vary with differing

sediment types. Surveys are being deferred to the PED phase of the project when the extent of potential disturbance would be more clearly known.

Transient visual and noise effects would result from construction, but no sensitive (i.e., architectural) resources would be adversely affected. The Virginia Department of Historic Resources concurred that no adverse effects to historic properties would result from visual or noise effects of construction, and this is documented in the Programmatic Agreement signed by the Virginia SHPO June 7, 2017. The Programmatic Agreement also allows Phase I and Phase II if needed to be deferred to the PED stage, and the procedures for mitigation if adverse effects to NRHP eligible properties are identified without additional agreement documents.

6.17 AESTHETICS

6.17.1 No Action/Future Without Project Alternative

Existing dredging operations, dredged material placement, and navigation would continue in the ROI. The maintenance dredging actions that would take place (e.g., dredge operation, pumps, tug/truck transportation, and final placement) would be consistent with the continued use of the river as a working waterfront within the ROI.

With implementation of the No Action/Future Without Project alternative, existing navigational uses within the project area (industry, commerce, military, and recreation) would continue and the viewsheds and vistas would reflect the continued industrial land use within the area. Over time, deep draft navigation would likely increase slightly with the predicted growth in commodity movement assumed to occur over the 50-year period of analysis.

Within the ROI, there are a number of larger-scale construction projects that would be expected to generate short-term, localized increases in construction under the No Action/Future Without Project condition including:

- Channel modifications to the Norfolk Harbor and Channels Project,
- Norfolk International Terminal Piers 1 and 2 removed, with area deepened to -50 feet,
- Craney Island Eastward Expansion – full build-out (USACE 2006), and
- I-64 High Rise Bridge Corridor (City of Chesapeake 2014).

Implementation of the No Action/Future Without Project alternative would result in no predicted changes to the visual resources within the ROI; the aesthetic environment of the ROI would continue to be that of a working waterfront with a mix of industrial, commercial, naval, marine, and urban shoreline uses.

6.17.2 Action Project Alternatives

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. The temporary viewshed impacts resulting from dredging operations with implementation of either of the action alternatives as compared to the No Action/Future Without Project Alternative 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. Potential cumulative effects would be similar to those described in the No Action/Future Without Project Alternative. Therefore, the effect of implementing either of

the action alternatives on the aesthetic resources within the ROI would be adverse, temporary and negligible.

6.18 RECREATION

6.18.1 No Action/Future Without Project Alternative

With implementation of the No Action/Future Without Project alternative, the maintenance dredging actions that would take place (e.g., dredge operation, pumps, tug/truck transportation, and final placement) would be consistent with the continued use of the river as a working waterfront within the ROI.

Existing navigational uses within the ROI (industry, commerce, military, and recreation) would continue and the recreational opportunities available within the ROI would be limited. Over time, deep draft navigation would likely increase slightly with the predicted growth in commodity movement assumed to occur over the 50-year period of analysis.

Within the ROI, there are a number of larger-scale construction projects that would be expected to generate short-term, localized, increases in construction activities that may affect recreational use of the ROI under the No Action/Future Without Project alternative including:

- Channel modifications to the Norfolk Harbor and Channels Project,
- Norfolk International Terminal Piers 1 and 2 removed, with area deepened to -50 feet,
- Craney Island Eastward Expansion – full build-out (USACE 2006), and
- I-64 High Rise Bridge Corridor (City of Chesapeake 2014).

While maintenance dredging and material placement/disposal activities are ongoing, areas adjacent to the dredging and placement actions would be unavailable for recreation and represent an adverse, 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. No substantive cumulative or synergistic impacts would be anticipated.

6.18.2 Action Project Alternatives

Dredging and dredged material placement/disposal operations that have the potential to impact recreational activities would be within approximately the same geographic area as those affected by the No Action/Future Without Project alternative. Additionally, the dredging equipment and methods would expected to be the same as, or similar to, the equipment currently used for maintenance dredging. As such, any interference with recreation within the ROI would be essentially the same as those with the No Action/Future Without Project Alternative, but for a longer duration. The effect of implementing either of the action alternatives on the recreational resources within the ROI would be adverse, temporary and negligible. Implementation of the Action Alternative is not anticipated to result in any substantive cumulative or synergistic impacts.

6.19 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

6.19.1 No Action/Future Without Project Alternative

With implementation of the No Action/Future Without Project Alternative, there would be no channel modifications to the Elizabeth River and Southern Branch of the Elizabeth River. However, routine USACE maintenance of the existing Federal channel is assumed to require dredging a portion of the Elizabeth River and Southern Branch of the Elizabeth River during 17 of the 50 years in the period of analysis (2023-2073). Under the No Action/Future Without Project alternative, the maintenance dredging actions that would take place would have some limited input to the local economy in association with the maintenance dredging work.

With implementation of the No Action/Future Without Project alternative, existing navigational uses within the ROI (industry, commerce, military, and recreation) would continue. Long-term forecasts for the region indicate continued growth of both population and employment, but at slower rates than has been experienced in the past decades. The HRPDC's Hampton Roads 2040 Socioeconomic Forecast predicts that the population and employment within the Hampton Roads MSA will both increase by 2040 (HRPDC 2013b). The HRPDC has estimated population growth for the constituent counties and cities as listed in Table 6-4; the total population is projected to increase from 1,666,310 in 2010 to 2,037,000 (approximately 22-percent) by 2040 (HRPDC 2013b).

