

# Continuing Authorities Program, Section 206, Aquatic Ecosystem Restoration, Belle Isle State Park, Lancaster, Virginia



## Final Integrated Feasibility Report/ Environmental Assessment



**US Army Corps  
of Engineers**®  
Norfolk District



OCTOBER 29, 2021

## FINDING OF NO SIGNIFICANT IMPACT

### CONTINUING AUTHORITIES PROGRAM, SECTION 206 AQUATIC ECOSYSTEM RESTORATION BELLE ISLE STATE PARK LANCASTER, VIRGINIA

The U.S. Army Corps of Engineers, Norfolk District (USACE) has conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended. The Final Integrated Feasibility Report and Environmental Assessment (IFR/EA) dated 29 October 2021, for the Continuing Authorities Program, Section 206 Aquatic Ecosystem Restoration, Belle Isle State Park Feasibility Study addresses restoration of eastern oyster (*Crassostrea virginica*) reef habitat, tidal wetland and Atlantic ribbed mussel (*Geukensia demissa*) habitat, and avian shoreline habitat located in Lancaster, Virginia.

The Final IFR/EA, incorporated herein by reference, evaluated various alternatives that would restore approximately 0.2 acres of oyster reef habitat, 1.1 acres of wetland habitat (including mussel restoration), 0.6 acres of Atlantic ribbed mussel habitat in existing wetland habitat, and restoration of 0.3 acres of avian shoreline habitat. The Recommended Plan is the National Ecosystem Restoration (NER) Plan and includes:

- Construction of oyster reef structures using artificial reef structures approximately 30 feet offshore from the existing shoreline;
- Restoration of historic wetland habitat by regrading and planting native cordgrass (*Spartina alterniflora*) containing native Atlantic ribbed mussels;
- Restoration of the shoreline by placing coir logs and planting native plant species; and
- Enhancing wetlands and restoring native Atlantic ribbed mussel habitat by planting additional cordgrass with Atlantic ribbed mussels.

In addition to a No Action/Future Without Action Alternative, sixteen alternatives were evaluated.<sup>1</sup> The alternatives included oyster reef habitat restoration, Atlantic ribbed mussel restoration, beach shoreline restoration, bank grading, bank filling, wetland restoration and varying combinations of the six measures. The alternatives were evaluated on their ability to provide the greatest ecological benefits to fish and wildlife resources, ecological connectivity, sustainability and for a reasonable budget. The final alternatives that were carried forward for detailed analysis included the No Action/Future Without Action Alternative and the Alternative 2-3-6 which combined oyster reef and Atlantic ribbed mussel restoration, as well as wetland and beach shoreline restoration.

For all alternatives, the potential effects were evaluated, as appropriate. A summary assessment of the potential effects of the Recommended Plan (Preferred Alternative),

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<sup>1</sup> 40 CFR 1505.2(b) requires a summary of the alternatives considered.

Alternative 2-3-6, are listed in Table 1:

**Table 1: Summary of Potential Effects of the Recommended Plan, Alternative 2-3-6**

	Insignificant effects	Insignificant effects as a result of mitigation*	Resource unaffected by action
Aesthetics	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Air quality	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Aquatic resources/wetlands	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Invasive species	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fish and wildlife habitat	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Threatened/Endangered species/critical habitat	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Historic properties	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other cultural resources	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Floodplains	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hazardous, toxic & radioactive waste	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hydrology	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Land use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Navigation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Noise levels	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Public infrastructure	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Socioeconomics	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Environmental justice	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Bathymetry	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Insignificant effects	Insignificant effects as a result of mitigation*	Resource unaffected by action
Tribal trust resources	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Water quality	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Climate change	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Geology	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Recreation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Occupational Health	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vegetation, Wetlands, and Submerged Aquatic Vegetation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

All practicable and appropriate means to avoid or minimize adverse environmental effects were analyzed and incorporated into the Recommended Plan. Best management practices (BMPs) as detailed in the IFR/EA would be implemented, if appropriate, to minimize impacts<sup>2</sup>. A detailed list of BMP's is included in Table 4-4 of the IFR/EA. Some of these include the use of turbidity curtains, geese fencing, careful placement of materials/equipment and time of year recommendations for the vegetation plantings and oyster reef structures.

Because the Recommended Plan is an environmental restoration project, no compensatory mitigation would be required as part of the Recommended Plan.

Public review of the draft IFR/EA and Finding of No Significant Impact (FONSI) was completed on 26 January 2021. All comments submitted during the public review period were addressed in the Final IFR/EA and FONSI.

Pursuant to Section 7 of the Endangered Species Act of 1973, as amended, the U.S. Army Corps of Engineers (USACE) determined that the Recommended Plan would have no effect to the federally listed northern long-eared bat (*Myotis septentrionalis*), which is under the jurisdiction of the U.S Fish and Wildlife Service (USFWS). There would be no effect to federally listed critical habitat under the jurisdiction of the USFWS. The USFWS concurred with the determination on 1 December 2020.

Pursuant to Section 7 of the Endangered Species Act of 1973, as amended, the USACE also determined that the Recommended Plan may affect, but is not likely to adversely affect, the following federally listed species or their designated critical habitat under the jurisdiction of the National Marine Fisheries Service (NMFS): the Atlantic sturgeon (*Acipenser oxyrinchus*), shortnose sturgeon (*Acipenser brevirostrum*), leatherback sea turtle (*Dermochelys coriacea*),

Kemp's ridley sea turtle (*Lepidochelys kempii*), hawksbill sea turtle (*Eretmochelys imbricate*), and loggerhead sea turtle (*Caretta caretta*). The NMFS concurred with the determination on 21 September 2020.

Pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, the USACE determined that historic properties would not be adversely affected by the Recommended Plan. The Virginia Department of Historic Resources (VDHR) concurred with the determination on 20 November 2020.

Pursuant to the Clean Water Act of 1972, as amended, the discharge of dredged or fill material associated with the Recommended Plan has been found to be compliant with the Clean Water Act Section 404(b)(1) Guidelines (40 CFR 230). The 404(b)(1) Guidelines evaluation is found in the Environmental Appendix of the IFR/EA.

The State Water Control Board issued conditional §401 Water Quality Certification for Nationwide Permit (NWP) 27 Aquatic Habitat Restoration, Enhancement, and Establishment Activities (effective date 19 March 2017) as meeting the requirements of the Virginia Water Protection Permit Regulation. A copy of the NWP 27 including terms and conditions is provided in the Integrated Report/Environmental Assessment Appendix A, Environmental Appendix. The Recommended Plan appears to meet the requirements of the NWP 27 and its associated Water Quality Certification, pending confirmation based on information to be developed during the Design and Implementation Phase. Therefore, this provides reasonable assurance that a Water Quality Certification pursuant to Section 401 of the Clean Water Act could be issued for the Recommended Plan from the VDEQ. A Water Quality Certification pursuant to Section 401 of the Clean Water Act would be obtained from the VDEQ prior to construction. All conditions of the Water Quality Certification would be implemented in order to minimize adverse impacts to water quality.

The VDEQ provided a determination of consistency with the Virginia Coastal Zone Management program pursuant to the CZMA on 09 February 2021. All conditions of the consistency determination will be implemented in order to minimize adverse impacts to the coastal zone.

All applicable environmental laws have been considered and coordination with appropriate agencies and officials has been completed. Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act, coordination has been completed with NMFS. The USACE determined that there would be negligible to minor adverse effects to Essential Fish Habitat (EFH) for various life stages of eight fish species that may be present in the vicinity of the project site in the Rappahannock River. The NMFS provided a concurrence determination on 11 December 2020.

Technical, environmental, and cost effectiveness criteria used in the formulation of alternative plans were those specified in the Water Resources Council's 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. All applicable laws, executive orders, regulations, and local government plans were considered in evaluation of alternatives.<sup>3</sup> Based on this report, the

reviews by other federal, state and local agencies, tribes, input of the public, and the review by my staff, it is my determination that the Recommended Plan would not cause significant adverse effects on the quality of the human environment; therefore, preparation of an Environmental Impact Statement is not required.<sup>4</sup>

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Date

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BRIAN P. HALLBERG, PMP  
COL, EN  
Commanding

<sup>2</sup> 40 CFR 1505.2(C) all practicable means to avoid and minimize environmental harm are adopted.

<sup>3</sup> 40 CFR 1505.2(B) requires identification of relevant factors including any essential to national policy which were balanced in the agency decision.

<sup>4</sup> 40 CFR 1508.13 states the FONSI shall include an EA or a summary of it and shall note any other environmental documents related to it. If an assessment is included, the FONSI need not repeat any of the discussion in the assessment but may incorporate by reference.

## EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (USACE), Norfolk District initiated this study in 2004 at the request of the non-Federal sponsor, the Commonwealth of Virginia's Department of Conservation and Recreation (VDNR). The USACE is the lead Federal agency for this study. Due to funding issues and program scope changes, the project restarted again in 2017.

At Belle Isle State Park, there has been a substantive loss of tidal wetland and beach shoreline habitats as the shoreline has retreated an estimated 0.84 feet per year based on review of aerial imagery from 1937 - 2017. Based on the estimated rate of shoreline loss, the tidal wetland and beach habitats are at high risk of loss. The tidal wetland and beach shoreline habitats provide wildlife habitat for a diverse community that includes migratory birds, fishery resources, reptiles, and mammals. Ecological connectivity and wildlife corridors in these habitats are crucial for species utilizing both the wetland and beach shoreline habitats. Concurrent with the loss of tidal wetlands, there has been a loss of native Atlantic Ribbed Mussels (*Geukensia demissa*) that are important components of the tidal wetland community along the shoreline. In addition to the wetland loss, there has been a substantive loss of beach shoreline habitat that provides important wading bird foraging habitat for federally protected migratory birds. The reduction in the beach/shoreline interface has adversely affected the biodiversity of the aquatic ecosystem and is limiting migratory bird foraging and stopover habitat. There has been a substantive loss of native eastern oyster (*Crassostrea virginica*) reef habitat due to overfishing and disease; populations are a fraction of historic levels. There has been only limited oyster restoration in this tributary. The loss of reef habitat adversely affects local fish and invertebrate communities and productivity of food web dynamics.

The Continuing Authorities Program (CAP) Section 206 feasibility studies must evaluate measures to restore aquatic ecosystems for fish and wildlife. This report identifies the alternatives that were considered to address this problem. During the feasibility phase, a total of sixteen action alternatives were considered that included the following measures: oyster reef restoration, Atlantic ribbed mussel restoration, tidal wetland restoration, bank restoration, and beach shoreline restoration.

Alternative 2-3-6, the Recommended Plan (Preferred Alternative), consists of oyster reef restoration, Atlantic ribbed mussel restoration at the existing wetland sites, wetland restoration at historic wetland loss sites (including mussel restoration) and beach shoreline restoration.

The Recommended Plan will cost approximately \$6,161,000 (Total Project Cost Fully Funded), with the 65% Federal cost share of \$4,004,650 and 35% non-Federal cost share of \$2,156,350. The Recommended Plan (or Preferred Alternative) is the National Ecosystem Restoration (NER) Plan and a best-buy plan. The ecological benefits associated with the Recommended Plan would include an estimated 9.02 habitat units.

## LIST OF ACRONYMS AND ABBREVIATIONS

**AAC** – Average Annual Cost  
**AAHUs** – Average Annual Habitat Units  
**AM** – Adaptive Management  
**AOU** – American Ornithologists' Union  
**APP** – Accident Prevention Plan  
**AQCR4** – Air Quality Control Region 4  
**ASA** – Assistant Secretary of the Army  
**BCE** – Before Common Era  
**BMP** – Best Management Practice  
**CAP** – Continuing Authorities Program  
**CE** – Common Era  
**CE/ICA** – Cost Effectiveness Incremental Cost Analysis  
**CEQ** – Council on Environmental Quality  
**CERCLA** – Comprehensive Environmental Response, Compensation and Liability Information System  
**CFR** – Code of Federal Regulation  
**CZMA** - Coastal Zone Management Act  
**dBA** – A-weighted decibel  
**DNL** – Day-Night Average Sound Level  
**DoD** – Department of Defense  
**DPS** – Distinct Population Segments  
**EA** – Environmental Assessment  
**ECO-PCX**- National Ecosystem Planning Center of Expertise  
**EFH** - Essential Fish Habitat  
**EO** – Executive Order  
**EPCRA** – Emergency Planning and Community Right-to-Know Act  
**ER** – Engineering Regulation  
**ESA** - Endangered Species Act  
**FAA** – Federal Aviation Administration  
**FEMA** – Federal Emergency Management Agency  
**FIRM** – Flood Insurance Rate Map  
**FONSI** - Finding of No Significant Impact  
**FOR** – Friends of the Rappahannock  
**FWCA** - U.S. Fish and Wildlife Coordination Act  
**FWOP** – Future Without Project  
**GIS** – Geographic Information Systems  
**HAB** – Harmful Algal Bloom  
**HU** – Habitat Unit  
**HTRW** – Hazardous, Toxic & Radioactive Waste  
**H&H** – Hydrology and Hydraulics  
**IFR/EA** – Integrated Feasibility Report/Environmental Assessment  
**IBI** – Index of Biological Integrity Score  
**IDC** – Interest During Construction  
**IPCC** – Intergovernmental Panel on Climate Change  
**LER** – Lands, Easements, and Rights-of-Way  
**LERRD** - Lands, Easements, Rights-of-Way, Relocations, and Disposal  
**MBTA** – Migratory Bird Treaty Act  
**MMPA** – Marine Mammal Protection Act  
**MSFCMA** - Magnuson-Stevens Fishery Conservation and Management Act

**MSL** – Mean Sea Level  
**MLLW** – Mean Lower Low Water  
**NAAQS** - National Ambient Air Quality Standards  
**NAVD** - North American Vertical Datum  
**NEPA** - National Environmental Policy Act  
**NER** – National Ecosystem Restoration  
**NHPA** - National Historic Preservation Act  
**NMFS** - National Marine Fisheries Service  
**NOAA** – National Oceanographic and Atmospheric Administration  
**NRHP** - National Register of Historic Places  
**O&M** - Operation and Maintenance  
**OMRR&R** - Operations, Maintenance, Repair, Rehabilitation and Replacement  
**OSHA** – Occupational Safety and Health Administration  
**PDE** – Partnership for the Delaware Estuary  
**PDT** – Project Delivery Team  
**PED** – Preconstruction, Engineering & Design  
**PPE** – Personal Protective Equipment  
**P&G** – Principles and Guidelines  
**RCRA** – Resource Conservation & Recovery Act  
**ROI** – Region of Influence  
**RSLR** – Relative Sea Level Rise  
**SARA** – Superfund Amendments and Reauthorization Act  
**SAV** - Submerged Aquatic Vegetation  
**SIP** – State Implementation Plan  
**TMDL** – Total Maximum Daily Load  
**TRI** – Toxics Release Inventory  
**TSP** – Tentatively Selected Plan  
**TSS** - Total Suspended Solids  
**USACE** – United States Army Corps of Engineers  
**USEPA** – U.S. Environmental Protection Agency  
**USFWS** - U.S. Fish and Wildlife Service  
**USGS** - United States Geological Survey  
**VDCCR** – Virginia Department of Conservation and Recreation  
**VDEQ** - Virginia Department of Environmental Quality  
**VDHR** - Virginia Department of Historic Resources  
**VDH** - Virginia Department of Health  
**VDOT** - Virginia Department of Transportation  
**VDWR** - Virginia Department of Wildlife Resources  
**VEC** – Virginia Employment Commission  
**VIMS** - Virginia Institute of Marine Science  
**VMRC** – Virginia Marine Resources Commission  
**WRDA** - Water Resources Development Act

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# 1. INTRODUCTION

This Final Integrated Feasibility Report and Environmental Assessment (IFR/EA) has been completed to present the study process and the engineering, economic, environmental, and socio-economic considerations used to select a plan, including identification of the National Ecosystem Restoration (NER Plan) for the Aquatic Ecosystem Restoration at Belle Isle State Park in Lancaster County, Virginia. The study area is located on the north bank of the Rappahannock River (Figure 1-1).

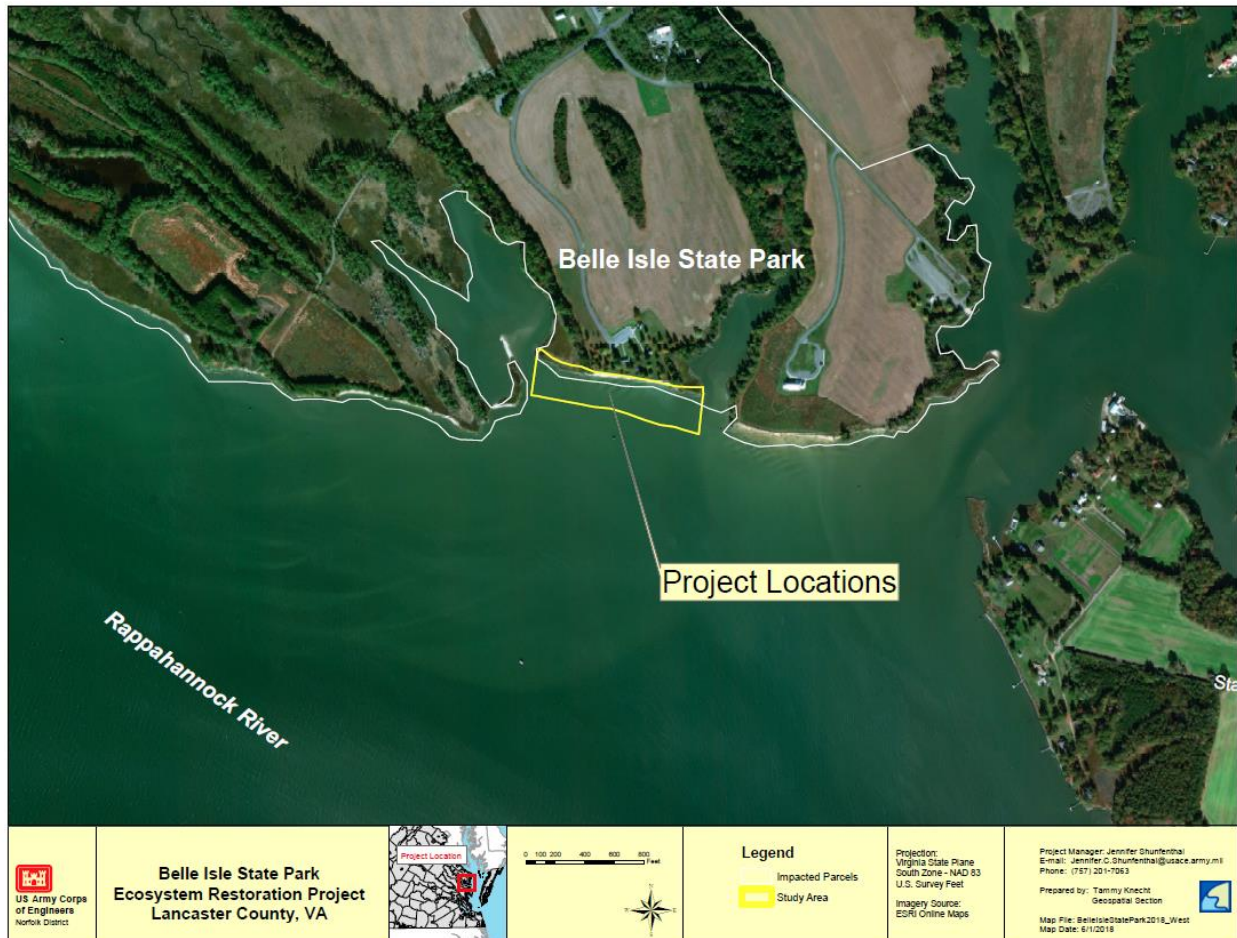


Figure 1-1. Map of Study Area

## 1.1 STUDY AUTHORITY

The Continuing Authorities Program (CAP) is a collection of programmatic authorities for USACE to plan, design, and construct limited water resource and environmental restoration projects without specific congressional authorization. The CAP focuses on water resource related projects of relatively smaller scope, cost, and complexity than traditional USACE civil works projects that are specifically authorized by Congress.