Table 6-4. Predicted Population Change Between 2010 and 2040

City or County	2010 Population	2040 Population Forecast	Percent Change
Chesapeake	222,209	314,600	41.58
Hampton	137,436	137,200	-0.17
Newport News	180,719	189,100	4.64
Norfolk	242,803	253,200	4.28
Poquoson	12,150	12,400	2.06
Portsmouth	95,535	98,200	2.79
Suffolk	84,585	182,700	116.00
Virginia Beach	437,994	497,500	13.59
Williamsburg	14,068	17,200	22.26
Gloucester Co., VA	36,858	40,200	9.07
Isle of Wight Co., VA	35,270	62,800	78.06
James City Co., VA	67,009	104,200	55.50
York Co., VA	65,464	82,700	26.33

Source: Hampton Roads Planning Commission

Within the ROI, there are a number of larger-scale construction projects that would be expected to generate short-term, localized increases in the economy under the No Action/Future Without Project Alternative Plan including:

- Channel modifications to the Norfolk Harbor and Channels Project,
- Norfolk International Terminal Piers 1 and 2 removed, with area deepened to -50 feet,
- Craney Island Eastward Expansion – full build-out (USACE 2006), and
- I-64 High Rise Bridge Corridor (City of Chesapeake 2014).

None of these actions would be expected to individually or cumulatively substantively change the demographic, socioeconomic, or EJ community trends that are present within the ROI; 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.

6.19.2 Action Project Alternatives

Implementation of either of the action project alternatives 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 increase in the local economy within the ROI. 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.

Regional Economic Development benefits would be anticipated to be beneficial and temporary and in relation to the dredging cycle. The improved navigation channel 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.
Compliance with Executive Order 12898 on EJ requires an evaluation of the nature of the proposed actions and the human context into which those actions would be undertaken. In order to have potential EJ impacts, a proposal must have potential for disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, or Native American tribes. Implementation of either of the action project alternatives 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.

Potential cumulative effects would be similar to those described in the No Action/Future Without Project Alternative Section. None of these actions would be expected to individually or cumulatively substantively change the demographic, socioeconomic, or EJ community trends that are present within the ROI; the effect on the socioeconomic character of the ROI from implementing the Action Alternative would be beneficial and minor.

6.20 LAND USE AND INDUCED DEVELOPMENT

6.20.1 No Action/Future Without Project Alternative Plan

With implementation of the No Action/Future Without Project alternative, the maintenance dredging actions that would take place (e.g., dredge operation, pumps, tug/truck transportation, and final placement) would be consistent with the existing land use as a working waterfront within the ROI.

Existing navigational uses within the ROI (industry, commerce, military, and recreation) would continue into the foreseeable future and the patterns of land use and economic activity associated with the Port of Virginia would continue within the ROI. The role the Port of Virginia plays in the local economy and socioeconomic environment would likely increase slightly in proportion to the predicted increase in vessel traffic assumed to occur over the 50-year period of analysis.

Within the ROI, there are a number of larger-scale construction projects that would be expected to generate short-term, localized, increases in the economy under the No Action/Future Without Project alternative including:

- Channel modifications to the Norfolk Harbor and Channels Project,
- Norfolk International Terminal Piers 1 and 2 removed, with area deepened to -50 feet,
- Craney Island Eastward Expansion – full build-out (USACE 2006), and
- I-64 High Rise Bridge Corridor (City of Chesapeake 2014).

Implementation of the No Action/Future Without Project alternative would result in no predicted changes to the patters of land use within the ROI; the land use within the ROI would continue to be a mix of industrial, commercial, naval, marine, and urban shoreline.

6.20.2 Action Project Alternatives

Implementing Alternative 1 or Alternative 2 would result in no effect on land use within or adjacent to the ROI as it would continue to be that of a working waterfront with a mix of industrial, commercial, naval, marine, and urban land uses. Implementing Alternative 1 would not be anticipated to result in induced development by the Port of Virginia or other entities that could utilize the deeper channel.

6.21 TRANSPORTATION

6.21.1 No Action/Future Without Project Alternative

Existing dredging operations, dredged material placement, and navigation would continue in the ROI. Existing navigational uses within the ROI (e.g., industry, commerce, military, and recreation) that contribute to localized traffic would continue and congestion associated with the deep draft navigation would continue to change in response to the demand for goods entering and exiting facilities at the Port of Virginia over the period of analysis.
There are a number of larger-scale construction projects within the ROI that would be expected to generate construction-related increases in vehicle traffic under the No Action/Future Without Project alternative including:

- Channel modifications to the Norfolk Harbor and Channels Project,
- Norfolk International Terminal Piers 1 and 2 removed, with area deepened to -50 feet,
- Craney Island Eastward Expansion – full build-out (USACE 2006), and
  I-64 High Rise Bridge Corridor (City of Chesapeake 2014).

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 2015a), the burden of truck traffic on surrounding surface roads would be predicted to proportionally decrease under the No Action/Future Without Project alternative. In addition, because the relative contribution to the regional trends in truck traffic are so small from deep draft navigation in the Elizabeth River and Southern Branch of the Elizabeth River, implementing the No Action/Future Without Project alternative would be predicted to result in no substantive changes to the regional traffic and surface road congestion within the ROI. Any potential impacts to transportation would be expected to be adverse, and negligible to minor. No substantive cumulative or synergistic impacts would be anticipated.