The proposed project at Belle Isle State Park would be constructed in accordance with USACE

obligations under CAP Section 206, Aquatic Ecosystem Restoration, of the Water Resources Development Act (WRDA) of 1996. Section 206 is as follows:

(1) In general

The Secretary may carry out a project to restore and protect an aquatic ecosystem or estuary if the Secretary determines that the project--

- (A) (i) will improve the quality of the environment and is in the public interest; or  
(ii) will improve the elements and features of an estuary (as defined in section 2902 of this title); and

(B) is cost-effective.

## 1.2 FEDERAL POLICY AND PROCEDURES

The Belle Isle State Park Aquatic Ecosystem Restoration Project, CAP Section 206, Lancaster County, Virginia Study (the “Study”) analyzes proposed measures for aquatic ecosystem restoration along the Rappahannock River pursuant to the authority of Section 206. The project will also be built in accordance with:

- USACE Planning Guidance Book (Engineering Regulation (ER) 1105-2-100)
- USACE Procedures for Implementing the National Environmental Policy Act (NEPA; ER 200-2-2)
- The Clean Water Act of 1977, as amended
- The National Historic Preservation Act of 1966, as amended (PL-96-515)
- The Archaeological and Historical Preservation Act of 1974, as amended (PL-93-291)
- Section 404 of the Clean Water Act
- The NEPA of 1969, as amended (PL-90-190)
- The Clean Air Act of 1970, as amended
- The Coastal Zone Management Act of 1972
- The Estuarine Protection Act
- The Fish and Wildlife Coordination Act, as amended
- The Endangered Species Act of 1973
- The Council on Environmental Quality (CEQ) Regulations for Implementation of NEPA (40 Code of Federal Regulations [CFR] parts 1500-1508)
- Executive Orders #11593 (Protection and Enhancement of the Cultural Environment), #13112 (Invasive Species), #11988 (Floodplain Management), #12898 (Environmental Justice) and #11990 (Protection of Wetlands).

## 1.3 STUDY PURPOSE AND SCOPE

The purpose of the study is to evaluate alternatives for aquatic ecosystem restoration in Belle Isle State Park, and to recommend a plan for construction.

### 1.3.1 Study Area

Belle Isle State Park, a 733-acre site in the rural Northern Neck of Virginia, was the first state park to be purchased with funds from the \$95 million 1992 Parks and Recreational Facilities

Bond Referendum. The waterfront on the lower Rappahannock River has been extensively developed by private landowners with little public recreational access, so the park is an important resource in the area. Belle Isle State Park is located in the rural Northern Neck of Virginia along the Rappahannock River in Lancaster County. The habitat within the park includes nontidal and tidal wetlands, active shorelines, lowland marshes, tidal coves, and upland forests within the Rappahannock River. The site is approximately 120 miles southeast of Washington, D.C., and 71 miles northwest of Norfolk, Virginia.

The study area, shown in Figure 1-1, is approximately 600 feet of eroding shoreline, including the marsh and wetland habitat along the east bank of the Rappahannock River near its confluence with Deep Creek. The study area is approximately 190 yards in length south of a playground and picnic area of the park. The study area was originally identified in 2004 by the non-Federal sponsor due to erosion and habitat degradation caused by high wave energy. The area historically has had substantive wetland and beach habitat loss. There was originally another area identified for study in 2004 but during a lull in the project time frame, the Virginia Department of Transportation (VDOT) began a project in that study area. Therefore, the scope project area of this feasibility study is limited to the area shown in Figure 1-1.

### 1.3.2 Purpose and Need for USACE Action

Belle Isle State Park includes seven miles of frontage on the northern shore of the Rappahannock River, and borders Deep and Mulberry Creeks. Areas within the Chesapeake Bay system, such as the Rappahannock River, are continually eroded by wave action, tidal currents, and waves generated by high winds from hurricanes and large storms. The park's historical wetlands and ecosystems along the shoreline are continually degraded as shoreline continues to be lost from wave action and erosion.

Bulkheads, groins, and riprap revetments have been used by private landowners on the Rappahannock River to stabilize their existing property and to stop the continued land loss. These methods, however, can cause sediment transportation and further degradation to the aquatic environment.

### 1.3.3 Scope

The study scope included an investigation of the habitats present in the study area and structural and nonstructural measures as possible alternatives. Features of the project include wetland restoration, bank restoration, oyster reefs, and mussel reefs.

## 1.4 PROBLEMS, OPPORTUNITIES, OBJECTIVES, AND CONSTRAINTS

### 1.4.1 Problems

There are various problems that could be addressed by an aquatic ecosystem restoration project at Belle Isle State Park, including:

- The accelerated rate of shoreline retreat (Figure 1-2) in the study area is estimated at 0.84 ft/yr. over the past 80 years (1937-2017). It has caused a loss of wetlands and beach/shoreline interface, which is negatively impacting the biodiversity of the aquatic ecosystem and is limiting migratory bird foraging and stopover habitat. The degradation

of the wetland habitat has subsequently caused a loss of Atlantic ribbed mussel populations.

- The shoreline loss has resulted in a loss of ecological connectivity of the tidal wetland and beach shoreline habitats that provide wildlife corridors.
- In the Rappahannock River, there is a substantive loss of oyster reef habitat due to overfishing and disease; populations are at a fraction of historic levels.
- The loss of fish and nursery habitat for recreational and commercial fishery species add to the aquatic issues within this tributary.

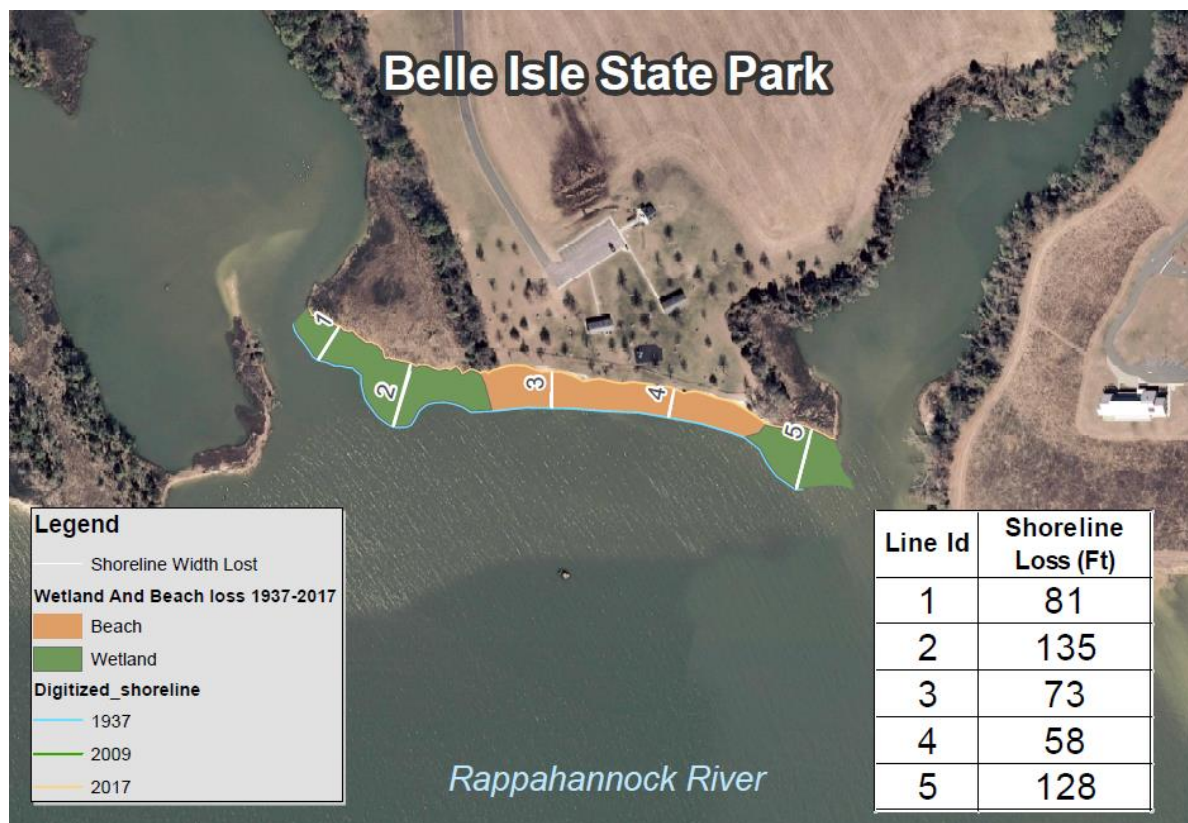


Figure 1-2. Since 1937 there has been an average of 95 feet of total shoreline loss at the project site at a rate of 0.84ft/yr.

### 1.4.2 Opportunities

An ecosystem restoration project at Belle Isle State Park could address the following opportunities:

- Create a self-sustaining tidal wetland and beach/shoreline interface habitat that would help restore the area’s historic aquatic biodiversity, native oyster and fish populations, and migratory bird (shoreline and wading birds) foraging and stopover habitat.
- Restore and improve habitat for the native Atlantic ribbed mussel population.
- Increase recreational opportunities such as beach and picnic areas, wading, and reef fishing.
- Increase public awareness and promote educational programs at Belle Isle State Park

regarding the importance of the oyster and mussel reefs.

- Have Belle Isle State Park staff and volunteers assist in the restoration effort such as planting native grass and plant species at the site or other components of the restoration project as appropriate.

### 1.4.3 Objectives

The main objective of the study is the restoration of aquatic habitat that will support a self-sustaining estuarine system at Belle Isle State Park. Specific objectives pertaining to the aquatic habitat and resources in the study area include:

- Restore native oyster reef habitat to increase the oyster population and increase fish abundance and diversity.
- Restore tidal wetland shoreline habitats that support native wetland vegetation and the associated invertebrate community including native Atlantic ribbed mussel habitat.
- Restore the river-shoreline interface that provides important stopover and foraging habitat for migratory shoreline and wading avian species.

### 1.4.4 Constraints and Considerations

Planning constraints are defined as any policy, technical, environmental, economic, social, regional, local, or institutional considerations that act to restrict or otherwise impact the planning process. Typical general constraints include state-of-the-art limitations, time, money, uncertainty of the future, policy, and the inaccuracies inherent in design procedures on which alternative plans are based. A summary of the formulation and evaluation criteria for environmental restoration options used in this study is presented in Chapter 2, Plan Formulation. These criteria involve physical, economic, environmental, and social factors that tend, in varying degrees, to constrain the options and/or ultimate selection of a restoration plan or plans for the Belle Isle State Park Project. Although all of the formulation and evaluation criteria were considered for the various alternatives, constraints include:

- Adverse impacts to bottom lands, coastal zones, and aquatic resources should be avoided or minimized;
- Adverse effects to navigation channels should be avoided;
- Adverse impacts to cultural/historic resources that may exist in the eroding banks should be avoided or minimized;

There are also some conditions and potential limitations that did not affect plan formulation as constraints but still were important considerations as plans were formulated and evaluated.

These considerations include:

- Suitable substrate is necessary for the success of the artificial and natural reef structures (such as oyster reef balls);
- Impacts on existing habitat during construction should be minimized;
- Availability of suitable materials;
- Likely public use of the beach located within the site;
- Existing infrastructure may affect project design; and
- Potential impacts to private oyster leases.

## 1.5 STUDY PARTICIPANTS AND COORDINATION

The USACE is responsible for conducting the overall study in cooperation the non-Federal sponsor, the Commonwealth of Virginia’s Department of Conservation and Recreation (VDCR). The USACE is the lead Federal agency for NEPA compliance.

## 1.6 PRIOR STUDIES AND REPORTS

The USACE has prepared one other aquatic ecosystem restoration report in the study area vicinity: The Section 510 Program, Rappahannock River, VA Oyster Restoration project.

### **SECTION 510 PROGRAM, RAPPAHANNOCK RIVER, VA OYSTER RESTORATION**

The Section 510 Program is authorized under the Water Resources Development Act (WRDA) of 1996, as amended. The Rappahannock River, VA Oyster Restoration project involved oyster restoration in the lower Rappahannock River, a major Virginia tributary to the Chesapeake Bay and once a very productive oyster producing area. Initial headquarters approval was received on 1 November 1999 of the Decision Document and associated EA. In 2001, three acres of oyster shell reefs were constructed over a clam shell base. These acres are sanctuary reefs and are mounds from 3-6 feet high over individual one-acre sites.

## 1.7 EXISTING WATER PROJECTS

Approximately 90 acres of oyster ground and an additional 3 acres of sanctuary reef were constructed by USACE as part of the Chesapeake Bay Oyster Recovery Program and Section 510 Program. Additional restoration projects along the Rappahannock River are spearheaded by various environmental groups. For instance, Friends of the Rappahannock (FOR) has multiple ecosystem restoration programs along the Rappahannock River that work to protect and restore the ecosystem services and include oyster reef sanctuaries (FOR, 2020).

## 1.8 NEPA SCOPING AND PUBLIC, AGENCY, AND TRIBAL COORDINATION

### 1.8.1 NEPA Scoping

The project was initiated with VDCR in 2004, however, due to funding issues the study was not completed at that time. Scoping was re-started with other federal agencies such as USFWS, NMFS and the USEPA in 2018. Additional scoping was completed with comments from educational institutions such as the Virginia Institute of Marine Science and Christopher Newport University in 2018. The Virginia Department of Health (VDH) also provided scoping comments on September 10, 2018. A public meeting was not held, therefore, there were no public comments received.

### 1.8.2 Resource Agencies

The USACE initiated Fish and Wildlife Coordination Act consultation with the USFWS on 16 August 2020; a Fish and Wildlife Coordination Act Report was provided on 1 December 2020 which designates compliance with the Fish and Wildlife Coordination Act. The report is provided in the Environmental Appendix.

Pursuant to the Endangered Species Act (ESA), Section 7, the USACE coordinated with the USFWS on 30 October 2020, using the Information, Planning and Consultation (IPaC) system. The USFWS concurred that there would be no effects to listed species or critical habitat under

their jurisdiction in letter submitted on December 1, 2020 to the USACE. A copy of the letter is provided in the Environmental Appendix.

Also pursuant to ESA Section 7, the USACE submitted a “Not Likely to Adversely Affect” Verification Form to NMFS for species and critical habitats under the jurisdiction of the NMFS, September 21, 2020. The NMFS responded on September 24, 2020, concurring that the Recommended Plan may affect but is not likely to affect federally listed species and would not adversely modify critical habitat under the jurisdiction of the NMFS. This concluded ESA, Section 7 consultation with the NMFS; and a copy of the signed form is provided in the Environmental Appendix.

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended October 11, 1996, requires all federal agencies to consult with the National Marine Fisheries Service (NMFS) of the National Oceanic and Atmospheric Administration on all actions, or proposed actions, permitted, funded, or undertaken by the agency, that may adversely affect Essential Fish Habitat (EFH). The USACE submitted the Essential Fish Habitat Assessment on September 23, 2020 and received a concurrence on December 11, 2020.

The Draft Integrated Feasibility Report/Environmental Assessment (IFR/EA) was released on the USACE public website and was published in the local newspaper and notifications to federal, state, and local agencies and tribal governments were sent via both hard copy letters and email notifications (where possible) to appropriate parties. No public comments were received on the Draft IFR/EA. Agency comments were received, and responses are provided in the Environmental Appendix.

The Draft IFR/EA contains the CZMA Federal Consistency Determination Report (within Environmental Appendix). The VDEQ provided its federal consistency concurrence on February 9, 2021.

### 1.8.3 Tribal Coordination

National Historic Preservation Act, Section 106 consultation has been completed. Initial scoping letters were sent to the Virginia Department of Historic Resources (VDHR) on June 23, 2010 and November 30, 2010. The VDHR’s finding was that the historic properties within the Area of Potential Effects would not be adversely affected by the undertaking on the project site. Letters to the Rappahannock tribe and Delaware Nation were sent on April 15, 2019 and a letter to the Pamunkey tribe was sent on April 16, 2019. Tribal nations were consulted due to the presence of two cultural resources within the project site. Additional letters to update the tribes and DHR were sent on October 21, 2020 with the Recommended Plan. Concurrence letters were received from the Pamunkey tribe on November 13, 2020 and VDHR on November 20, 2020. All correspondence is provided in Cultural Resource Appendix.

## 1.9 HISTORY OF PROJECT

This feasibility study was initiated in 2004. When the study began, it was fully federally funded. Since that time, the structure of the CAP has changed, and studies became cost-shared under the revised program. As the program became cost-shared, there were starts and stops to the project due to funding conflicts. In 2010, the study was re-started and in May 2010, the USACE conducted a preliminary subsurface exploration at the project site in support of the feasibility

study. In 2011, the study was paused and was not re-started until 2017.

Previous measures developed for this study relied heavily on hardened structural measures (i.e. breakwaters, revetments, seawalls, and groins) to reduce the shoreline erosion that has affected the aquatic habitat in the study area. Other alternatives previously considered measures such as beach-fill and wetland plantings.

The current Recommended Plan as described in this Final IFR/EA includes measures to restore and protect the ecosystem using a natural approach with native plantings and reef habitat restoration versus a structural approach. The current plan includes oyster reef restoration, wetland restoration, Atlantic ribbed mussel restoration, and shoreline restoration.

## 2. AFFECTED ENVIRONMENT

This chapter describes the existing environmental and socioeconomic conditions found within the Region of Influence (ROI), the area of potential impact of the project alternatives. This chapter has been prepared in accordance with the NEPA and the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulation (CFR) 1500-1508), regulations. This EA has been prepared under the procedural provisions of NEPA (40 CFR 1500-1508) that were last amended in 2005 as this project was initiated prior to September 14, 2020.

This section summarizes the existing (baseline) conditions, to provide a sound basis for plan formulation and the impact analysis. The topics in this section are structured to mirror the topics presented in Section 5: Environmental Consequences of the Alternatives, where the “future without project” and “future with project” alternative is evaluated and compared.

Environmental Justice and public infrastructure were considered but dismissed from further analysis because no anticipated impacts would occur with implementation of the alternatives.

### 2.1 AESTHETICS

Aesthetics is referred to as the study of sensory or sensory emotional values, and as a result is subjective by nature.

The visual experience in any locale is dependent upon the pattern of the land (i.e., the topography), the pattern of water bodies, vegetation, and manmade development. Within the ROI, 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.

In order to assess aesthetics, a viewshed must be defined. A viewshed is the area that is visible from a fixed vantage point. The viewshed from areas surrounding the Belle Isle State Park, Lancaster, Virginia, is generally consistent due to the flat topography of the region. The general character of the area is a riverine, rural landscape with little surrounding development. The horizon is typically defined by trees, fields, or open water. The foreground of a viewshed is typically the main focal point and after a few hundred feet, objects in the background tend to fade into the viewshed background, which at Belle Isle State Park it is dominated by undeveloped areas consisting of wetlands, woods or fields and the Rappahannock River. There is some limited development within the ROI including parking lots, stairs, and roadways in the park. Figure 2-1 below provides a visual of the project site.



Figure 2-1. Landscape Features of Project Area, Belle Isle State Park, Lancaster, Virginia.

## 2.2 AIR QUALITY

The ROI for air quality is defined by the U.S. Environmental Protection Agency's (USEPA's) regulatory boundary of the Northeastern Virginia Area, which is comprised of the cities of Charlottesville and Fredericksburg, and the counties of Accomack, Albemarle, Caroline, Culpeper, Essex, Fauquier, Fluvanna, Gloucester, Greene, King and Queen, King George, King William, Lancaster, Louisa, Madison, Mathews, Middlesex, Nelson, Northampton, Northumberland, Orange, Rappahannock, Richmond, Spotsylvania, Stafford, and Westmoreland, Virginia.

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

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

The Clean Air Act Section 176(c)(4) established the General Conformity Rule, which USEPA implemented through rulemaking in 1993 and most recently amended in 2010 (75 FR 17253). The General Conformity Rule implements the Clean Air Act's requirement that federal actions occurring in nonattainment and maintenance areas shall not hinder local efforts to control air pollution. Nonattainment areas are Air Quality Control Regions that are in violation of one or more of the NAAQS. Maintenance areas are Air Quality Control Regions that USEPA previously designated as nonattainment area 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 violate) 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 (USEPA 2015).

The Belle Isle State Park is located within Lancaster County, which is part of the Northeastern Virginia Intrastate Air Quality Control Region (Chapter 20, Section 200). According to the VDEQ Air Division, the project site is located in an ozone attainment area and an emission control area for volatile organic compounds (VOCs) and oxides of nitrogen (NO<sub>x</sub>), which are contributors to ozone pollution.

### 2.3 BATHYMETRY, HYDROLOGY, AND TIDAL PROCESSES

The ROI is any areas that are impacted directly, through excavation, fill, or placement of structures, and indirectly, such as changes in currents or deposition.

The nearshore areas adjacent to the Belle Isle State Park shoreline are characterized by sandy, gently sloping substrate and shallow water depths gradually becoming deeper towards the center of the Rappahannock River (Figure 2-2). Belle Isle State Park is located within the lower to mid portion of the Rappahannock River where the stratification of fresh and saltwater is relatively weak, and mixing occurs over a transition zone seaward of Tappahannock (Kuo and Moustafa 1989). Seasonal hypoxic conditions (dissolved oxygen less than 5 milligrams/liter) typically persist throughout the summer months particularly in deeper portions of the lower reaches of the Rappahannock River (Kuo et al. 1991).

The tidal portions of the Rappahannock River extend to the fall line in Fredericksburg, Virginia. The closest tidal gauge is at Windmill Point located at the confluence of the Rappahannock River and Chesapeake Bay. The mean tidal range based on data collected by the Windmill Point gauge is approximately 1.2 feet; though this may vary substantially with spring and neap tides and due to storm activity, which can create significant storm surges well beyond the normal tidal range.

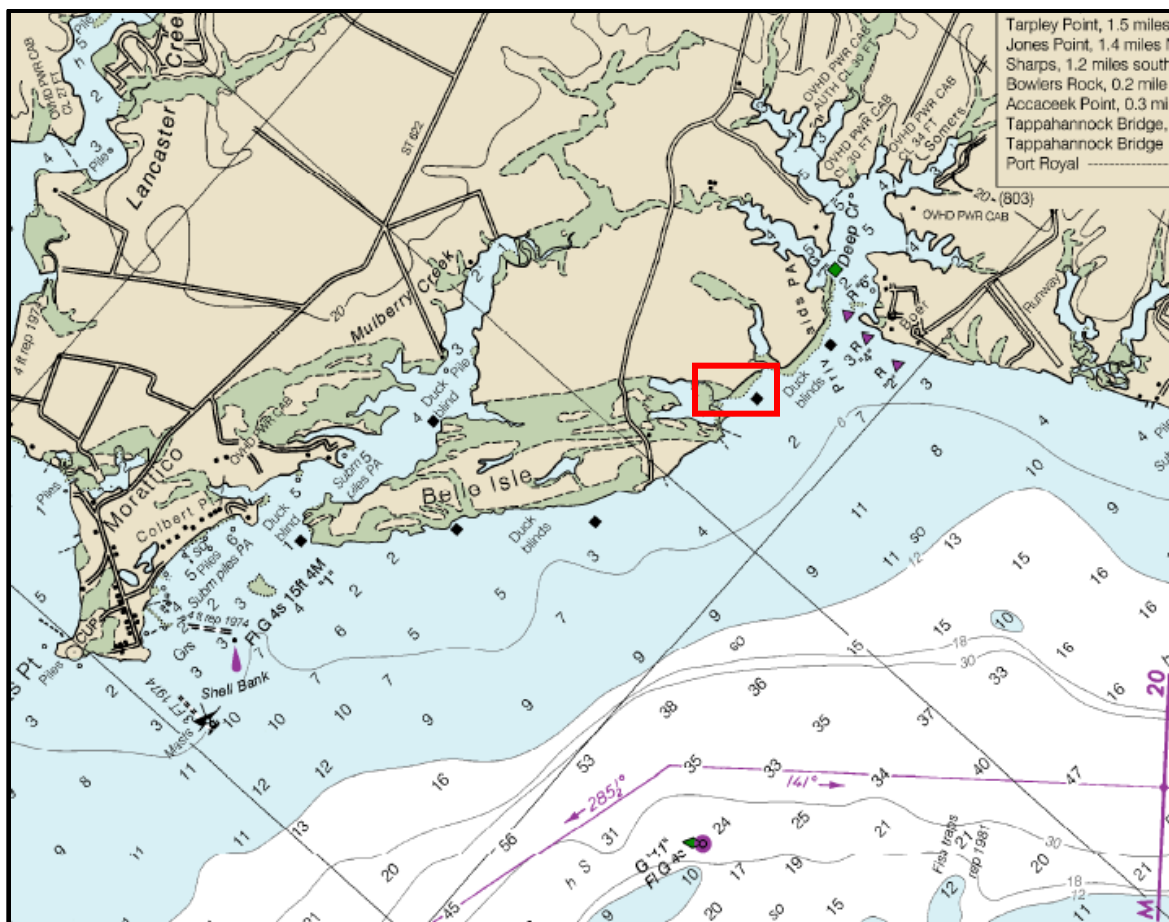


Figure 2-2. Proposed Project Site and Bathymetry of the Region of Influence (NOAA 2019).

## 2.4 BENTHIC FAUNA

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

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

## **Resources in the ROI**

### *Mussel Resources*

The Atlantic ribbed mussel, a filter-feeding bivalve, is native to the Atlantic coast of North America and is commonly found within cordgrass-dominated salt marshes throughout the Chesapeake Bay. Ribbed mussels attach to the stems and roots of *S. alterniflora* using byssal threads, and their distribution within the marsh may be influenced by substrate characteristics such as percentages of sand, silt, clay, and organic matter (Kraus and Crow 1985). Ribbed mussels, which serve as secondary foundation species, enhance biodiversity and specific ecosystem functions locally as well as on larger spatial scales (Angelini et al. 2015). The role of mussels, in terms of stabilizing, influencing nutrient levels of marsh sediments, increasing biomass and facilitating production of cordgrass may vary depending on whether they are located in the marsh flats or at the marsh edge (Bertness, 1984). Bilkovic et al. (2017) conclude that water quality functions, such as filtration and denitrification, are enhanced by ribbed mussel-cordgrass mutualism. Furthermore, their results suggest that water quality may improve as a result of restoring and conserving even fringing marshes with ribbed mussels present (Bilkovic et al. 2017).

### *Oyster Resources*

The eastern oyster is a reef-forming, filter feeding bivalve, native to the Chesapeake Bay. Eastern oysters' function as ecosystem engineers by providing structural reef habitat which supports a diverse assemblage of organisms including fishes, invertebrates, and crustaceans. Oyster reef habitat, in conjunction with other living shoreline approaches, may enhance shoreline protection through wave attenuation. Eastern oysters also filter nutrients from the water column and improve water quality.

The eastern oyster supports an important commercial fishery that includes the harvesting of wild-caught oysters and farm raised oysters in the Chesapeake Bay. Historically, eastern oyster populations once thrived in Chesapeake Bay, however, due to overharvesting, disease, and poor water quality (Wilberg et al. 2011), the current population in the Bay is a fraction of historic levels. State, Federal, and local agencies as well as, nongovernmental organizations, have been successfully implementing programs to increase oyster populations and reef habitat.

There are no Baylor Grounds (designated public oyster ground managed by the Commonwealth of Virginia) or private oyster ground leases located adjacent to the site. The closest private oyster leases are approximately 2 miles from the site and the closest Baylor Grounds are approximately 3 miles from the site.

During site visits conducted in 2019 no live oysters or oyster reefs were observed; however, many oyster shells were located on the beach shoreline.

### *Blue Crab Resources*

The blue crab is a bottom dwelling crustacean that uses all of the Chesapeake Bay's habitats during the course of its life. Distribution varies based on age, sex and season. Although abundant in shallow waters and Bay grass beds during warm weather, it hibernates in the deep trenches of the Bay in winter. The cordgrass-dominated wetlands found in the ROI may provide

some potential nursery habitat for blue crabs. Males spend more time in the fresher waters of the Bay and its rivers, while females congregate in saltier waters. Blue crabs are scavengers and have an opportunistic diet consuming clams, oysters, mussels, smaller crustaceans, freshly dead fish, and plant and animal detritus. They will even eat smaller and soft-shelled blue crabs. Blue crabs are an important recreational commercial fishery and are considered the highest-valued commercial resource in the Chesapeake Bay (CBP 2016b).

#### *Horseshoe Crab Resources*

Horseshoe crabs (*Limulus polyphemus*), are a benthic natural resource found in the Chesapeake Bay. Between 2010 and 2014, over 1.5 million pounds of Horseshoe Crabs were commercially landed in Virginia (NOAA 2016). Horseshoe crabs play an important ecological role in the food web. Horseshoe crab species support several important commercial fisheries, are used for biomedical purposes, and are considered an important food source for migratory shorebirds and sea turtles. The Chesapeake Bay is used in the summer months as a summer nursery area and as an overwintering site in the winter months. Shorebirds primarily feed on horseshoe crab eggs exposed on the surface, but sufficient surface eggs are available only if horseshoe crabs are spawning at high densities. Sea turtles feed on adult horseshoe crabs, but their diet depends on relative abundance of the prey species as well.

This fishery is managed through the Atlantic States Marine Fisheries Commission which has created and amended the Horseshoe Crab Fishery Management Plan. The VMRC (through 4 VAC 20-900-10 et Seq.) has been regulating this fishery resource in accordance with this Commission by establishing licensing requirements and exemptions for the harvesting of horseshoe crabs by hand. The VMRC also established commercial fisheries management measures, including an annual commercial quota for horseshoe crabs that comply with the provisions of the Interstate Fishery Management Plan for Horseshoe Crab (VMRC 2016e).

Although it is uncertain, horseshoe crabs have the potential to occur in the ROI.

#### **Benthic Index of Biological Integrity:**

The existing overall health of the general benthic community in the ROI is evaluated yearly by the Chesapeake Bay Benthic Monitoring Program. This program establishes an Index of Biological Integrity (IBI-Score) for Benthic Habitat in the Chesapeake Bay and its tributaries. In the ROI, there are multiple stations gathering data on this topic (CBBMP 2018). In the most recently published data, the Benthic Habitat or IBI-score for the ROI is degrading, shown in Figure 2-3).

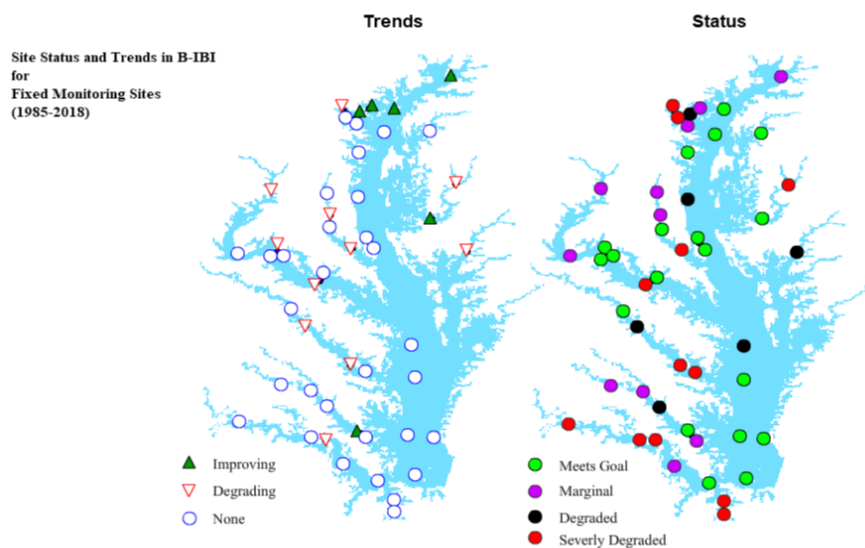


Figure 2-3. Benthic Index of Biological Integrity (IBI-score) in the Region of Influence and throughout the Chesapeake Bay Watershed.

### Plankton Community

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 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, the most abundant phytoplankton in the Rappahannock River are diatoms and dinoflagellates (VIMS 2015).

The abundance of phytoplankton in the river is seasonal with the highest abundance occurring during the spring when the highest concentration of nutrients flow into the River from melting snow and rain events. Nutrient pollution can cause a harmful algal bloom (HAB) which can reduce oxygen levels in the water (VIMS 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 microscopic, free-floating animal life and are the most abundant animals found in the Chesapeake Bay and its surrounding tributaries, including the Rappahannock River (VIMS 2015). Zooplankton form a crucial link in the food chain between the primary producers and higher levels of the food chain. Zooplankton consist 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 including the Rappahannock River (VIMS 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.

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

## 2.5 CULTURAL RESOURCES

Several federal laws and regulations have been established to manage cultural resources, including the National Historic Preservation Act (NHPA) of 1966, the Archeological and Historic Preservation Act of 1974, the American Indian Religious Freedom Act of 1978, the Archeological Resource Protection Act of 1979, and the Native American Graves Protection and Repatriation Act of 1990. In addition, DoD I 4710.02, Department of Defense Interactions with Federally-Recognized Tribes (2006), governs DoD interactions with federally recognized tribes and Executive Order (EO) 13175, Consultation and Coordination with Indian Governments (2000), charges federal departments and agencies with regular and meaningful consultation with Native American tribal officials in the development of policies that have tribal implications. In order for a cultural resource to be considered significant, it must meet one or more of the following criteria for inclusion on the National Register of Historic Places (NRHP):

“The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and: 1) that are associated with events that have made a significant contribution to the broad patterns of our history; or 2) that are associated with the lives or persons significant in our past; or 3) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or 4) that have yielded, or may be likely to yield, information important in prehistory or history” (36 CFR 60.4).

### 2.5.1 Existing Conditions

The ROI is any areas impacted directly or indirectly by construction of the reefs and wetlands, or by changes in historical viewshed.

#### **Regional Archeological Setting**

Earliest human inhabitation of the Americas remains one of the most debated issues in archaeology, but it is well evidenced that Native Americans began to inhabit the Chesapeake Bay Region over 12,000 years ago. Many of the sites left by the ‘Paleo-Indians’ of this period may now be submerged on the bottom of the bay, its tributaries and the Atlantic continental shelf; sea-levels during the Wisconsin Glaciation of the Pleistocene epoch, or Ice Age, were some 400 feet below contemporary levels (Bratton et al. 2002).

During the Archaic Period, 8000–1200 Before Common Era (BCE), populations were evidently low, but grew considerably. The Archaic Period is divided into Early (8000-6500 BCE), Middle (6500 to 3000 BCE) and Late (3000 to 1200 BCE) Archaic Periods. Along with increasing population, there is evidence of an increased diversity in resources hunted and gathered for food, with a particularly notable expansion in fishing and shellfish gathering (Thompson and Worth 2011).