6.21.2 Action Project Alternatives

Dredged material needing upland placement would be dewatered as it's dredged and then barged to Port Weanack, where it would be mixed with cement and then transported to either the Charles City Landfill or the Tri-City Regional Landfill & Recycling Center in Petersburg. Depending on the route utilized, one-way truck haul distances to these facilities would be approximately 13 and 17 miles, respectively. The route from Port Weanack to the Charles City Landfill is a two-lane paved road through substantially rural areas that are assumed to have traffic flow at or above the posted speed limits. Depending on the route selected, truck traffic between Port Weanack and the Tri-City Regional Landfill & Recycling Center could pass through more densely populated areas (e.g., Hopewell and Fort Lee) with existing baseline traffic below free-flow on some roads during peak hours. Also, in order to access the Tri-City Regional Landfill, all trucks would need to cross the Benjamin Harrison Memorial Bridge over the James River. The route to the Tri-City Regional Landfill could avoid urban areas and signalized intersections by taking more rural roads. The roads that would most likely be utilized to access both of these landfills are not within the area routinely assessed for traffic conditions by the Hampton Roads Transportation Planning Organization (HRTPO 2014). Implementation of the Alternative 1 or 2 would result in minor increases in truck traffic between Port Weanack and landfills as compared to implementation of the No Action/Future Without Project Alternative.

Implementing the channel modifications would result in fewer vessels calling on the Port of Virginia facilities in the Elizabeth River and Southern Branch of the Elizabeth River to move the same quantity of cargo. Existing vessels would transport the same quantity of cargo more efficiently (i.e., fewer trips to move the annual quantity of cargo) which would decrease the number of vessels moving cargo into and out of the Elizabeth River and Southern Branch of the Elizabeth River.

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 increase under Alternative 1 or 2.

Implementation of either Alternative 1 or Alternative 2 would result in temporary, minor adverse impacts to transportation. No substantive cumulative or synergistic impacts would be anticipated.

7 SUMMARY OF BEST MANAGEMENT PRACTICES/MITIGATION MEASURES

Impact evaluations conducted during preparation of this EA have determined that no significant impacts would result from implementation of the Draft Recommended Plan (also referred to as the Preferred Alternative or Locally Preferred Plan). 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 either of the Action Alternatives 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.
- 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.
- 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-ft 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.
- 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.

8 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).

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

Table 8-1. Summary 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	Coordination with the U.S. Fish and Wildlife Service (USFWS) is ongoing
Anadromous Fish Conservation Act of 1965	16 U.S.C. 757 a et seq	Coordination with the NMFS is ongoing
Clean Air Act of 1972, as amended	42 U.S.C. 7401 et seq	Coordination with the DEQ is ongoing
Clean Water Act of 1972, as amended	33 U.S.C. 1251 et seq	Coordination with the DEQ is ongoing
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.
Coastal Zone Management Act of 1972, as amended	16 U.S.C. 1451 et seq	Coordination with the DEQ is 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
Endangered Species Act of 1973	16 U.S.C. 1531	Coordination with the USFWS 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	Coordination with the USFWS and state wildlife agencies is ongoing
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	Coordination with the NMFS is ongoing

Title of Law	U.S. Code	Compliance Status
Marine Mammal Protection Act of 1972, as amended	16 U.S.C. 1361	Coordination with the NMFS is ongoing
Marine Protection, Research, and Sanctuaries Act of 1972	33 U.S.C. 1401	N/A; no open ocean disposal of dredged material is anticipated
Migratory Bird Conservation Act of 1928, as amended	16 U.S.C. 715	Coordination with the USFWS is ongoing
Migratory Bird Treaty Act of 1918, as amended	16 U.S.C. 703	Coordination with the USFWS is ongoing
National Environmental Policy Act of 1969, as amended	42 U.S.C. 4321 et seq	Coordination with Federal, state, local agencies, tribal governments, and the public is ongoing
National Historic Preservation Act of 1966, as amended	16 U.S.C. 470	Full Compliance
National Historic Preservation Act Amendments of 1980	16 U.S.C. 469a	Full Compliance
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
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 8-2. Summary of Compliance with 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
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

Title of Executive Order	Executive Order Number	Compliance Status
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	Full Compliance
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 8-3. Summary of Environmental Compliance Permits, Certifications, Agreements, and Notifications

Law	Agency Responsible	Permit, Certification, Agreement, 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	DEQ	401 Water Quality Certification (Will be coordinated under CZMA process)
Coastal Zone Management Act (CZMA)	DEQ	CZMA Federal Consistency Concurrence
Endangered Species Act of 1973	NMFS	Biological Opinion with Incidental Take statement (Formal Consultation)

Law	Agency Responsible	Permit, Certification, Agreement, or Notification Required
Endangered Species Act of 1973	USFWS	Concurrence Determination (Informal Consultation)
Fish and Wildlife Coordination Act (FWCA)	USFWS	Fish and Wildlife Coordination Act Report preparation is underway.
Magnuson-Stevens Fishery Conservation and Management Act	NMFS	Notification of any noncompliance; none anticipated
Marine Mammal Protection Act of 1972, as amended	NMFS	Incidental Take Authorization
Marine Protection, Research, and Sanctuaries Act of 1972	USEPA	N/A
Migratory Bird Treaty Act of 1918, as amended	USFWS	"Take" permit; no take permit is required
National Historic Preservation Act of 1966, as amended	Advisory Council on Historic Preservation, Virginia Department of Historic Resources	Programmatic Agreement in place
Noise Control Act of 1972	USEPA	Notification of any noncompliance; none anticipated
Resource Conservation and Recovery Act of 1976	USEPA, DEQ	Testing, quantification, and notification for any hazardous materials.