Around 1200 BCE, people in the region began making and using pottery. This marks the beginning of the Woodland Period, also divided into Early (1200-500 BCE), Middle (500 BCE to Common Era (CE) 900), and Late (CE 900-1600) Woodland Periods. Through the Woodland Period populations increased with the expansion of agriculture, as did political hierarchy. The settlement pattern consisted of a series of hamlets strung along the shores of the major estuaries with a larger, often palisaded, chief’s village central to them. This was the state of native culture in the Chesapeake Bay region during the Protohistoric Period to 1600-1650 CE (Turner 1992). John Smith’s map (Figure 2-4), based on observations made in 1608, shows native settlements in the vicinity of the project area (Smith and Hole 1624). The chief’s villages in what is now Lancaster and Richmond Counties were Moraugtacund and Cuttawoman on Smith’s map. The former place name lives on in the community of Morattico just upriver from Belle Isle. The contemporary Rappahannock Tribe considers people living in this area to be among their ancestors (Strickland et al. 2016).

Initial European settlement along the Rappahannock did not begin until 1642, the first being John Carter who settled on the nearby Corrotoman River (Strickland et al. 2016), a name derived from the name of the native village Cuttawoman. Within 20 years the native peoples of the Rappahannock were being hammed in by ever more land claims and settlement of the English. The 17th century boom in Virginia tobacco swelled the colony’s population, and to produce the labor-intensive crop an ever-larger portion of that population was made up of enslaved Africans. Planters grew wealthy on the tobacco trade, and one of the wealthiest was Robert “King” Carter of nearby Corrotoman.

In the mid-18th century William Bertrand had established a plantation at Belle Isle. At the time of his death in 1759 he owned 29 slaves. His estate was left to his grandson Thomas Bertrand Griffin. Thomas prospered and when he passed in 1778 the house was lavishly furnished, and he owned 38 slaves. The property changed hands several times, then in 1786 was bought by

Rawleigh William Downman who added two wings to the main house and gave the property the name “Belle Isle Plantation.”

Lancaster County was spared any major action in the Revolutionary War, War of 1812, and Civil War. There would have been privations as suffered by the general population, along with some occasional foraging soldiers in each of these conflicts. The economy was based on agriculture and fishing. Like many counties in rural eastern Virginia, Lancaster County’s population declined after the 1790 census, as many migrated to the frontier, but less than many other locales in the state. While the population rose in the twentieth century, it was still relatively sparse, and the economy still dominated by agriculture and fishing. Belle Isle Plantation

changed hands several times and was then bought by the state to be made into a park.



Figure 2-4. Section from the Smith-Hole map of 1624 with the Vicinity of Belle Isle Circled in Red.

## 2.5.2 Archaeological Resources

When the state took over the property for a state park, an archaeological assessment was contracted by Wittkofsky et al. (1993). They recorded two archaeological sites in the vicinity of the project, 44LA0154 and 44LA0155. Site 44LA0154 extends along the shoreline for most of the project area, and inshore for up to 75 meters (246 ft.). Artifacts were observed during surface survey in 1993, when the area was cultivated, but in stubble. The artifacts included quartzite debitage, with no diagnostic artifacts (prehistoric, but not otherwise datable) and historic ceramics dating between the late 17th and late 18th centuries. No collections were

made. The site is listed as not evaluated. Site 44LA0155 is submerged in the southwest part of the project area, and surface observations were made at low tide in 1993. Artifacts were all Native American, with a Late Archaic (3000-1200 BCE) component represented by Savannah River type projectile points and a Woodland Period (1200 BCE-1606 CE) component represented by a net impressed pot shard. This site is also listed as unevaluated.

Table 2-1. Phase I Archaeological Survey in the Belle Isle Area (1993 reconnaissance survey not included).

DHR_ID	Site Types	Time Periods	Evaluation Status
44LA0011	Camp, Trash pit	Prehistoric/Unknown (15000 B.C. - 1606 A.D.), 17th Century: 2nd half (1650 - 1699)	null
44LA0014	null	null	null
44LA0015	null	18th Century: 1st half (1700 - 1749)	null
44LA0016	null	17th Century: 2nd half (1650 - 1699)	null
44LA0050	Camp, base, Dwelling, single	Middle Woodland (300 - 999 A.D.), 19th Century: 4th quarter (1875 - 1899), 20th	DHR Staff: Potentially Eligible
44LA0144	Camp	Middle Woodland (300 - 999 A.D.), Late	null
44LA0145	Camp	Middle Woodland (300 - 999 A.D.)	null
44LA0146	Camp	Prehistoric/Unknown (15000 B.C. - 1606	null
44LA0147	Camp, temporary, Dwelling, single, Warehouse	Middle Woodland (300 - 999 C.E), Late	DHR Staff: Eligible
44LA0148	Artifact scatter	Woodland (1000 - 1606), Contact Period	null
44LA0149	Village/Town	Contact Period (1607 - 1750)	null
44LA0150	Outbuilding	Woodland (1200 B.C. - 1606 A.D.)	null
44LA0151	Camp	19th Century (1800 - 1899), 20th Century	null
44LA0152	Camp	Prehistoric/Unknown (15000 B.C. - 1606	null
44LA0153	Camp, Other	Woodland (1200 B.C. - 1606 A.D.)	null
44LA0154	Other	Prehistoric/Unknown (15000 B.C. - 1606	null
44LA0155	Camp	Prehistoric/Unknown (15000 B.C. - 1606	null
44LA0156	Other	A.D.), 17th Century: 2nd half (1650 - 1699)	null
44LA0157	Camp	Prehistoric/Unknown (15000 B.C. - 1606	null
44LA0158	null	Woodland (1200 B.C. - 1606 A.D.), 18th	null
44LA0159	null	Century (1700 - 1799), 19th Century (1800 -	null
44LA0160	null	19th Century (1800 - 1899)	null
44LA0161	null	18th Century (1700 - 1799), 19th Century	null
44LA0162	null	Woodland (1200 B.C. - 1606 A.D.)	null
44LA0163	null	Woodland (1200 B.C. - 1606 A.D.)	null
44LA0164	null	Woodland (1200 B.C. - 1606 A.D.)	null
44LA0165	null	Historic/Unknown	null
44LA0167	Dwelling, single, Other	Late Archaic (3000 - 1201 B.C.), 18th	null
44LA0168	null	Century: 2nd half (1750 - 1799)	null
44LA0169	null	18th Century: 4th quarter (1775 - 1799), 19th	null
44LA0173	null	Century: 1st quarter (1800 - 1825)	null
44LA0174	null	Historic/Unknown	DHR Staff: Not Eligible
44LA0175	null	Historic/Unknown	DHR Staff: Not Eligible
		Prehistoric/Unknown (15000 B.C. - 1606	DHR Staff: Not Eligible
		Late Woodland (1000 - 1606)	DHR Staff: Not Eligible

All of Belle Isle State Park is listed in the NRHP as a historic district in 1971 (DHR ID 051-0001). Contributing are the main residence, parts of which date to 1759. Several other dwellings and associated sheds, barns, and other outbuildings contribute, dating to the 18th through 19th centuries, as well as a garden and a cemetery. Additionally, the house at 1632 Belle Isle Road, which serves as the Belle Isle State Park Office, was determined NRHP eligible in 2000 (DHR ID 051-5092).

## 2.6 CLIMATE CHANGE

The climate of Belle Isle State Park is typical of southeastern Virginia, with mild winters and warm, humid summers. The temperature and weather experienced at the State Park is tempered by its proximity to the Chesapeake Bay and Atlantic Ocean. These large bodies of water are slow in reacting to atmospheric changes, contributing greatly to the humid summers and mild winters. The average annual temperature is approximately 60 degrees Fahrenheit (°F), with ranges from an average of 41°F in January to 79°F in July. Extreme temperatures of 103°F and -5°F have been recorded in the area.

The prevailing winds in Lancaster County are from the northeast and north in February, March, September, and October and south or southwest for the remainder of the year. Average, annual, wind velocity is about 11 miles per hour. Wind velocities may exceed 50 miles per hour during hurricanes, passage of cold fronts, and severe thunderstorms. The entire Chesapeake Bay area is vulnerable to hurricanes, which can cause significant damage to property and shoreline erosion. Ten major hurricanes have been recorded between 1901 and 1986. The Atlantic Coast also experiences large storms from the northeast, called “Nor’easters” that occur during the fall and winter and are characterized by high winds, large waves, and heavy rainfall. These storms can also cause significant erosion and destruction of property.

The average annual precipitation is approximately 42.5 inches and is fairly evenly distributed throughout the year. Hot, dry weather in the summer may cause an occasional drought.

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). 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). 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 mm/yr. 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.

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 et al., 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.

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 2019), which provide guidance to the USACE for how to incorporate sea level change for civil works projects.

The USACE engineering documents require that planning studies and engineering designs

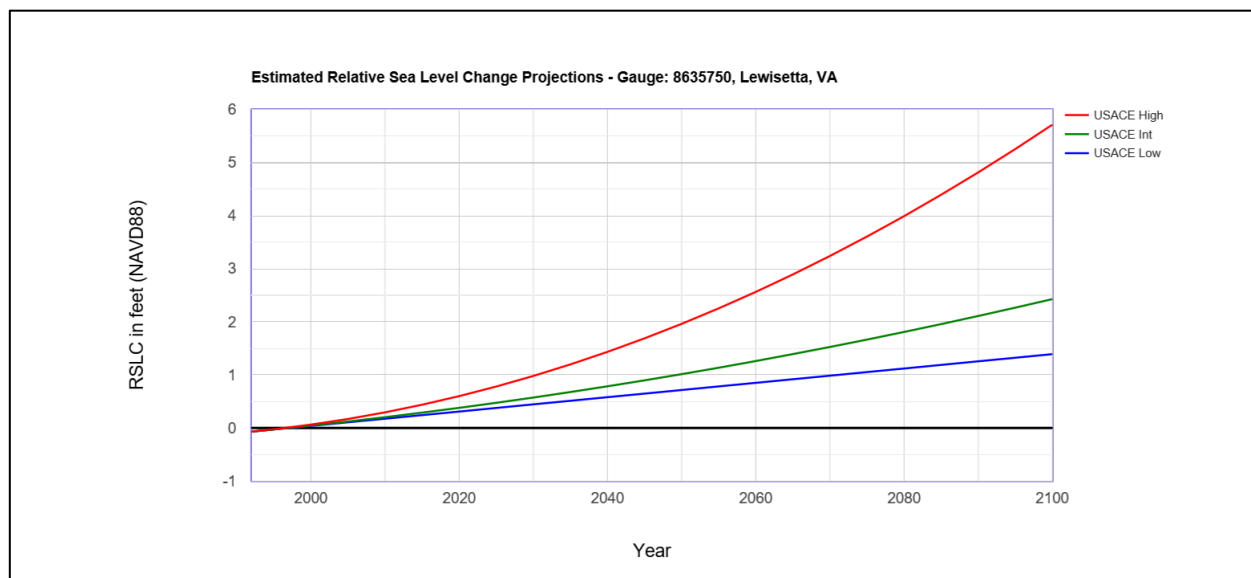


Figure 2-5. Relative Sea Level Rise, Lewisetta, VA, Chesapeake Bay (USACE 2018).

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 2014; USACE 2019). 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. The local rate, determined by the USACE, using the Lewisetta Point tide gauge outside the project ROI, however, the closest gauge to this project site and has been operating for over 40 years, was determined using the USACE sea level rise predictor (USACE 2018). The results can be seen in Figure 2-5.

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). Lancaster County is also prone to significant storm surges roughly every four to five years, which could be influenced by the effects of climate change, increasing in frequency.

## 2.7 FISHERY RESOURCES AND ESSENTIAL FISH HABITAT

### **Fishery Resources and Essential Fish Habitat**

The ROI is any habitat areas that are impacted directly, through excavation, fill, or placement of structures, and indirectly, such as changes in currents or deposition.

Approximately 350 species of fish are known to inhabit the Chesapeake Bay region, with only 32 species considered to be year-round residents of the Chesapeake Bay (CBP 2016a). Resident fishes tend to be smaller than migratory species and are often found in shallow water, where they feed on a variety of invertebrates. Migratory fishes include both anadromous and catadromous species. According to the Virginia Department of Wildlife Resources (VDWR) online database, Fish and Wildlife Information Service, several species of anadromous fish may potentially occur in the vicinity of Belle Isle State Park. These include the federally listed shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) described in further detail in Section 4.17 (Special Status Species), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), striped bass (*Morone saxatilis*), sea lamprey (*Petromyzon marinus*) and gizzard shad (*Dorosoma cepedianum*). The catadromous fish, the American eel (*Anguilla rostrata*), is also found in the Rappahannock River basin.

#### **Atlantic Sturgeon**

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), distinguished by their five rows of bony scutes, are present in coastal waters in the Chesapeake Bay and its tributaries. The New York Bight, Chesapeake Bay, South Atlantic, and Carolina Distinct Population Segments (DPS) of Atlantic Sturgeon are listed as endangered under the ESA, and the Gulf of Maine DPS is listed as threatened. Juvenile, subadult, and adult Atlantic sturgeon have the potential to migrate and forage in the proposed project area. Critical habitat for the Chesapeake Bay DPS of Atlantic sturgeon is present from the mouth of the Rappahannock River up to the U.S. Highway 1 Bridge.

#### **Shortnose Sturgeon**

Shortnose sturgeon (*Acipenser brevirostrum*), are listed as endangered throughout their range under the ESA. Similar to Atlantic sturgeon, shortnose sturgeon are slow growing and late maturing. Adult life stages of shortnose sturgeon may occupy the proposed project area during migration or for foraging purposes. Although shortnose sturgeon have previously been documented in various tributaries of Chesapeake Bay (Balazik et al. 2017), research on the status and life history of them inhabiting the Bay is limited.

#### **Essential Fish Habitat**

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended October 11, 1996, requires all Federal agencies to consult with the National Marine Fisheries Service (NMFS) of the National Oceanic and Atmospheric Administration on all actions, or proposed actions, permitted, funded, or undertaken by the agency, that may adversely affect Essential Fish Habitat (EFH). EFH is defined under the MSFCMA as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” and has been designated in the Rappahannock River for eight fish species. Only specific life stages occur

within the river and would therefore be impacted by a project located within the system. The table below lists fish species and the specific life stage that might be impacted by the proposed project (NMFS 2020a). The “NMFS Essential Fish Habitat Designations” section in the Environmental Appendix describes these species and their associated EFH.

Table 2-2. NMFS Listed Fish Species With Essential Fish Habitat within the Rappahannock River (NMFS 2020a)

Common Name	Scientific Name	Egg	Larvae	Juveniles	Adult
Windowpane flounder	<i>Scopthalmus aquosus</i>			X	
Bluefish	<i>Pomatomus saltatrix</i>			X	X
Summer flounder	<i>Paralichthys dentatus</i>		X	X	X
Atlantic sea herring	<i>Clupea harengus</i>				X
Red hake	<i>Urophycis chuss</i>	X	X	X	X
Winter skate	<i>Leucoraja ocellata</i>				X
Little skate	<i>Leucoraja erinacea</i>				X
Clearnose skate	<i>Raja eglanteria</i>			X	X

## 2.8 FLOOD PLAINS

The ROI is any flood plain areas that are impacted directly, through excavation, fill, or placement of structures, and indirectly, such as changes in currents, flooding, or deposition.

Through Executive Order (EO) 11988, federal agencies are required to evaluate all proposed actions within the 1% annual chance (100-year) flood plain. 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) flood plain should be evaluated for critical actions or facilities, such as storage of hazardous materials or construction of a hospital.

USACE Engineering Regulation (ER) 1165-2-26 – Implementation of EO 11988 on Flood plain Management. This regulation sets forth general policy and guidance for USACE implementation of EO 11988 as it pertains to the planning, design, and construction of Civil Works projects and activities under the Operation and Maintenance and Real Estate Programs. As shown in ER 1165-2-26 and in accordance with EO 11988, USACE uses an eight-step

process as part of the decision-making for projects that have potential impacts to or are within the Base Floodplain. The eight steps and project-specific responses for EO 11988 are discussed further in Chapter 7.

The objective of the EO is the avoidance, to the extent possible, of long and short term adverse impacts associated with the occupancy and modification of the 1% annual chance flood plain and the avoidance of direct and indirect support of development in the 1% annual chance flood plain wherever there is a practicable alternative. Under the EO, USACE is required to provide leadership and take action to avoid development in the flood plain, unless it is the only practicable alternative; reduce the hazard and risk associated with floods; minimize the impact of floods on human safety, health and welfare; and restore and preserve the natural and beneficial values of the 1% annual chance floodplain.

The EO provides an eight-step process to evaluate activities in the flood plain that generally includes a plan to: 1) determine if the proposed action is in the flood plain; 2) provide public review; 3) identify and evaluate practicable alternatives to locating in the 1% annual chance flood plain; 4) identify the impacts of the proposed action; 5) minimize threats to life and property and to natural and beneficial flood plain 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.

Located along the north side of the Rappahannock River, Belle Isle State Park can be impacted by coastal storms, such as tropical systems and nor'easters. The shoreline for the project site is vulnerable to storm surge and wave action, especially from storms and winds generally approaching from a west-northwest to northerly direction. As noted, the shoreline is retreating at approximately 0.84 feet per year. The area is also experiencing ongoing sea level rise and subsidence, such that shoreline retreat will only worsen over time. While not as severe as coastal storms, the park shoreline can also be exposed to high water from upstream river inflows due to large watershed type rainfall events. In addition, aside from coastal storms, the exposed shoreline can be impacted by normal daily persistent winds considering the available open water fetch.

Figure 2-6 below displays a portion of the effective Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for Lancaster County, Virginia, dated October 2, 2014, for the study area. As shown, the 1% annual chance flood (blue color) is at an elevation of approximately 8 to 9 feet, referenced to the North American Vertical Datum of 1988 (NAVD88), that includes wave action (Zone VE) along the shoreline. From the FEMA Flood Insurance Study (2014), the 1% annual chance still water elevation (no wave action) is 5.0 feet and the 0.2% annual chance (orange color) is 6.4 feet, NAVD88. Lowest adjacent ground elevations around the two buildings and parking area are approximately 6.5 feet, NAVD88.



Figure 2-6. FEMA National Flood Hazard Layer (effective date 10-2-2014).

Coastal flooding can be short term in duration or long term. For tropical events, peak tidal flooding will typically last during one astronomical tide cycle. In addition, the stronger the storm, typically the higher the storm surge and wave action will be. When tropical systems reach the mid-Atlantic latitude, they also start to move faster in forward speed. On the other hand, nor'easters are usually slow moving and large in size, have storm surge that is similar in magnitude to a tropical storm, and high-water levels caused by storm surge can stay elevated above normal astronomical tide cycles for long periods of time. Because they are slow moving and large in size, these types of storms can cause significant beach and shoreline erosion over a large area from persistent wave action and long duration tidal flooding.