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

8.2 National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 et seq.

The NEPA requires that all Federal agencies use a systematic, interdisciplinary approach to protect the human environment. This approach promotes the integrated use of natural and social sciences in planning and decision-making that could have an impact on the environment. NEPA requires the preparation of an environmental impact statement (EIS) for any major Federal action that could have a significant impact on quality of the human environment and the preparation of an Environmental Assessment (EA) for those Federal actions that do not cause a significant impact but do not qualify for a categorical exclusion. The NEPA regulations issued by CEQ provide for a scoping process to identify and the scope and significance of environmental issues associated with a project. The process identifies and eliminates from further detailed study issues that are not significant. As previously stated, the USACE used this process to comply with NEPA and focus this General Reevaluation Report/EA (GRR/EA) on the issues most relevant to the environment and the decision making process. For a description of the agency, tribal, and public coordination completed to date and information on the NEPA scoping that was completed, please refer to the Section 1.9.2, National Environmental Policy Act Scoping and Public, Resource Agency, and Tribal Coordination. The Draft GRR/EA is undergoing a 30-day agency, tribal, and public review period. All comments/edits will be

addressed in the development of the Final GRR/EA, and will include responses to the comments. The GRR/EA, including all appendices and supporting documentation will fulfill requirements of the NEPA for the Elizabeth River and Southern Branch Navigation Improvements Project. Upon completion of the GRR/EA, which is signified by the signing of the Finding of No Significant Impact, the project will be in full compliance with the NEPA.

8.3 Clean Water Act

The USACE will obtain a Water Quality Certification from the Commonwealth of Virginia pursuant to the Clean Water Act (CWA). This GRR/EA contains sufficient information to demonstrate that the recommended plan is in compliance with the CWA.

8.4 Wetlands

Section 404 of the CWA and 33 C.F.R. 336(c)(4) and 33 C.F.R. 320.4(b) require the USACE to avoid, minimize, and mitigate impacts to wetlands. No impacts to jurisdictional wetlands are anticipated with implementation of this project.

8.5 Federal Coastal Zone Management Act, 16 U.S.C. 1451 et seq.

The Federal Coastal Zone Management Act (CZMA) requires each Federal agency activity performed within or outside the coastal zone (including development projects) that affects land or water use, or natural resources of the coastal zone to be carried out in a manner which is consistent to the maximum extent practicable, i.e. fully consistent, with the enforceable policies of approved state management programs unless full consistency is prohibited by existing law applicable to the Federal agency.

To implement the CZMA and to establish procedures for compliance with its Federal consistency provisions, the U.S. Department of Commerce, National Oceanic and Atmospheric Administration

(NOAA), promulgated regulations which are contained in 15 C.F.R. Part 930. As per 15 CFR 930.37, a Federal agency may use its NEPA documents as a vehicle for its consistency determination.

The Virginia Coastal Management Program was established under the guidelines of the national Coastal Zone Management Act (1972) as a state-Federal partnership to comprehensively manage coastal resources. The DEQ is the designated state coastal management agency and is responsible for the implementation of the state's Coastal Management Program. Implementation includes the direct regulation of impacts to coastal resources within the critical areas of the state including coastal waters, tidelands, beaches and beach dune systems; and indirect certification authority over Federal actions and state permit decisions within the eight coastal counties.

The goals of the Virginia Coastal Management Program are attained by enforcement of the policies of the State as codified within the Virginia Code of Regulations. "Policy" or "policies" of the Virginia Coastal Management Program means the enforceable provisions of present or future applicable statutes of the Commonwealth of Virginia. The statutes cited as policies of the Program were selected because they reflect the overall program goals of developing and implementing a balanced program for the protection of the natural resources, as well as

promoting sustainable economic development of the coastal area. In accordance with the CZMA, it has been determined that the proposed deepening of the Federal navigation channel would be carried out in a manner that is fully consistent with the enforceable policies of the Virginia CMP (The Federal Consistency Determination with the CZMA is provided in Appendix G).

8.6 Clean Air Act, as amended, 42U.S.C. 7401 *et seq.*

There would be negligible to minor impacts to air quality resulting from operation of dredging vessels and dredging and material placement/disposal equipment operations. The Hampton Roads Intrastate Air Quality Control Region is in attainment with all National Ambient Air Quality Standards. Therefore, no conformity analysis is required for this project.

8.7 U.S. Fish and Wildlife Coordination Act, 16 U.S.C.661-666(c)

The project is undergoing coordination with the U.S. Fish and Wildlife Service and the Commonwealth of Virginia. A Fish and Wildlife Coordination Act Report is being prepared by the U.S. Fish and Wildlife Service.

8.8 Endangered Species Act

A Biological Assessment evaluating the potential impacts of the proposed action on endangered and threatened species has been prepared and is provided in Appendix E. Although there is designated critical habitat for some of the Federally listed species that occur in the Action Area, there is no designated critical habitat located within the Action Area. Coordination with the USFWS and the NMFS pursuant to Section 7 of the ESA for the species provided in Table 8-4 below is ongoing. The table shows those Federally listed species known or with the potential to occur in the Action Area and affect determinations with implementation of the preferred alternative (Swingle et al. 2017-2009; USFWS 2016a; VDGIF 2016b; DCR 2016; NMFS 2012; Jensen and Silber 2003).

Table 8-4. Federally Listed Species Known or With the Potential to Occur in the Action Area

Taxonomic Category/Common Name	Scientific Name	Status	Critical Habitat	Affect Determination
Birds				
Piping plover	*Charadrius melodus*	T	Y	May Affect, Not Likely to Adversely Affect
Red knot	*Calidris canatus rufa*	T	N	May Affect, Not Likely to Adversely Affect
Fish				
Atlantic sturgeon (Chesapeake Bay DPS)	*Acipenser oxyrinchus*	E	Y	May Affect, Not Likely to Adversely Affect

Taxonomic Category/Common Name	Scientific Name	Status	Critical Habitat	Affect Determination
Shortnose sturgeon	*Acipenser brevirostrum*	E	N	May Affect, Not Likely to Adversely Affect
Mammals				
Blue whale	*Balaenoptera musculus*	E	N	May Affect, Not Likely to Adversely Affect
Fin whale	*Balaenoptera physalus*	E	N	May Affect, Not Likely to Adversely Affect
North Atlantic right whale	*Eubalaena glacialis*	E	Y	May Affect, Not Likely to Adversely Affect
Northern long-eared bat	*Myotis septentrionalis*	T	N	No Effect
Sei whale	*Balaenoptera borealis*	E	N	May Affect, Not Likely to Adversely Affect
Sperm whale	*Physeter macrocephalus*	E	N	May Affect, Not Likely to Adversely Affect
West Indian manatee	*Trichechus manatus*	T	Y	May Affect, Not Likely to Adversely Affect
Sea Turtles				
Green sea turtle (North Atlantic DPS)	*Chelonia mydas*	T	Y	May Affect, Not Likely to Adversely Affect
Hawksbill sea turtle	*Eretmochelys imbricata*	E	Y	May Affect, Not Likely to Adversely Affect
Kemp's Ridley sea turtle	*Lepidochelys kempii*	E	N	May Affect, Not Likely to Adversely Affect
Leatherback sea turtle	*Dermochelys coriacea*	E	Y	May Affect, Not Likely to Adversely Affect
Loggerhead sea turtle (Northwest Atlantic DPS)	*Caretta caretta*	T	Y	May Affect, Not Likely to Adversely Affect

DPS = Distinct Population Segment; T = Threatened; E = Endangered; Y=Yes; N = No ^Species status is reported as it pertains to the DPS/Action Area; Critical Habitat not located in Action Area

8.9 Magnuson-Stevens Fishery Conservation and Management Act (MSA), 16 U.S.C.1801 et seq.

This Act requires Federal action agencies to consult with the National Marine Fisheries Service

(NMFS) if a proposed action may affect Essential Fish Habitat (EFH). The USACE evaluated potential project impacts on NMFS-managed fish species and their Essential Fish Habitats (Appendix H). Negligible to minor, adverse impacts to EFH is anticipated, however no impacts are anticipated to substantively impact EFH. Coordination with the NMFS is ongoing.

8.10 Anadromous Fish Conservation Act, 16 U.S.C. 757, *et seq.*

The project considered habitat impacts to the anadromous fish listed below in Table 8-5. Mitigation would not be required for the negligible to minor, adverse affects on these species due to water quality changes and/or habitat displacement. Coordination with the NMFS is ongoing.

Table 8-5. Anadromous Fish Known or With the Potential to Occur in the Region of Influence

Common Name	**Scientific Name**
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*
Alewife	*Alosa pseudoharengus*
American shad	*Alosa sapidissima*
Blueback herring	*Alosa aestivalis*
Hickory shad	*Alosa mediocris*
Striped bass	*Morone saxatilis*
Yellow perch	*Perca flavescens*

8.11 Marine Mammal Protection Act, 16 U.S.C. 1631 et seq.

The Marine Mammal Protection Act (MMPA) prohibits the take of marine mammals including the West Indian manatee, and all cetaceans found in the ROI. The project is being coordinated with the USFWS and NMFS. No incidental take statement is anticipated to be required per the MMPA. Coordination with the USFWS and the NMFS is ongoing with this project.

8.12 Section 106 and 110(f) of the National Historic Preservation Act, 16 U.S.C. 470 *et seq.*

The National Historic Preservation Act (NHPA) applies to properties listed in or eligible for listing in the National Register of Historic Places (NRHP); these are referred to as “historic properties.” Historic properties eligible for listing in the NRHP include prehistoric and historic sites, structures, buildings, objects, and collections of these in districts. Section 106 of the NHPA and its implementing regulations at 36 CFR Part 800, require the lead Federal agency to assess the potential effects of an undertaking on historic properties that are within the proposed project’s Area of Potential Effect (APE), which is defined as “the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist” (36 C.F.R. § 800.16[d]).