There is a National Oceanic Atmospheric Administration (NOAA) tide gauge at the mouth of the Rappahannock River near Windmill Point, with records starting in 1970. Table 2-3 below shows the maximum recorded storm tide elevation at the Windmill Point tide gauge and other nearby NOAA stations. It is noted, the Windmill Point gauge failed during Hurricane Isabel in September 2003. A High-Water Mark (HWM) collected by the U.S. Geological Survey (USGS) for FEMA showed a storm tide elevation of 5.3 feet, NAVD88 for Hurricane Isabel, also shown in the Table below. The HWM was an identified mud line located at the nearby Morattico U.S. Post Office.

Table 2-3. NOAA Tide Gauge Stations – Maximum Storm Tide Elevations.

Gauge Station Name/Number	Location	Begin Date	Maximum Storm Tide Elevation, Feet, NAVD88	Storm Event
Lewisetta/8635750	Potomac River	1970	4.8	Tropical Storm Ernesto, September 2006
Windmill Point/8636580	Rappahannock River	1970	4.0/5.3	Tropical Storm Ernesto, September 2006/Hurricane Isabel HWM, September 2003
Yorktown USCG Training Center/8637689	York River	2004	5.4	Nor’Ida, November 2009
Sewells Point	Hampton Roads	1927	6.4/6.3	1933 Hurricane/Hurricane Isabel, September 2003

Since 1927, historical high-water tidal flood events have mainly been from tropical storms, weak Category 1 hurricanes, or nor’easters; the State has not experienced a major hurricane on official record. Historical accounts do show that Virginia has been impacted by major storm events. For examples, some storms were strong enough to alter land masses, including the widening of the Lynnhaven River (September 6, 1667) and formation of Willoughby Spit (October 19, 1749). Reports also indicate severe flooding was caused by these storms, water levels raised 12-15 feet. The October 1878 storm resulted in Cobb and Smith Islands on the Eastern Shore being completely submerged (HRPDC 2017).

It has been documented by NOAA, USGS, and research through the Virginia Institute of Marine Science and Old Dominion University that the mid-Atlantic region has some of the highest rates of relative sea-level rise on the East Coast. Sea level rise and land subsidence combine to cause relative sea level rise. Data shows that land subsidence has been responsible for more than half of the relative sea level rise. In general, sea level rise can be attributed to global sea level rise and more locally, the slowing down of the Gulf Stream. Land subsidence can be attributed to movement of the earth’s crust from glacial adjustments, continued compaction from a meteor that struck near Cape Charles about 35 million years ago, and more locally, groundwater withdrawals used by paper mills in the city of Franklin and the town of West Point.

Considering sea level rise, if the 1933 Hurricane would have occurred today, the maximum water level would be about a foot higher at the Sewells Point gauge (HRPDC 2017).

## 2.9 GEOLOGY, PHYSIOGRAPHY, AND TOPOGRAPHY

The proposed project site is located in the outer edge of the Coastal Plain Physiographic Province of Virginia and consists of a wedge of Cretaceous to Recent (Holocene) geologic age sediments. The underlying topography of the Coastal Plain is a terraced landscape that slopes eastwards towards the coast. Sediments in this province are generally of fluvial-estuarine and marine origin and were typically deposited in a cyclical environment of advancing and retreating sea levels. According to the Geologic Map of Virginia (1993), the project site's soils are part of the Poquoson Member and Lynnhaven Member of the Tabb Formation. The Quaternary period deposit such as the Tabb Formation is typically underlain by older soils of the Chesapeake Group.

The Poquoson Member and Lynnhaven Member generally consist of gray medium to coarse pebbly sand, clayey and silty sand, and sandy silt. These deposits are reported to be 15 to 20 feet thick.

The Chesapeake Group is composed of fine to coarse grained sand, silt, clay with varying amounts of shells and diatomite. The Chesapeake Group may include the following formations: Chowan River, Yorktown, Eastover, St. Mary's, Choptank, and Calvert.

The ROI is any areas that are impacted directly, through excavation, fill, or placement of structures, and indirectly, such as changes in currents, flooding, or deposition. The ROI is located within in the Virginia Coastal Plain Physiographic Province (Figure 2-7). 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.

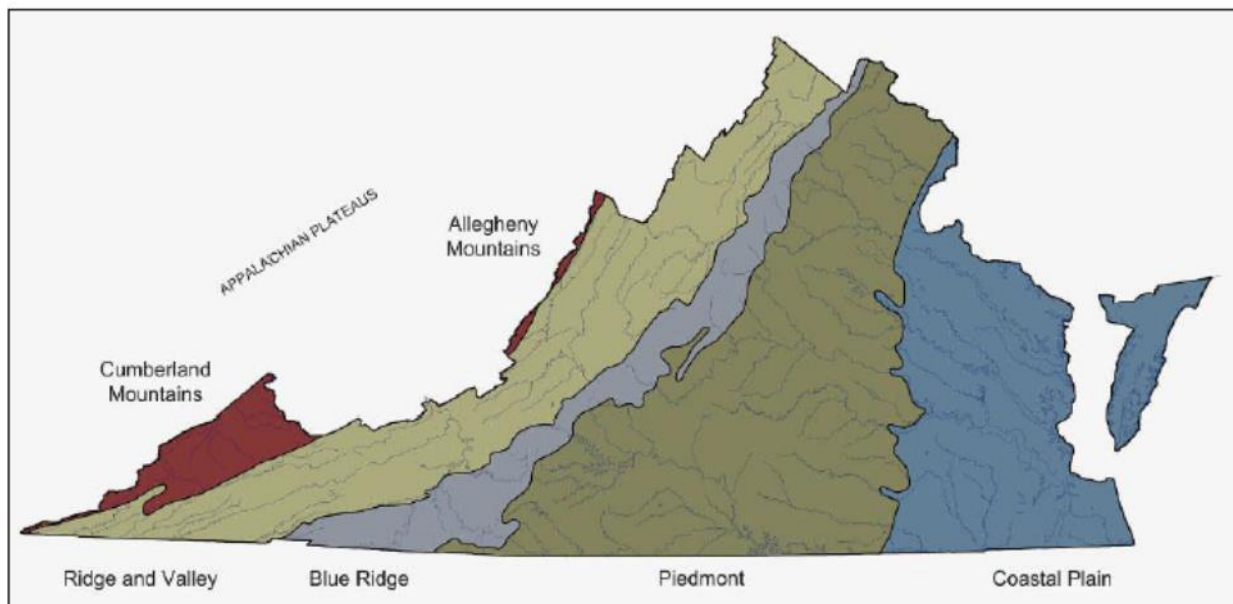


Figure 2-7. Physiographic Provinces of Virginia (DCR 2018).

## 2.10 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

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 or more of the following characteristics: ignitable, corrosive, reactive, or toxic. Radioactive waste is the radioactive by-products from the operation of a nuclear reactor or from the reprocessing of depleted nuclear fuel; however, there is no history of radioactive waste deposited in the ROI. Therefore, radioactive waste is dismissed from further consideration.

The ROI includes the surrounding area within the project area at Belle Isle State Park and the Rappahannock River, as well as outside of the project area, up to one mile, where potential contaminants could be spread by suspension and movements of sediments and also the water itself. The geographic extent of impacts is dependent upon factors such as the type of equipment used and environmental conditions such as wind and currents (USACE 1983).

### *The National Priorities List sites within the Vicinity of the ROI*

The National Priorities List (NPL) established by Section 105(a)(8)(B) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA; Superfund), as amended, requires that the statutory criteria provided by the EPA be used to prepare a Hazardous Ranking System. This system is composed of a list of national priority waste sites that are known to release or threaten to release hazardous substances, pollutants, or contaminants throughout the United States. The USEPA regulations outline a formal process for assessing hazardous waste sites and placing them on the NPL. The NPL is intended primarily to guide USEPA in determining which sites warrant further investigation. Within a one-mile radius from the ROI, there are no identified locations.

*Toxics Release Inventory (Superfund Amendments and Reauthorization Act TITLE III/  
Emergency Planning and Community Right-to-Know Act)*

The Toxic Chemical Release Inventory System (TRIS) identifies facilities that release toxic chemicals to the air, water, and land in reportable quantities under the Superfund Amendments and Reauthorization Act (SARA) of 1986, Title III statute (SARA TITLE III), also known as the Emergency Planning and Community Right-to-Know Act (EPCRA). This regulation was created to synthesize a cooperative relationship among government, business, and the public involving all of them in the effort to prevent, to plan, to prepare for, and to manage chemical emergencies. U.S. facilities report detailed information to USEPA on their management of toxic chemicals, including releases to the environment. The Toxics Release Inventory (TRI) National Analysis contains this information and trends in releases, waste management practices, and pollution prevention activities. Lancaster County does not have any TRI facilities or on/off site disposals or releases, therefore there would be no anticipated contamination within the ROI (USEPA 2020).

## 2.11 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, parks and open space. The ROI for land use analysis is limited to the shoreline and adjacent upland areas to the project location.

Belle Isle State Park is located in Lancaster, Virginia on the Rappahannock River in the Coastal Plain Region. Lancaster County is approximately 120 miles southeast of Washington D.C., and 71 miles northwest of Norfolk, Virginia.

Lancaster's landscape consists mostly of farms, forests, and marshlands, interspersed with small towns. Existing land uses adjacent to the proposed project includes agricultural use and recreational opportunities offered by the park. Land use in the County is mostly residential, farming, or woodlands. Waterfront use adjacent to the ROI is predominantly fishing, recreational uses, and waterfowl hunting.

Lancaster County covers approximately 135 square miles or approximately 86,267 acres of land. The County is rural in nature with limited public infrastructure; however, the Town of Kilmarnock operates a public water supply and sewage collection/treatment plant. Due to this limited public infrastructure, development in Lancaster County usually requires on-site sewage facilities for disposal of waste and individual or community wells for domestic water supplies.

Development in Lancaster County is closely tied to the physical characteristics of the site to be developed. These characteristics include the suitability of the soil for septic systems, the degree of slope of the land, the depth of the soil to the water table, the shrink-swell potential of the soil, and the proximity of the intended development to sensitive environmental features. This close bond with the land is further magnified by the wide variety of environmentally sensitive areas found in the County including steep slopes, flood plains, prime agricultural lands, wetlands, and soils not suitable for septic systems. In all, approximately 56,229 acres or 65.2% of Lancaster County land is limited in some form. There is still a large quantity of land that has no limitations and is suitable for development. In total 30,038 acres or 34.8% of Lancaster

County land has no physical constraints for development; however, no development is anticipated within the project ROI, because it is a state park.

## 2.12 NOISE AND VIBRATION

Noise is defined as an undesirable or “unwanted sound.” Accurately predicting the levels of noise produced during construction is difficult due to variability of several factors, including the distance from the construction site, vegetation, changes in elevation, temperature, and humidity. Noise affects the full range of human activities and must be considered in local and regional planning (NYDEC 2001).

Noise levels are measured in units called decibels. Because people cannot perceive all pitches or frequencies equally, noise production is frequently reported in A-weighted decibels, or dBA, where noise is weighted to correspond to human hearing,

While there are no federal standards for allowable noise levels, several agencies have developed guidelines for acceptable noise levels. The Department of Housing and Urban Development Guidelines denote Day-Night Sound Levels or DNLs (a noise rating developed by the USEPA for specification of community noise from all sources) below 65 dBA as normally acceptable levels of exterior noise in residential areas. The Federal Aviation Administration (FAA) denotes a DNL of 65 dBA as the level of significant noise impact. Several other agencies, including the Federal Energy Regulatory Commission, use a DNL criterion of 55 dBA as the threshold for defining noise impacts in sparse suburban and rural residential areas (Schomer et al. 2001). The USACE Safety and Health Requirements Manual provides criteria for temporarily permissible noise exposure levels, for consideration of hearing protection, or for the need to administer sound reduction controls (Table 2-4).

Table 2-4. Permissible Non-Department of Defense Noise Exposures.

Duration/day (hours)	Noise level (dBA)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105

Noise and vibration are 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.

The USEPA's Noise Control Act of 1972 (42 U.S.C. 4901 to 4918) as amended by the Quiet Communities Act of 1978, states that the policy of the United States is to promote an environment for all Americans free from noise that jeopardizes their health or welfare (USEPA, 1996). The USEPA generally recognizes an average day-night noise level (DNL) of less than 50 decibels a-weighting (dBA) (USEPA, 1978) for rural areas and between 55 and 60 dBA for urban areas. Hearing loss could result if the average outdoor noise level is in excess of 70 dBA or for 24 hours over a 40-year period (USEPA, 1974). Several factors affect response to noise levels, including background level, noise composition, noise fluctuation, time of the year, time of day, history of exposure, community tolerance, and individual emotional factors. In general, people are more tolerant of a given noise if the background level is closer to the level of the new noise source. Also, people are more tolerant of noises during daytime than at night when background noise normally diminishes, increasing sound awareness. Residents are more tolerant of an activity if it is considered to benefit the economic or social wellbeing of the community or them individually. Noise levels also have a much greater effect on outdoor than indoor activities.

The U.S. Occupational Safety and Health Administration (OSHA) regulates noise impacts on workers. OSHA regulations on noise standards ensure that workers are not exposed to noise levels higher than 115 dBA. Exposure to 115 dBA is limited to 15 minutes or less during an 8-hour work shift. Exposure to impulsive or impact noise (loud, short duration sounds) is not to exceed 140 dBA peak sound pressure level.

The ROI has a radius of 1-2 miles, as noise can travel that distance across the nearby beach, tidal wetlands, mudflats and surrounding areas adjacent to the Belle Isle State Park, in Lancaster County. The geographic extent of noise impacts is dependent upon factors such as the type of equipment required to perform operations for the project, and environmental conditions such as wind speed and direction.

## 2.13 OCCUPATIONAL HEALTH AND SAFETY

The occupational health and safety environment in the ROI of this project would be along the shoreline and water depending on the final project, including all construction and staging areas. Risk factors in the occupational safety and health environment include operation of heavy equipment, operation of vessels, placement of materials, and potential exposure to environmental elements (American National Standards Institute 2011).

Phases of work each have their own set of potential hazards. The proposed project involves the following phases of work:

- Mobilization;
- Surveying;
- Hauling gear maintenance and cable replacement;

- Land Disturbance;
- Weather Precautions; and
- Demobilization.

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

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

Safety concerns include first aid and emergency medical care, eye injuries, vessel/water safety, fire hazards, electrical hazards, slip and fall hazards, and equipment hazards.

## 2.14 RECREATION

Lancaster County's major recreational feature is its access to numerous miles of shoreline fronting the Rappahannock River, Chesapeake Bay, and their tributaries. Belle Isle State Park is managed by the Virginia Department of Conservation and Recreation and offers camping, fishing, hiking trails, educational activities, picnic area, playground, boat ramp, boardwalk, and beach access. The park has seven miles of waterfront and is a major recreational asset to the county and the region. Sport fishing, recreational boating, and sailing are high usage recreational activities associated with the waterways of the area. The numerous marshes, tidal coves, and upland forests provide abundant recreational opportunities within the park in addition an aesthetically pleasing area. From its banks the park also provides an opportunity for scenic views of the Rappahannock River.

The ROI for recreation is limited to those waters and upland areas within and adjacent to the project area. The ROI located at the Belle Isle State Park has many recreational opportunities. Recreational boaters from the surrounding areas use the Rappahannock River and adjacent creeks. Some boaters will pull their boats up to the beach that is within the project area to enjoy and utilize the shoreline.

Recreational fishing is popular in the project area along the Rappahannock River. The waters teem with many fish species, blue crabs, oyster beds, and clam. Waterfowl hunting is permitted within the ROI. Hunters utilize the duck blind located in the project area and the adjacent marshes and creeks.

## 2.15 SOCIOECONOMICS

The ROI for the socioeconomic analysis is limited to areas affected directly or indirectly along the shoreline and adjacent upland areas to the project location. The ROI also would include effects with respect to land use changes or local employment.

Belle Isle State Park is in Lancaster County, which is one of the rural counties occupying the Northern Neck, a peninsula bounded by the Potomac and Rappahannock Rivers. The county's estimated population as of July 2019 was 10,603, a 6.9 percent decrease from the year 2010 (US Census 2020). The county's population grew 14 percent between 1980 and 2000 but has slowed down considerably since then. All these rates are significantly less than the rates for the state as a whole. Projections from the Virginia Employment Commission (VEC) through 2030 show the county's population staying relatively the same throughout the period.

The age composition of Lancaster County's population began shifting in the second half of the 20th century and accelerated in the 1990s as young adults moved out and retirees moved in. The completion of the Rappahannock Westminster-Canterbury retirement community, which opened in 1985, has been a significant attraction for older retirees. The numerous waterways, marinas and relatively quiet lifestyle are also attractive to retirees. As of 2019, it was estimated that 36 percent of the county's population was over 65 years old, a figure which is about two and a half times larger than the state and national averages for this age group (U.S. Census 2020).

Lancaster's economy is heavily focused on the services sector, which supplies almost half the jobs in the county (VEC 2010). An additional 28 percent of the county's employment can be found in retail trade and government. The largest private employers are the Rappahannock General Hospital, Walmart, and Rappahannock Westminster-Canterbury. Per capita income for the county as of 2018 was \$37,196. The estimated median household income for 2018, however, at \$50,739 is significantly below the \$71,564 figure for the entire state (U.S. Census 2020).

The specific census tract that encompasses the Study Area (tract 9901) is similar to the county as a whole, demographically. The county seat is Lancaster, and the largest town is Kilmarnock, which has about 10% of the county's population. The county's ethnic makeup is 70% white, 29% African American, with other races making up only about 1%. Thirty-point five percent of the census tract's population in 2019 was minority compared to 31.5 percent for the county. The percent of the United States population with incomes below the poverty level was 10.7, while the county percentage was 12.3 percent (U.S. Census 2020).

Most of the land in Lancaster County can be characterized as undeveloped, which encompasses agricultural, forested, and open space lands. The primary centers of commercial activity are the incorporated towns of Kilmarnock, White Stone, and Irvington. There are also smaller villages, such as Lancaster, Lively, Morattico, and Weems, which have small concentrations of residences and a few commercial establishments. Most of these towns and villages are located where two highways cross or near a waterway (Lancaster County Comprehensive Plan 2013).