The USACE evaluated the potential for adverse impacts to archaeological or historic resources. No submerged archaeological resources have been recorded within the APE for dredging. Archaeological sites may exist within unsurveyed parts of the APE. As per a Programmatic Agreement with the Virginia State Historic Preservation Office signed on June 7, 2017, surveys will be conducted for these areas during the Preconstruction, Engineering, and Design (PED) Phase of the Project. The procedures for any mitigation if adverse effects to NRHP eligible properties are identified are also described in the Programmatic Agreement. The Virginia Department of Historic Resources concurred that no adverse effects to historic properties would result from visual or noise effects of construction, and this is also documented in the Programmatic Agreement.

8.13 Resource Conservation and Recovery Act, as amended, 42 U.S.C. 6901 *et seq*.

The Resource Conservation and Recovery Act (RCRA) controls the management and disposal of hazardous waste. "Hazardous and/or toxic wastes," as classified by RCRA, are materials that may pose a potential hazard to human health or the environment due to quantity, concentration, chemical characteristics, or physical characteristics. This applies to discarded or spent materials that are listed in 40 CFR 261.31-.34 and/or that exhibit one of the following characteristics: ignitable, corrosive, reactive, or toxic. Radioactive wastes are materials contaminated with radioactive isotopes from anthropogenic sources (e.g., generated by fission reactions) or naturally occurring radioactive materials (e.g., radon gas, uranium ore).

Substantive geotechnical and environmental sediment sampling studies have been conducted in the Elizabeth River--including the Southern Branch--and provide the basis for the nature and extent of chemical contamination within portions of the sediment profile in the ROI. For a description of these studies and key contaminants of concern that are known to occur in the ROI (heavy metals, PCBs, PAH, and TPH), please refer to the Sediments and HTRW section.

Dredging within the Elizabeth River Southern Branch Navigation Improvements Project Area is anticipated to generate material with chemical contamination within portions of Segment 1 and within Segment 2 that exceeds the acceptance criteria of CIDMMA. Contaminated dredged material will need to be disposed of at an approved upland site(s). Potential upland disposal sites that could be used are described in the Sediments and HTRW Section of this document. Dredged material will be tested as described in the Sediments and HRTW section, to determine suitability for placement at the CIDMMA or at an upland disposal site(s). Effluent monitoring would be conducted at the CIDMAA spillway discharge sites as described in the Sediments and HRTW Section.

8.14 Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601 *et seq*.

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund) governs the liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive hazardous substance disposal sites.

There are CERCLA/Superfund sites bordering, but not within, the ROI; and this project constitutes a navigation improvement project, rather than a clean-up effort under CERCLA. However, contamination from these sites may be present within the dredging limits of the ROI,

and if so, it will be handled as described in Part 6.12 above and as described in the Hazardous, Toxic, and Radioactive Waste Section.

8.15 Marine Protection, Research and Sanctuaries Act

The Act has two essential aims: to regulate intentional ocean disposal of materials, and to authorize any related research. While the MPRSA regulates the ocean dumping of waste and provides for a research program on ocean dumping, it also provides for the designation and regulation of marine sanctuaries.

While no ocean dumping, research, or designation of marine sanctuaries is anticipated to occur with this project (as it is anticipated that dredged material would be placed at the CIDMMA or at upland disposal sites), should any future ocean dumping of dredged material be required, the sediment testing requirements of the MPRSA will be followed to ensure that any sediments placed at open ocean disposal sites will meet MPRSA standards.

8.16 Executive Order 11988, Floodplain Management

This EO states that Federal agencies shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out agency responsibilities. The proposed project would have only negligible and temporary impacts to the floodplain.

8.17 Executive Order 11990, Protection of Wetlands

This EO directs all Federal agencies to minimize the destruction, loss, or degradation of wetlands; and preserve and enhance the natural beneficial values of wetlands in the conduct of the agency's responsibilities. No direct impacts to jurisdictional wetlands are anticipated with implementation of this project.

8.18 Executive Order 13112, Invasive Species

Under this EO, the introduction of invasive species has been evaluated in Section 6.22. The project would not induce the introduction of invasive species to the project area.

8.19 Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations

In accordance with this EO, the USACE has determined that no group of people would bear a disproportionately high share of adverse environmental consequences resulting from the proposed work.

8.20 Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks

This EO ensures that all Federal actions address the unique vulnerabilities of children. In accordance with this EO, the USACE has determined that no children would bear a disproportionately high share of adverse environmental consequences resulting from the proposed work.

8.21 Migratory Bird Treaty Act, 16 U.S.C. 703 *et seq*.; Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds

This Act makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations. Temporary to permanent impacts to migratory birds would range from adverse to beneficial effects that would range from a negligible to a minor level of impact.

8.22 LIST OF PREPARERS

The project delivery team for the study was extensive. It comprised team members from District's in the USACE North Atlantic and South Atlantic Division (Norfolk, Jacksonville, and Mobile). The team members listed in the following table provided substantial text to the Integrated Feasibility Report/Environmental Impact Statement.