Statistics for Belle Isle State Park are more closely related to the project than the demographics of Lancaster County. Belle Isle is one of 37 Virginia State Parks, which together had 10.02 million visits in 2016 (Virginia Department of Conservation and Recreation 2019). Economic impact of the state parks is considerable, with an annualized \$2.3 million at Belle Isle. Of this \$883,000 was from Virginia residents, and \$680,000 was from non-residents. A similar split is shown between day users, \$671,000 and overnight users \$893,000 (Magnini 2020).

## 2.16 SPECIAL STATUS SPECIES

The ROI (or Action Area as it is referred to for threatened and endangered species per 50 CFR 402.02) is defined as “all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action.” (The terms ROI and Action Area are used interchangeably when referring to federally listed species in the Environmental Assessment.)

The ROI consists of the shoreline along Belle Isle State Park and the waters of the Rappahannock River, comprised of beach and tidal wetlands. This section provides a summary of the special status species that are known or have the potential to occur in the Action Area.

### 2.16.1 Federally Threatened and Endangered Species and Designated Critical Habitat

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 in the ESA. “Candidate species” are species for which the USFWS and NMFS have sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA. Critical habitat is designated per 50 CFR parts 17 or 226 and defines those habitats that are essential for the conservation of a federally threatened or endangered species and that may require special management and protection.

Relevant consultation correspondence and a copy of the reports generated from the federal and state databases will be provided as part of the Environmental Appendix. There are no candidate species known or with the potential to occur in the Action Area. However, critical habitat for the Atlantic sturgeon Chesapeake Bay DPS extends from the U.S. Highway 1 Bridge in Fredericksburg downstream to the confluence of the Rappahannock River and Chesapeake Bay.

Please note that all these species listed in Table 4-5 are also state listed in the Commonwealth of Virginia with the same status level as described for the federal listing.

### 2.16.2 Federal Species

The U.S. Fish and Wildlife Service’s Information, Planning and Conservation System (IPaC) lists the northern long-eared bat (*Myotis septentrionalis*) as the only federally threatened mammal within the ROI. During the summer months habitat for the bats include dead and dying trees whereas during the winter they hibernate in caves and mines (USFWS 2020). It is not predicted that any northern Long-eared Bats are within the project ROI due to lack of habitat within the action area. There is no critically listed habitat under the jurisdiction of the USFWS in the Action Area.

The NMFS, list six federally listed species with a potential to occur within the project area (Table 2-5). The NMFS has the project site listed as in or near critical habitat for Atlantic Sturgeon. The endangered shortnose sturgeon (*Acipenser brevirostrum*) and threatened/endangered Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) are predicted to utilize the Rappahannock

River from the mouth to the US Highway 1 Bridge for migrating and foraging during various life stages, as noted in the table. Adult Shortnose Sturgeon are known to be in the project area from the beginning of April through November. Juvenile Atlantic Sturgeon are predicted to be within the area year-round, whereas sub-adult and adult Atlantic Sturgeon may be in the Rappahannock from the middle of March through November (NMFS 2020b). The Action Area is located within the nearshore intertidal and subtidal zone and is not preferred habitat for the Atlantic sturgeon so their presence in the Action Area would be unlikely.

Four species of sea turtles, as listed in the table, either in juvenile or adult life stage, may occur within the project area from May through November for foraging and migrating. These turtles include the federally threatened Green sea turtle (*Chelonia mydas*) and Loggerhead sea turtle (*Caretta caretta*) as well as the federally endangered Leatherback sea turtle (*Dermochelys coriacea*) and the Kemp’s Ridley sea turtle (*Lepidochelys kempii*) (NMFS 2020b). There is no sea turtle nesting habitat in the Action Area.

Table 2-5. Federally Listed Species with the Potential to Occur within the Project Area (USFWS 2020; NMFS 2020b)

Species	Life stage	Status
<b>US Fish &amp; Wildlife Service</b>		
Northern Long-eared Bat ( <i>Myotis septentrionalis</i> )	All	Threatened
<b>National Marine Fisheries Service</b>		
Shortnose Sturgeon ( <i>Acipenser brevirostrum</i> )	Adult	Endangered
Atlantic Sturgeon ( <i>Acipenser oxyrinchus oxyrinchus</i> )	Juvenile, Sub-Adult, Adult	Threatened/Endangered
Green Sea Turtle ( <i>Chelonia mydas</i> )	Juvenile, Adult	Threatened
Loggerhead Sea Turtle ( <i>Caretta caretta</i> )	Juvenile, Adult	Threatened
Kemp's Ridley Sea Turtle ( <i>Lepidochelys kempii</i> )	Juvenile, Adult	Endangered
Leatherback Sea Turtle ( <i>Dermochelys coriacea</i> )	Juvenile, Adult	Endangered

### 2.16.3 State Listed Species

The Virginia Department of Wildlife Resources (VDWR) describes state listed species, in addition to those federally listed as mentioned above. Federally listed species are automatically state listed species, and all are listed in Table 4-6. Two species of turtles, the northern diamond-back terrapin (*Malaclemys terrapin terrapin*) and the spotted turtle (*Clemmys guttata*) are listed as collection concern species. Table 4-6 lists species that have been identified as state endangered, and state threatened, in addition to federally listed endangered and threatened species that may be found within three miles of the Belle Isle State Park project site (VDWR 2020).

Table 2-6. Species with State Status (DWR 2020)

Status	Common Name	Scientific Name
FESE	Shortnose Sturgeon	<i>Acipenser brevirostrum</i>
FESE	Atlantic Sturgeon	<i>Acipenser oxyrinchus oxyrinchus</i>
FESE	Kemp’s Ridley Sea Turtle	<i>Lepiochelys kempii</i>
FEST	Green Sea Turtle	<i>Chelonia mydas</i>
FTST	Loggerhead Sea Turtle	<i>Caretta caretta</i>
FTST	Northern Long-eared Bat	<i>Myotis septentrionalis</i>
SE	Eastern Black Rail	<i>Laterallus jamaicensis jamaicensis</i>
SE	Little Brown Bat	<i>Myotis lucifugus</i>
SE	Tri-colored Bat	<i>Perimyotis subflavus</i>
ST	Northeastern Beach Tiger Beetle	<i>Cincindela dorsalis dorsalis</i>
ST	Peregrine Falcon	<i>Falco peregrinus</i>
ST	Loggerhead Shrike	<i>Lanius ludovicianus</i>

### 2.16.4 Marine Mammals

The Marine Mammal Protection Act of 1972, as amended (MMPA) prohibits, with certain exceptions, the “take” of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. In reference to the MMPA, a marine mammal is a species found in the U.S. that is classified into one of the following four distinct groups: cetaceans (whales, dolphins, and porpoises), pinnipeds

(seals, sea lions, and walruses), sirenians (manatees and dugongs), and marine fissipeds (polar bears and sea otters). 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 Fisheries 2018). 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.

Lancaster County had a reported stranding of one bottlenose dolphin in 2018 (Costidis et al. 2019).

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

Previously listed as federally endangered, the bald eagle (*Haliaeetus leucocephalus*) has made a remarkable comeback and is no longer federally listed. It is currently protected under the American Bald and Golden Eagle Act, and the Migratory Bird Treaty Act (MBTA). 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 2018a).

A large raptor, such as the bald eagle has a wingspread of about seven feet. Adults have a dark brown body and wings, white head and tail, and a yellow beak. Juveniles are mostly brown with white mottling on the body, tail, and undersides of wings. Bald eagles typically breed and winter in forested areas adjacent to large bodies of water. However, such areas must have an adequate food base, perching areas, and nesting sites. Throughout its range, bald eagles select 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 2018a).

The USFWS National Bald Eagle Management Guidelines (2007) are used to assess potential effects to nesting bald eagles and provides management guidelines to avoid impacts to nesting bald eagles. To avoid disturbing bald eagles, a nest buffer is recommended between the human activity and the nest, where applicable. Human impacts are considered detrimental to nesting success within the primary buffer and within the secondary buffer. The primary buffer is a distance of 330 feet from the nest and the secondary buffer is a distance of 660 feet from the nest. Human activities that are considered detrimental to breeding activities (e.g. development,

logging, use of toxic chemicals, etc.) are to be limited within the primary buffer and those that could impact the integrity of the primary buffer are restricted within a secondary buffer (e.g. developments, roadways, etc.). Per the Management Guidelines, a nest buffer of 2,640 feet is recommended from the nest for loud, disturbing noises such as those caused by blasting and other loud, intermittent noises.

There are no active bald eagle nests existing within the ROI (The Center for Biology Conservation CCB Mapping Portal 2020).

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

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

Migratory birds' nest throughout North America, some as far north as the Arctic. In late summer and fall, they migrate south for the winter. Some overwinter in the southern United States, Mexico, the Caribbean or Central America while others go as far as South America. Each spring they return north to their breeding grounds. Many migratory songbirds, shorebirds, and raptors rest and refuel in the Chesapeake Bay Watershed during their spring and fall migrations. Others winter south and return to the Chesapeake Bay watershed each spring to breed (USFWS 2018b).

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

- 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.
- It (a) belongs to a family or 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 American Ornithologists' Union (AOU) or other competent scientific authorities.
- It is a species listed in the annex to the Japanese convention of 1972.
- It is a species listed in the appendix to the Russian convention of 1976.

Table 2-7. Migratory Birds Known or with the Potential to Occur in the Region of Influence (USFWS 2020)

Common Name	Scientific Name
Bald eagle	<i>Haliaeetus leucocephalus</i>
Bobolink	<i>Dolichonyx oryzivorus</i>
Kentucky Warbler	<i>Oporornis formosus</i>
Prairie warbler	<i>Dendroica discolor</i>
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>
Wood thrush	<i>Hylocichla mustelina</i>

## 2.17 VEGETATION, WETLANDS, AND SUBMERGED AQUATIC VEGETATION

The ROI for vegetation, wetlands, and submerged aquatic vegetation (SAV) is any areas that are impacted directly, through excavation, fill, or placement of structures, and indirectly, such as changes in currents, flooding, or deposition.

Wetlands are defined as “areas that are inundated or saturated by surface or groundwater 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). Wetlands are resources that combine shallow water, high levels of nutrients, and primary productivity, which is ideal for the development of organisms that form the base of the food web and provide foraging sites for fish, amphibians, shellfish and insects. Dead plant leaves and stems break down in the water to form detritus, which feeds many small aquatic insects, shellfish and small fish that are food for larger predatory fish, reptiles, amphibians, birds and mammals. Many species of birds and mammals rely on wetlands for food, water, and shelter, especially during migration and breeding. Salt marshes rank among the most productive ecosystems on earth and provide essential ecosystem services. Salt marshes are comprised of a variety of plants, including rushes, sedges, and grasses; all of which are adapted to live in a saline environment. Salt marshes buffer shorelines from storm damage and improve water quality through sediment trapping, reducing pollutant and nutrient runoff.

The tidal salt marshes located at either end of the project site are characterized by native marsh vegetation including cord grass. Cord grass grows in the low marsh at elevations between mean low water (MLW) and mean sea level (MSL) and is inundated during every tidal cycle. The Atlantic ribbed mussel, a filter-feeding bivalve, is native to the Atlantic coast of North America and is commonly found within cordgrass-dominated (*S. alterniflora*) salt marshes throughout the Chesapeake Bay including the project site. The high marsh community is dominated by salt meadow hay (*Spartina patens*) and is periodically inundated. Saltbushes, including both marsh elder (*Iva frutescens*), and groundsel tree (*Baccharis hamifolia*) are also present along the banks as the marsh transitions to the upland. Undercutting of the

channelward extent of the marsh, or the marsh toe, was observed at the project site. Over the years, the existing tidal wetlands have eroded at an approximate rate of 0.84 ft per year, and the loss is expected to continue and accelerate due to sea level rise in the absence of shoreline restoration efforts (Figure 2-8).

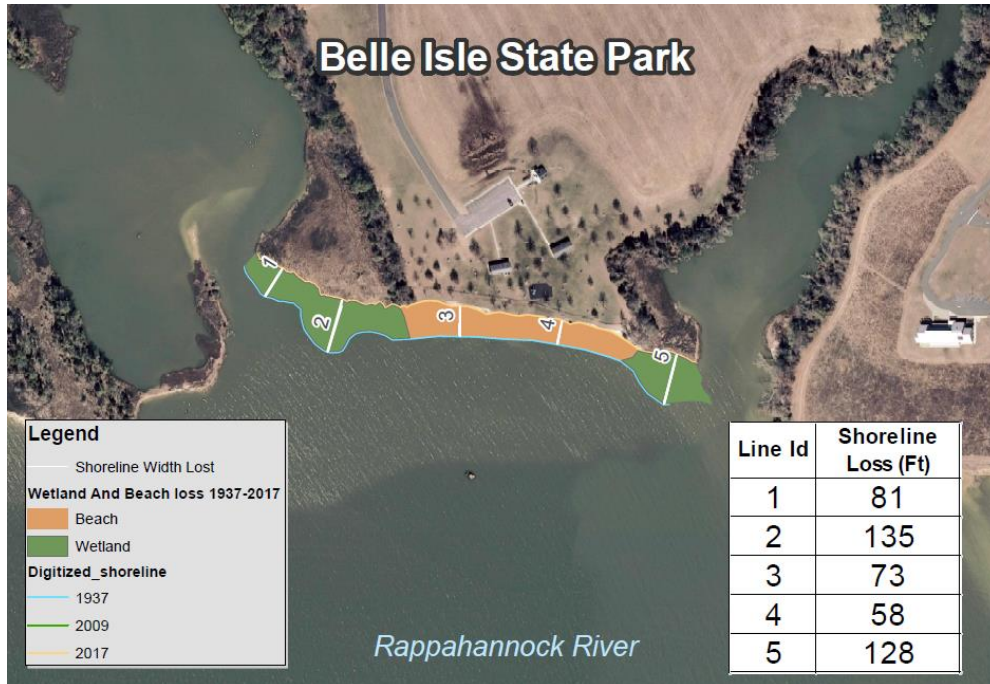


Figure 2-8. Beach and Wetland Loss at the Project Site since 1937.

### 2.17.1 Shallow Intertidal and Subtidal Habitat

The majority of the project site is composed of intertidal and subtidal habitat (Figure 2-9). Water depths range between 0 and 5 ft., with a mean tidal range of 1.6 ft. The bottom substrate consists of a thin layer of soft recent alluvial deposit (and possible remnant of previous marsh) over gravelly sand, silty sand, and sand strata. Fallen trees exist along intertidal and subtidal portions of the shoreline providing evidence of the substantial erosion that has occurred over time.



Figure 2-9. Tidal Marsh and Nearshore Habitats Adjacent to the Project Site.

### 2.17.2 Submerged Aquatic Vegetation (SAV)

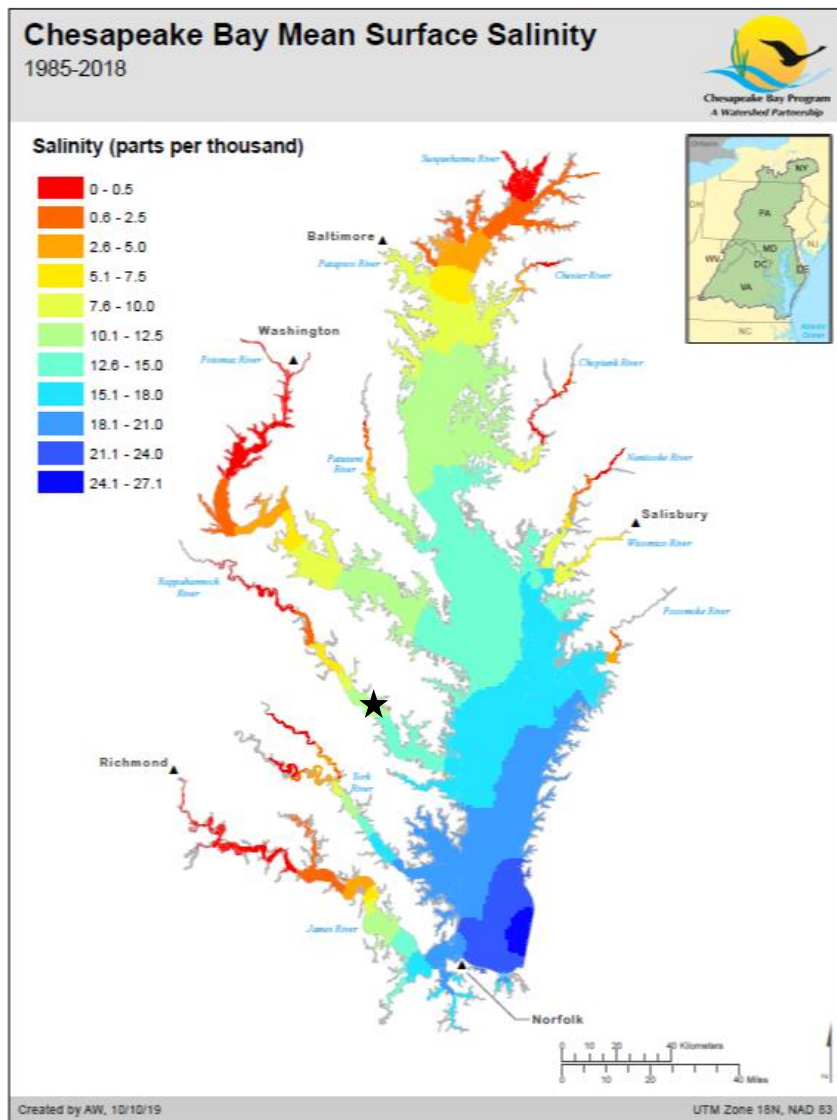
Submerged Aquatic Vegetation (SAV) is a valuable resource found throughout areas of the Chesapeake Bay and its tidal tributaries. SAV serves as an important water quality indicator based upon habitat requirements to support its growth, reproduction, and survival (Dennison et al. 1993). This aquatic vegetation is important in Virginia waters for certain life stages of many fish species and is a critical food and habitat source for a wide variety of waterfowl, shellfish, and fishes. SAV provides a complex refuge that serves as nursery and juvenile habitat for many fish species and provides increased prey availability (Schlaffer 2013).

There is currently no presence of SAV within the proposed project area or within the ROI. Photointerpretation of historical imagery prior to 1971 indicates that SAV was likely to be present in nearshore areas adjacent to Belle Isle State Park; however, only 1% of the estimated 3,100 hectares of historical SAV in the lower Rappahannock River was observed in 1999 (Moore et al. 2001). Since 1999, annual SAV monitoring and reporting conducted by the Virginia Institute of Marine Science indicates that SAV is not present in the ROI or in the nearby vicinity of the ROI.

### 2.18 WATER QUALITY

More than 150 major rivers and streams flow into the Chesapeake Bay's 64,000 square mile drainage basin, covering parts of six states from New York, Pennsylvania, Delaware, Maryland, Virginia and West Virginia, as well as the District of Columbia. The watershed surrounding the project ROI, includes all tributaries and streams that drain into the waters of the Rappahannock. This includes the upstream watershed as well, which during large watershed type rainfall events, the ROI can be exposed to high water from the upstream river inflows. Groundwater and stormwater also may drain within the limits of the project area, influencing water quality in the area. The ROI includes areas inside and outside of the project where water quality impacts such as increased levels of Total Suspended Solids (TSS), turbidity, and potentially nutrient fluctuations may occur. The geographic extent of water quality impacts is dependent upon factors such as the type of project and equipment used, and environmental conditions such as wind and currents (USACE 1983).

The Chesapeake Bay is a slightly stratified estuary which forms where tidal activity is strong and river volume is moderate. A saltwater wedge moves from the ocean west through the ROI causing salinity shifts and circulation patterns as freshwater from tributaries drain into the river. Seawater moves landward along the bottom and is diluted with freshwater moving out towards the mouth of the Bay (Figure 2-10). Water circulation is primarily driven by the movement of fresh water from the north and saltwater from the south. Daily tidal currents in and out of the Bay enhance mixing of the two layers. As seawater moves landward and river water moves seaward, they are influenced by the Coriolis Effect. Nutrients and other important materials are mixed and resuspended in the area where fresh and saltwater meet. This area is called the zone of maximum turbidity and it is located within the ROI. The salinity at the project site ranges from 10.1-12.5ppt (see star on Figure 2-10).



## Figure 2-10. Salinities of the Chesapeake Bay.

### 2.18.1 Impaired Waterways

The USEPA established a Total Maximum Daily Load (TMDL) for the Chesapeake Bay Watershed on December 29, 2010. The TMDL identified the nitrogen, phosphorus, and sediment reductions that each Bay jurisdiction needs to achieve for the Chesapeake Bay to meet water quality standards. The TMDL included Phase I Water Implementation Plans developed by States within the Bay watershed. The Commonwealth of Virginia Phase I Water Implementation Plan outlined the actions expected of the wastewater sector, urban/stormwater sector, agriculture sector, and on-site sewage sector in order to meet statewide nutrient and sediment reduction goals.

There are many impaired waterways contributing to the water quality of the ROI. An annual Virginia Water Quality Assessment 305(b)/303(d) Integrated Report summarizes findings and makes recommendations for a list of impaired waters by 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 (VDEQ 2020). In order to maintain the water quality standard, VDEQ 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 USEPA based on monitoring data. There are six designated uses that may be applied to surface waters: aquatic life, fish consumption, shellfish, 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 water fails to support a designated use when it has one or more impairments. Figure 2-11 indicates the locations and descriptions of these impairments. Within the project ROI, the Rappahannock River is impaired for dissolved oxygen and benthic communities. The project area's water quality will be able to support oyster reefs despite the impairments given to the Rappahannock by VDEQ. Oysters need a minimum salinity of 8 ppt to survive. Oysters were seen within the project area during site visits, which is a good indicator that the water quality is suitable for their survival.

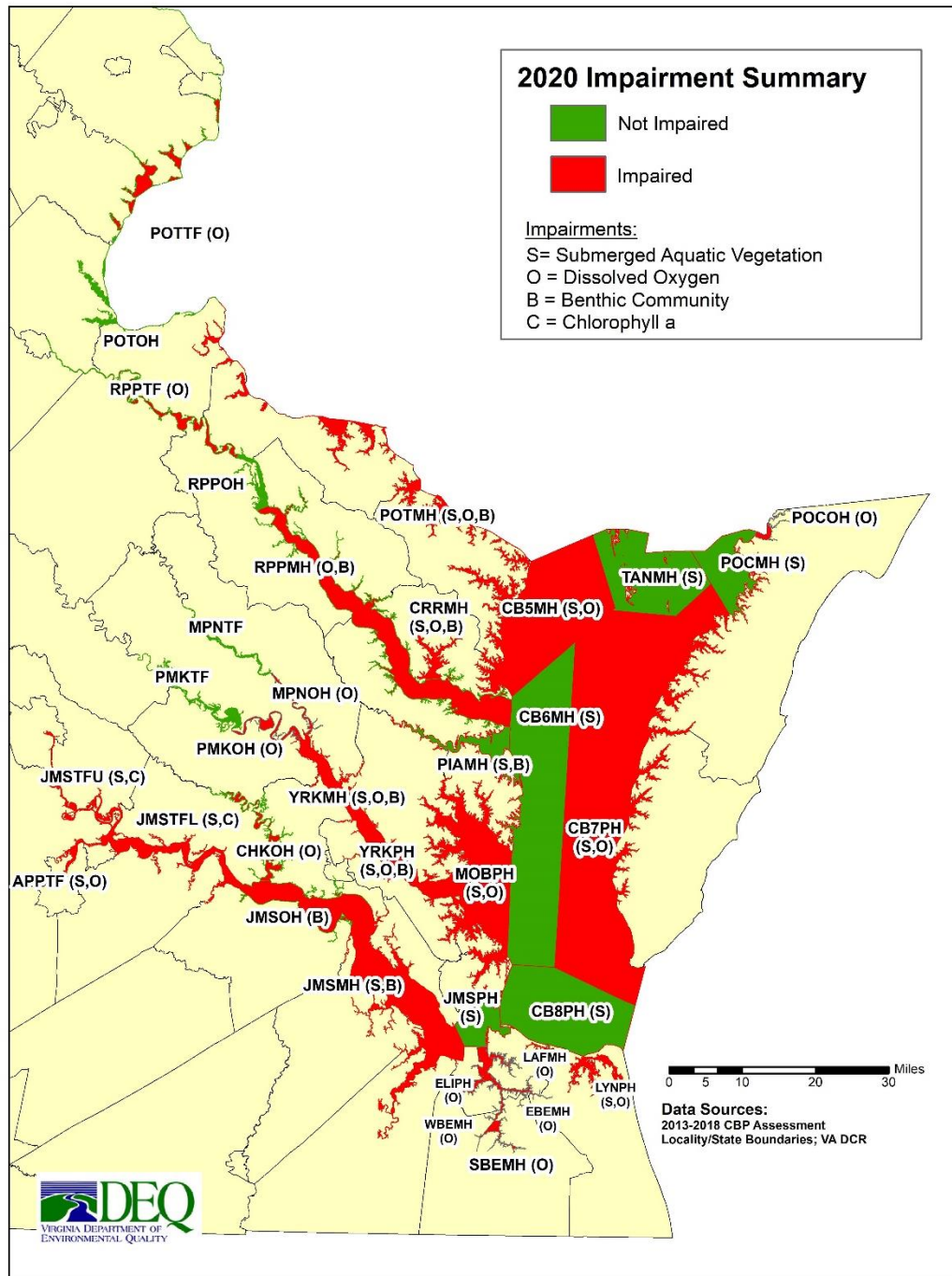


Figure 2-11. Impairment Status of the Bay Aquatic Use (VDEQ 2020).

## 2.19 WILDLIFE

The ROI for wildlife includes surrounding vegetated areas on land, the wetland and beach

habitat within the Park, the as well as aquatic areas in the Rappahannock. The surrounding vicinity has very little commercial development or large housing developments. The Rappahannock River does not have a lot of commercial vessel traffic, but it is utilized by commercial and recreational fishing vessels.

For the purpose of the following discussion, wildlife consists of amphibians, birds, mammal species (excluding marine mammals) and terrestrial reptiles. Avian species may migrate through and/or forage within or adjacent to the project area. The project area provides habitat for a diversity of bird species that utilize shallow water, beach, and open flats. The shallow habitat at the beach shoreline-river interface provides viable opportunities for variety of wading birds including great blue herons and great egrets. A variety of bird species reside, breed, migrate through, and/or overwinter in the area. The area is also used as a stopover area for waterfowl and shorebirds during migration events (USFWS 2018b). The enhancement of the shoreline habitat and restoration of the wetland will improve the habitat for avian wildlife. The restoration of the wetland area will improve the foraging opportunities and the increased vegetation will provide additional habitat for breeding, migrating, residential and overwintering avian species.

Mammals that would typically occur in the area include the gray squirrel, eastern chipmunk, otter, eastern cottontail, porcupine, skunks, Virginia opossum, whitetail deer, red fox, and raccoon. A listing of wildlife species with the potential to occur in and/or near the Study Area was compiled from the Virginia FWIS (species within a 3-mile radius of the Study Area) (DWR, 2020), IPaC (species in Study Area) (FWS 2020), and Virginia Natural Heritage databases (DCR 2015) and is provided in the Environmental Appendix.

### 3. PLAN FORMULATION

In general, the plan formulation process follows six major steps, as listed and summarized below. This procedure is in accordance with the USACE Principles and Guidelines and related regulations. The six steps are:

- Step 1: Identification of problems and opportunities;
- Step 2: Inventory of forecasting conditions;
- Step 3: Formulation of alternative plans;
- Step 4: Evaluation of alternative plans;
- Step 5: Comparison of alternative plans; and
- Step 6: Selection of a plan.

Preliminary plans were formulated by combining management measures. Each plan was formulated in consideration of the following four criteria described in the Principles and Guidelines:

- **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; and
- **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 objective of ecosystem restoration studies as described in ER 1105-2-100 is to contribute to NER. Contributions to NER output are increases in the net quantity and/or quality of desired ecosystem resources. Measurement of NER is based on changes in ecological resource quality ER 1105-2-100 22 Apr 2000 2-2 as a function of improvement in habitat quality and/or quantity and expressed quantitatively in physical units or indexes (but not monetary units). These net changes are measured in the planning area and in the rest of the nation. Single purpose ecosystem restoration plans shall be formulated and evaluated in terms of their net contributions to increases in ecosystem value (NER outputs), expressed in non-monetary units.

#### 3.1 MANAGEMENT MEASURES

Ecosystem restoration management measures were identified and evaluated individually based on their suitability, applicability, and merit in meeting the planning objectives and constraints for the study. The management measures identified for this project were developed through analysis of previous plans for the project and with information gathered during discussions and site visits with PDT members and personnel from Belle Isle State Park. Additionally, measures

were developed through consultation with USFWS, EPA, and VDOT.

There were several measures formulated prior to the restart of this study after a multi-year hiatus and additional measures were considered in the current study effort. Prior measures formulated include tidal marsh habitat with low toe sills, beach habitat with rock groins, tidal marsh habitat with traditional breakwaters, and beach habitat with traditional breakwaters.

Potential measures were identified by field site visits, sponsor feedback, data from the Virginia Institute of Marine Science (VIMS), discussions with technical oyster experts, historical Baylor data and historical maps. Measures identified as potential aquatic ecosystem restoration improvements to Belle Isle State Park included:

- Oyster reef habitat restoration (creation)
- Atlantic ribbed mussel restoration (at existing wetland sites)
- Wetland restoration at Historic Wetland Loss Sites (including Atlantic ribbed mussel restoration)
- Wetland Creation Adjacent to the Beach
- Shoreline restoration
- Bank restoration by grading back the bank
- Bank restoration with fill material
- Breakwaters
- Bulkheads, Revetments, Groins, and Seawalls
- Submerged Aquatic Vegetation (SAV) restoration

### **Oyster Reef Habitat Restoration (Creation)**

Oysters are a keystone species in the Chesapeake Bay Watershed and provide significant habitat for native fish and invertebrates and serve to improve water quality. Overharvesting, disease, poor water quality (Wilberg et al. 2011), and lack of suitable substrate were the main causes of oyster population decline. Today, the commercial oyster fishery is highly regulated by the Virginia Marine Resources Commission (VMRC) to prevent overharvesting and promote a sustainable fishery. Oyster diseases are still prevalent in the Bay, however, advanced oyster science from the Virginia Institute of Marine Science has allowed for the creation of disease resistant oysters. Shell replenishment programs have prevented the valuable shell resource from ending up in landfills and putting them back in the water. The use of alternative substrate has provided additional habitat for larval oysters to recruit. Alternative substrates can also deter poaching from the reef. The success of the oyster reef at Belle Isle State Park is not anticipated to be impacted by any of the historic reasons for the decline of the oyster population.

Oyster reefs were considered because the project provides ideal site conditions for oyster habitat suitability and there has been significant oyster reef habitat loss in this river system. In addition, the wetland and beach system has substantively eroded resulting in habitat loss and the oyster reef system would help to naturally reduce erosion and protect the native wetland and beach habitats and provide a more sustainable ecosystem. This measure was considered favored by the non-federal sponsor because it provides a natural solution to help preserve and protect native habitat. Oyster reefs provide shelter and nursery areas for fish and invertebrates and provide forage fish for native wading bird and shorebird species as well. An additional opportunity is that the sponsor could use the reefs as an educational interpretive opportunity as

well.

This management measure would consist of construction of artificial reef structures approximately 30 ft offshore of the existing beach and wetland areas. The reef structures would be approximately three ft in diameter by approximately two ft in height with minimal spacing between the structures.

#### **Atlantic Ribbed Mussel Restoration (at Existing Wetland Sites)**

Atlantic ribbed mussels were found in association with the existing cordgrass marshes and serve to effectively hold and maintain the wetland habitat. With the substantive wetland loss at the study area, there has also been a comparable historic loss of Atlantic ribbed mussels because of their integral association with cordgrass in the tidal marsh ecosystem. Species of crabs and shorebirds feed on mussels which make them a critical component of the marsh food web and ecosystem. The mussels filter water entering the marsh similar to oyster filtering, providing an important water quality benefit as well.

This measure would consist of restoration of 0.6 acres of Atlantic ribbed mussel habitat at existing wetland sites by propagation of Atlantic ribbed mussels on cordgrass and then planting of the cordgrass/mussel plugs at the existing wetland sites.

#### **Wetland Restoration (at Historic Wetland Loss Sites)**

Wetland restoration was proposed in areas that were historically wetlands and that have eroded away since the 1930s. Wetland restoration was proposed in the segments 1, 2 and 5 of the study area (Figure 3-1). Since 1937, there has been wetland loss of approximately 81 feet at the shortest segment and 128 feet of wetland loss at the largest segment and an estimated total of 1.1 acres.

This measure would consist of the restoration of 1.1 acres of historical wetlands by; placement of clean, coarse, restoration grade sand, grading of the fill to attain a suitable elevation for native vegetation and the planting of native cordgrass containing propagated Atlantic ribbed mussels. Shell bags made of biodegradable mesh would be staked as needed along the fringes of the wetland restoration site.

#### **Wetland Creation Adjacent to the Beach**

This measure would consist of creation of wetland adjacent to the beach habitat and would convert historic (and existing) open water habitat to wetland habitat. This measure is similar to the Wetland Restoration Measure in terms of what is proposed (wetland creation) but is different in terms of construction and management because it requires hard structures in order to plant low marsh and high marsh adjacent to the beach area. A rock sill, approximately three feet high at the crest, would be required to reduce wave energy to the marsh habitat. The sills would not be continuous, in order to allow tidal inundation. Analysis of the substrate suggests that the rock structures may subside up to 18" into the river bottom. The maximum distance between the shore and the sills would be approximately 200 ft. In the area between the sills and the shore, clean, coarse, restoration grade sand fill would be placed on a 1:20 slope. Coarse sand is more durable and there will be less loss than fine restoration sand. Low marsh plants (cordgrass) would be planted from an area that is located between mean low and mean high

tides to above mean high tide. Upper marsh plants (saltmeadow cordgrass (*Spartina patens*), shrubs etc.) would be planted in areas above mean high tides. No tidal creeks would be designed into the project. Instead, the tidal channels would be allowed to develop naturally through the work of tides and the flow of runoff from the uplands.

### **Shoreline Restoration**

This measure would serve to help restore the beach shoreline habitat via placement of coir logs with native vegetation that would be planted behind and adjacent to the coir log. The coir log would serve to help restore and maintain the existing wading bird shoreline habitat. This measure would restore approximately 0.3 acres of avian shoreline foraging habitat.

### **Bank Restoration by Grading Back the Bank**

Grading back the bank and replanting the bank could prevent continued erosion of the project site and allow for vegetation to naturally grow. The bank is currently too steep and eroded for vegetation to grow. The grade back would extend into the existing park area into the existing playground. The playground would need to be moved or removed to implement this measure.

### **Bank Restoration with Fill Material**

This measure would be to backfill the bank with less erodible soils and plant the bank with vegetation. Clean, restoration grade sand will be used to back fill the bank, brought in from a sand distributing company. Rock groins would possibly be needed to stabilize the area. Instead of grading back the bank to reduce the steepness of the bank, this would bring the bank out further into the Rappahannock River. This would also create a wider beach area than existing conditions.