Table 8-6. List of Report Preparers

Name	Contribution/Education	Affiliation	Years of Experience
John Haynes	Cultural Resources/MA, Anthropology	USACE	28
Alicia Logalbo	Environmental Analysis/MS, Biology	USACE	18
Jason O'Neal	GIS Mapping/BS, Geology	USACE	12
Miranda Ryan	Environmental Analysis/BS, Biology	USACE	2
David Schulte	Environmental Analysis/MS, Marine Science	USACE	18
Todd Nettles	Economic Analysis/BS, Economics	USACE	17
Idris Dobbs	Economic Analysis/BS, Economics	USACE	10
Jerry Diamantides	Plan Formulation & Economics/Ph.D. Economics	DMA	30
Michael McGarry	Environmental Analysis/B.S. Biology	DMA	22
Laura Evans	Environmental Analysis/B.S. Biology & J.D.	DMA	12
Dan Hughes	Plan Formulation/Ph.D. Applied Anthropology	USACE	27
Rachel Haug	Plan Formulation/B.S. Environmental Policy and Planning	USACE	8
Kimberly Koelsch	Biologist/B.A. Urban Affairs and Planning	USACE	6
Robert Pretlow	Plan Formulation/MS, Civil Engineering	USACE	42
Ira Brotman	Engineering and Costs/BS, Civil Engineering	Moffatt and Nichol	25

9 AGENCIES, TRIBAL GOVERNMENTS, AND PERSONS CONSULTED

Table 9-1 list the Agencies consulted with during this project. Consultation will be ongoing through the length of this study.

Table 9-1. Agencies, Tribal Governments, and Persons Consulted

Agency	Name of Contact People
Advisory Council on Historic Preservation (ACHP)	Brian Lusher, Artisha Thompson
U.S. Navy (USN)	Michael King, Brian Ballard, Mercedes Holland
U.S. Coast Guard (USCG)	Ken Kostecki
National Marine Fisheries Service (NMFS)	Christine Vaccaro, David O'Brien, Brian Hopper
U.S. Environmental Protection Agency (USEPA)	Barbara Rudnick, Nora Theodore
U.S. Fish and Wildlife Service (USFWS)	Troy Andersen, Chris Guy
Virginia Department of Environmental Quality (VDEQ)	Bert Pariolari, Bettina Sullivan
Virginia Marine Resources Commission (VMRC)	Tony Watkinson, Rachael Peabody
Virginia Department of Historic Resources (VDHR)	Marc Holma, Greg LaBudde
Virginia Department of Game and Inland Fisheries (VDGIF)	Amy Ewing
Virginia Department of Conservation and Recreation (VDCR)	Ali Baird
City of Chesapeake, Planning	Director of Planning
City of Hampton, Planning	Keith Cannady
City of Newport News, Planning	Sheila McAllister

Agency	Name of Contact People
City of Norfolk, Planning	Susan McBride
City of Portsmouth, Planning	Robert Baldwin
City of Virginia Beach, Preservation Commission	Mark Reed
Catawba Indian Nation	Wenonah Haire
Delaware Nation	Nekole Alligood
Delaware Tribe	Susan Bachor
Narragansett Indian Tribe	Chief Sachem Thomas
Shinnecock Indian Nation	Bryan Polite
Naval History and Heritage Command	Robert Neyland

10 RECOMMENDATIONS

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

I recommend that the existing deep-draft navigation project Norfolk Harbor and Channels Project from the Lamberts Bend to the Chesapeake Extension (Referred to as the Elizabeth River and Southern Branch Navigation Improvements (ERSB)) be modified to provide for implementation of a Federal project for deeper draft commercial vessels in accordance with the plan selected herein, with such further modifications thereto as in the discretion of the Chief of Engineers, may be advisable. Aids to navigation would be provided at 100% Federal cost. For the purpose of calculating the Section 902 limit, the estimated first cost of the project is $128,839,000 including an estimated Federal share of $90,810,000 an estimated non-Federal share of $38,029,000. The average annual costs are $$6,462,000. Average annual benefits are $5,443,000 with a benefit to cost ratio of 2.4.

The Draft 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 is contingent upon the non-Federal sponsor agreeing to comply with applicable Federal laws and policies. Prior to implementation, the non-Federal sponsor shall agree to:

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

(1) 25 percent of the costs of design and construction of the general navigation features (GNFs) and mitigation (including mitigation LERR) attributable to dredging to a depth in excess of -20 feet MLLW but not in excess of -50 feet MLLW, plus

(2) 100 percent of the costs of design and construction of the general navigation features attributable to dredging beyond the NED plan that are required to implement the LPP.

B. 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.

C. 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.

D. 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.

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

F. 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.

G. 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.

H. 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.

I.

J. 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.

K. 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.

L. 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.

M. To the maximum extent practicable, perform its obligations in a manner that will not

cause liability to arise under CERCLA.

N. 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.

O. 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.

P. 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)).

Q. 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.

R. 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.

No additional Congressional authorization is required for the implementation of the Recommended Project as its features fall within the Norfolk Harbor and Channels Project authorized in Section 291 of the Water Resources Development Act of 1986. Additionally, the current estimated initial construction costs of the Recommended Project do not exceed the project cost limits calculated in accordance with Section 902 of the WRDA of 1986.

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 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 Congress 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.

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Jason Kelly, PMP
Colonel, Corps of Engineers,
Commanding

11 DRAFT FINDING OF NO SIGNIFICANT IMPACT

ELIZABETH RIVER AND SOUTHERN BRANCH NAVIGATION IMPROVEMENTS

NORFOLK, VIRGINIA

The U.S. Army Corps of Engineers, Norfolk District (USACE), and its non-Federal sponsor, the Commonwealth of Virginia, acting through its agent the Virginia Port Authority, have developed a General Reevaluation Report/ Environmental Assessment (GRR/EA) for the Elizabeth River and Southern Branch Navigation Improvements Project. This study is being conducted under Section 216 of the Flood Control Act of 1970 (Public Law 91-611), which authorizes the review of completed projects in the interest of navigation and related purposes to determine the feasibility of further port deepening.

The Recommended Plan or Preferred Alternative (Alternative 2) is the Locally Preferred Plan and would consist of constructing and maintaining the following features:

- Deepening the channel from Lamberts Bend to Perdue Farms (Segment 1a) from a required depth of 40 feet to 45 feet deep, and deepening the channel from Perdue Farms to the Norfolk Southern Lift Bridge (Segment 1b) from a required depth of 40 feet to 42 feet.
- Deepening the channel from the Norfolk Southern Lift Bridge to the Gilmerton Bridge (Segment 2), from a required depth of 35 feet to 39 feet deep; and
- Continuing to maintain the channel from the Gilmerton Bridge to the Chesapeake Extension to a required depth of 35 feet (Segment 3).

The purpose of the project is to determine whether the authorized plan is still in the Federal interest and to evaluate measures which would potentially improve the current and future operational efficiency of commercial vessels using the Elizabeth River. The impacts of the proposed project construction, operation, and maintenance of each channel segment were examined for their effects on the human environment.

The public was invited to a scoping meeting and solicited for comments in September 2015. The USACE prepared a Draft GRR/EA for public comment in December 2017 and a 30 day public comment period was granted. Comments received were recorded, reviewed, and appropriately considered by the USACE prior to finalizing the GRR/EA in compliance with the National Environmental Policy Act of 1969 (40 CFR 1500-1508), as amended.

Throughout the study process, USACE has taken reasonable measures to assemble the known foreseeable impacts of the project in the report. The possible consequences of implementation of the Preferred Alternative were considered in terms of probable environmental, social well-being, and economic impacts. This report presents the impacts that could potentially result from channel deepening and the placement/disposal of dredged material during construction and maintenance. With implementation of the Preferred Alternative, there would be no anticipated significant impacts to the human environment and impacts to resources did not exceed a minor level of impact.

There would be no anticipated significant cultural, socioeconomic, or environmental impacts as a result of implementation of the Preferred Alternative. This project would be expected to have a

beneficial impact on the economy of Hampton Roads and the Commonwealth of Virginia. In addition, a Programmatic Agreement was coordinated and signed by the USACE, the Virginia Port Authority and the Virginia State Historic Preservation Office in June 2017 to address any cultural resource impacts with the potential to occur during project implementation.

Endangered Species Act, Section 7 consultation was also conducted with the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration/National Marine Fisheries Service. With implementation of the Preferred Alternative, a determination of "May Affect, Not Likely to Adversely Affect" was concluded with the implementation of the Preferred Alternative for loggerhead, Kemp's Ridley, green, hawksbill, and leatherback sea turtles. A determination of "May Affect, Not Likely to Adversely Affect" was also concluded for Atlantic sturgeon, piping plover, listed whale species (blue whale, fin whale, north Atlantic right whale, sei whale, and sperm whale), red knot, and the West Indian manatee. Impacts to these species would not be anticipated to be "significant," as defined by the significance thresholds in National Environmental Policy Act guidelines. There would be no effect to critical habitat as there is no designated critical habitat in the Action Area. Best Management Practices and standard USACE protocols for the protection of the Atlantic sturgeon, listed turtle and whale species, and other marine mammal species would be implemented to avoid and minimize potential impacts of the project. It has also been determined that no incidental take provisions for harassment of marine mammals would be necessary under the Marine Mammal Protection Act for this project.

Consultation under the Magnuson-Stevens Fishery Conservation and Management Act was concluded to determine implementation of the Preferred Alternative would result in adverse but not significant impacts to Essential Fish Habitat (EFH). No significant adverse impacts to fish or fish habitat are anticipated and no population level impacts to any managed fish species or associated prey species would be anticipated. The implementation of best management practices/mitigative measures would help avoid and minimize impacts to fish and fish habitat.

With implementation of the Preferred Alternative, there would be no anticipated significant impacts to benthic resources. Any impacts would be expected to be temporary and minor in nature with the local benthic community expected to repopulate and reestablish itself within six months to two years. Impacts to water quality would also be anticipated to be temporary to permanent and minor. Total Suspended Solids and turbidity in the water column at dredge locations and dredged material placement/disposal sites would quickly return to ambient conditions following dredging and dredged material placement/disposal.

There is no 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 Preferred Alternative. Best Management Practices have been incorporated in order to protect the environment and minimize impacts during construction, and operation and maintenance cycles.

The conclusions of this report are based on an evaluation of the effects that the proposed action would have on the human environment. Cumulative impacts of other activities were also considered in this evaluation. Implementation of the Preferred Alternative would not be anticipated to substantially cumulatively or synergistically interact with climate change or other potential cumulative effects.

Due to the absence of significant adverse environmental impacts, a preparation of an Environmental Impact Statement will not be required.

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Jason E. Kelly, PMP Date

Colonel, Corps of Engineers, Commanding

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