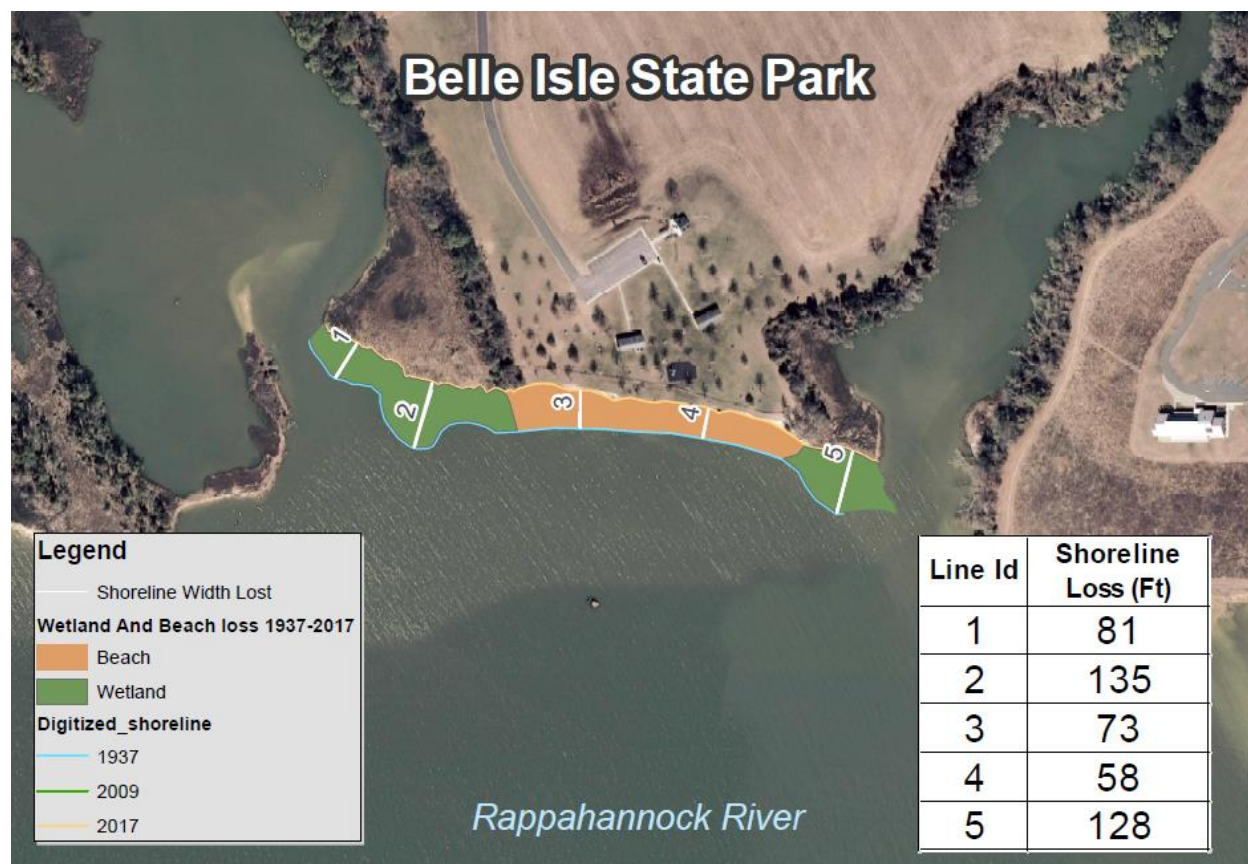


Figure 3-1. Wetland and Beach Loss from 1937 - 2017.

### Bulkheads, Revetments, Groins and Seawalls

When the study first began in 2004, USACE considered bulkheads, revetments, groins and seawalls as potential measures. A seawall is a large structure that is primarily designed to resist wave action along coastal properties. They are either gravity or pile-supported structures made of concrete or stone and can have curved or stepped faces. A groin is a structure built perpendicular to a shoreline and traps sand. A revetment is another feature built to protect a scarp, embankment, or other shoreline feature against erosion. The revetment is built immediately on top of the shoreline and is made up of three elements: an armor layer, a filter layer, and a toe. The armor layer is made up of an erosion resistant material, such as stone or concrete and provides the basic protection against wave action, while the filter layer supports the armor, allows water to pass through the structure and prevent the underlying soil from being washed through the armor. The toe protection prevents displacement of the seaward edge of the revetment. Bulkheads are retaining walls which hold or prevent backfill from sliding. These structures are used to protect eroding bluffs by retaining soil at the toe and increasing stability, or by protecting the toe from erosion and undercutting. Bulkheads are often used in marinas and other structures where deep water is needed directly at the shore.

### Breakwaters

Breakwaters are structures that reduce the effects of wave action on a shoreline because they

dissipate or reflect the wave energy. The proposed breakwaters in the study area would be constructed of rock and concrete positioned offshore. Clean, sand fill would be placed in the area between the breakwaters and the shoreline in order to create a tombolo that would provide open beach and vegetated dune habitat. Alternatively, lower and upper marsh plantings of cordgrass species and scrub/shrub species could be used between the structures, but that would require the elevation of the clean fill to be lower than it would be for a beach and dune habitat in order to allow tidal inundation needed to support the marsh plantings.

### **Submerged Aquatic Vegetation Restoration**

A measure was proposed to plant SAV in the aquatic portion of the project area. The SAV can provide food for shorebirds and habitat for fish species. This measure would have met the objectives of restoring the river-shoreline interface that provides important stopover and foraging habitat for migratory shoreline and wading avian species and conducting habitat restoration that support a self-sustaining estuarine system.” However, after an analysis of VIMS data dating back to 1978, it was found that this area did not historically have SAV.

## **3.2 SCREENING OF MEASURES**

An initial screening of measures was completed to identify the measures that did not fulfill the ecosystem restoration and protection purpose and need of the project and/or were inappropriate because of other factors, such as prohibitively high costs. Measures were screened based on knowledge gained from researching past reports and the professional expertise of the study team members and other USACE personnel. Six measures were carried through to be included in the initial array of alternatives. These included: oyster reef habitat restoration, Atlantic ribbed mussel restoration, wetland restoration at areas of historical loss, bank fill and grading back the bank, and shoreline restoration (with coir logs and vegetation plantings). After the initial array was formulated and further analysis occurred, the bank fill and grading back the bank measures were screened out due to cultural resource concerns and cost concerns. Measures that were screened out initially included: breakwaters, seawalls, bulkheads, groins and revetments, planting SAV, wetland creation adjacent to the beach, and bank restoration with fill material. Measures were assessed on whether the measure met the study objectives, historical accuracy of restoration (did the project site historically have the habitat type or plants being recommended to restore), cost, feasibility, long-term sustainability, and effects to cultural resources. The following measures were screened for one or more of these reasons.

### **SAV and Wetland Creation Adjacent to the Beach**

The SAV and wetland creation adjacent to the beach measures were screened out because the implementation of these measures would not be consistent with the habitat types that historically existed in the study area. According to VIMS data dating back to 1978, there was no SAV present in the project area and according to aerial imagery from 1937, there were no wetlands in the present or directly adjacent to the current beach habitat. The Wetland Creation Adjacent to the Beach Area measure was also not preferred because there is a steep grade, and fill material necessary to achieve successful propagation of marsh plants would have been costly. The sponsor also indicated that they would prefer to maintain the beach area for recreational purposes and the creation of a marsh would mean the loss of the beach recreation.

## **Breakwaters**

Breakwaters were previously considered by USACE when this study began in 2004 but were not carried forward in this plan formulation because oyster reefs can accomplish the same goal with higher environmental benefits and lower cost. This measure was also not preferred because breakwaters may affect sediment transport upstream/downstream or adjacent to the shoreline causing environmental degradation.

## **Bulkheads, Revetments, Groins and Seawalls**

The bank protection structures, including bulkheads, revetments, groins and seawalls, were screened from consideration because these are mainly shoreline stabilization measures and not aquatic ecosystem restoration measures. These structures were mainly determined to be inappropriate for the Belle Isle Project because they do not provide adequate opportunity for the restoration of aquatic habitat. Restoration of terrestrial ecosystems are possible shoreward of the structures, but because they are built immediately on top of the existing berm, restoration of aquatic systems shoreward of the structures would not be feasible. Restoration of aquatic habitat on the seaward side of the structures typically is not successful because these structures have been found to can increase wave reflection, thus increasing the re-suspension of substrate (i.e. sand and mud) in the water in front of the structures. This process can lead to the movement of bottom material alongshore, away from the project site. So, material placed in front of a bulkhead, revetment, groin or seawall would not remain in place. As with breakwaters, groins may affect sediment transport upstream/downstream or adjacent to the shoreline resulting in environmental degradation.

A second reason bulkheads, revetments, groins and seawalls were screened is the cultural resources present at the Belle Isle Project site. The three structures would require reshaping of the existing bank, in order to decrease the slope of the berm. In addition, the structures would require to be keyed into the bank. Therefore, construction of a bulkhead, revetment, groin or seawall would potentially adversely affect archeological resources that exist in the eroding bank.

### **3.3 MEASURE ASSESSMENT PROCESS**

As stated in Chapter 1, the primary goal of the project is the restoration of a diverse aquatic estuarine ecosystem, with the study objectives to restore oyster reefs, tidal wetlands, and the shoreline. Out of the six measures carried forward, each measure was evaluated to determine its contribution to these three objectives to restore the different habitats that are critical to restore the aquatic ecosystem in the study area. The oyster reef habitat restoration measure was the only measure that contributed to all three study objectives, but all the measures carried forward from initial screening met at least one study objective (Table 3-1).

Table 3-1. Habitat Restoration by Measure

MEASURE	TYPE OF HABITAT RESTORED		
	OYSTER REEF	TIDAL WETLAND	BANK-SHORELINE INTERFACE
Oyster Reef Habitat Restoration	X	X	X
Atlantic Ribbed Mussel Restoration		X	
Wetland Restoration Adjacent to Existing Wetland		X	
Grade Back Bank			X
Bank Fill			X
Coir Log and Bank Vegetation Planting			X

Because all six measures meet at least one study objective, they were all carried forward to be formulated into alternative plans.

### 3.4 ALTERNATIVES CONSIDERED

The initial array of alternatives was created by combining the six measures that were carried forward to create various plans. When formulating alternatives, the team ensured that a measure was included for restoration of each habitat type. Therefore, oyster reef was the only measure that could stand alone as an alternative plan as it is the only measure that meets all three study objectives. The rest of the measures each effectively only contribute to the restoration of one study objective. This also meant that each alternative must include the oyster reef measure in order to meet all three objectives as it is the only measure that would restore oysters in the study area. The Grade Bank Back and Bank Fill measures are independent and would not be included in the same alternative. Both measures are dependent on the implementation of the coir log/bank vegetation planting measure, which would ensure that the bank would not continue to erode. Coir/log Bank Vegetation Planting as a measure is not dependent on any other measure. Table 3-2 shows the initial array of alternatives.

Table 3-2. Initial Array of Alternatives

ALTERNATIVES	MEASURES					
	Oyster Reef Habitat Restoration	Atlantic Ribbed Mussel Restoration	Wetland Restoration Adjacent to Wetland	Grade Back Bank	Bank Fill	Shoreline Restoration - Coir log / Bank Vegetation Planting
No Action						
Alternative 1	X					
Alternative 2	X	X				
Alternative 3	X		X			
Alternative 4	X			X		X
Alternative 5	X				X	X
Alternative 6	X					X
Alternative 2-3	X	X	X			
Alternative 2-3-4	X	X	X	X		X
Alternative 2-3-5	X	X	X		X	X
Alternative 2-3-6	X	X	X			X
Alternative 2-4	X	X		X		X
Alternative 2-5	X	X			X	X
Alternative 2-6	X	X				X
Alternative 3-4	X		X	X		X
Alternative 3-5	X		X		X	X
Alternative 3-6	X		X			X
	Constitutes combinations of alternatives					

### Screening Criteria

Screening criteria were applied for each potential project alternative. The screening criteria included whether each alternative met the study objectives, whether the alternative included costly measures, and the whether the alternative had potential cultural resource impacts.

Table 3-3. Initial Array of Alternatives Screening Process.

ALTERNATIVE S	SCREENING CRITERIA					Carried Forward ?
	Meets Oyster Restoration Objective	Meets Tidal Wetland Restoration Objective	Meets Shoreline Interface Restoration Objective	Potential Cultural Resource Impacts	High Costs	
No Action/Future Without Project						YES
Alternative 1	X	X	X			YES
Alternative 2	X	X	X			YES
Alternative 3	X	X	X			YES
Alternative 4	X	X	X	X	X	NO
Alternative 5	X	X	X	X	X	NO
Alternative 6	X	X	X			YES
Alternative 2-3	X	X	X			YES
Alternative 2-4	X	X	X	X	X	NO
Alternative 2-5	X	X	X			YES
Alternative 2-6	X	X	X			YES
Alternative 3-4	X	X	X	X	X	NO
Alternative 3-5	X	X	X	X	X	NO
Alternative 3-6	X	X	X			YES
Alternative 2-3-4	X	X	X	X	X	NO
Alternative 2-3-5	X	X	X	X	X	NO
Alternative 2-3-6	X	X	X			YES

After this analysis, the final array of alternatives was developed. All alternatives which included bank fill and/or grading back the bank were screened out due to the reasons listed below.

#### Bank Fill Alternatives Screened Out

Area sources of fill are limited in the county and cost to haul from outside of the area will be costly. The soil in the area is clay sand mixture which is very erodible and hard to stabilize without additives and a topsoil cover which could be costly.

#### Grading Back the Bank Alternatives Screened Out

Grading back the bank was screened out because grading would adversely affect cultural

resources and would likely require costly mitigation. Additionally, grading back the bank would not accomplish the project’s goal of aquatic ecosystem restoration as a standalone measure.

### Alternative Placement

Using GIS and field survey data from site visits, the team assessed the best placement for the measures and alternatives (Figure 3-2).

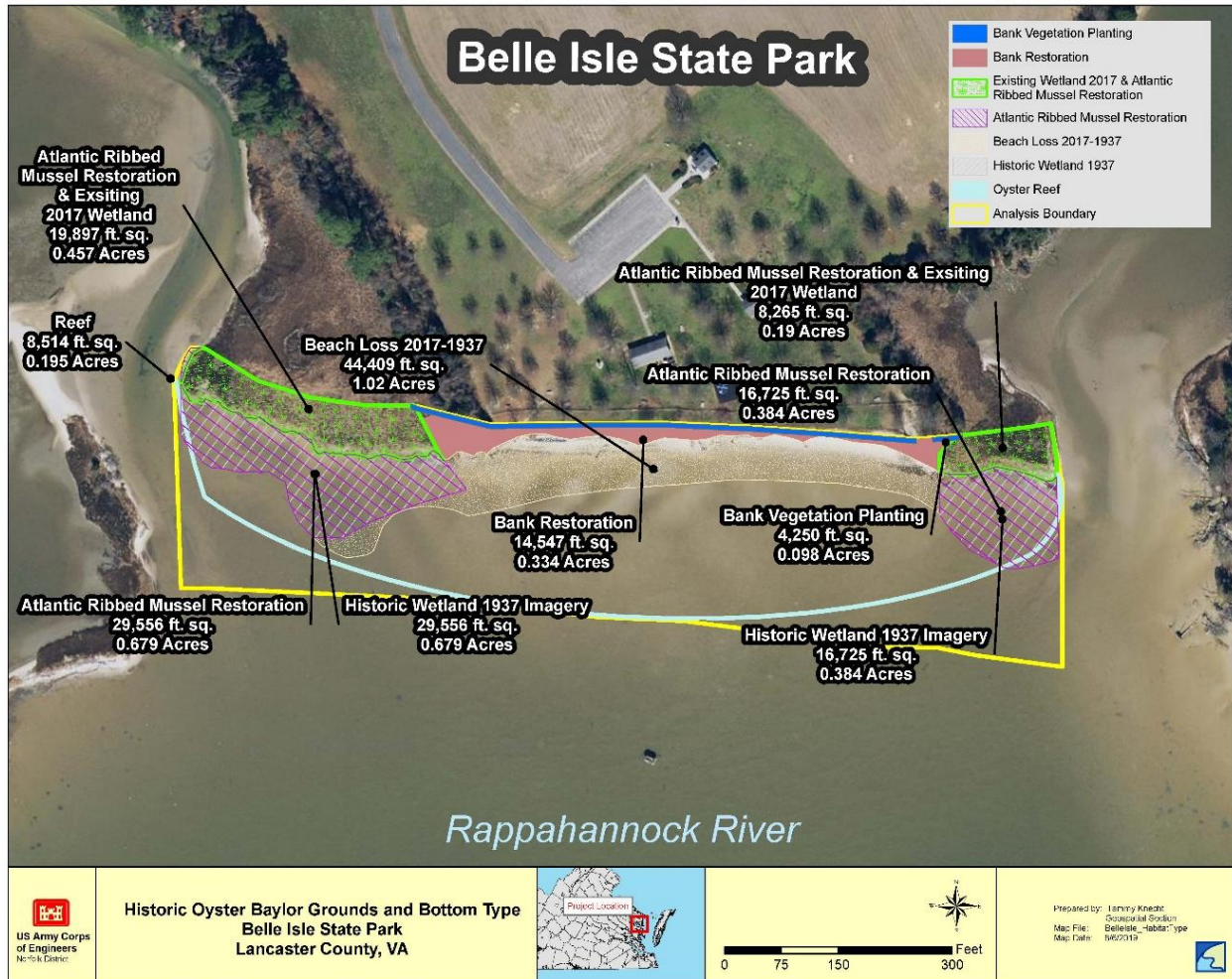


Figure 3-2. Measure Placement at Project Site.

The total amount of acreage in each measure (add for alternatives) is the following:

- Oyster Reef Habitat Restoration: **0.2 acres**
- Atlantic Ribbed Mussel Restoration at Existing Wetland Sites: **0.6 acres**
- Wetland Restoration Sites at Areas of Historical Loss (includes Mussel Restoration at Wetland Restoration Sites): **1.1 acres**
- Bank Restoration (with Coir Logs and Plantings): **0.3 acres**

### 3.4.1 Final Array of Alternatives

After screening out the alternatives that included bank fill and grading back the bank, the final array of alternatives included the following alternatives:

**Alternative 1:** Oyster Reef Restoration

**Alternative 2:** Oyster Reef Restoration and Mussel Restoration on Cordgrass at Existing Wetland Sites

**Alternative 3:** Oyster Reef Restoration and Wetland Restoration (including Mussel Restoration)

**Alternative 6:** Oyster Reef Restoration and Shoreline Restoration

**Alternative 2-3:** Oyster Reef Restoration and Mussel Restoration on Cordgrass at Existing Wetland Sites and Wetland Restoration (including Mussel Restoration on Cordgrass)

**Alternative 2-6:** Oyster Reef Restoration and Mussel Restoration on Cordgrass at Existing Wetland Sites

and Shoreline Restoration (with Native Plantings and Coir Logs)

**Alternative 3-6:** Oyster Reef Restoration and Wetland Restoration (including Mussel Restoration on Cordgrass) and Shoreline Restoration (with Native Plantings and Coir Logs)

**Alternative 2-3-6:** Oyster Reef Restoration, Mussel Restoration on Cordgrass at Existing Wetland Sites, and Wetland Restoration (including Mussel Restoration on Cordgrass) and Shoreline Restoration (with Native Plantings and Coir Logs).

### 3.5 COSTS OF CONSTRUCTION

The costs for constructing the different alternatives were developed using the Micro-Computer Aided Cost Estimating System. These amounts represent total or fixed fee cost estimates and are a conceptual representation of the approximate order-of-magnitude costs associated with the design concepts described. These estimates were based upon representative unit costs for similar construction projects in the area. All costs used in the comparison between alternatives are in October 2020 (Fiscal Year 2021) price levels, with a 2.50 percent discount rate used in present value and annualized over a 50-year period of analysis with a base year of 2022.

### 3.6 FIRST COSTS OF CONSTRUCTION

The costs for each alternative plan include the following: preconstruction, engineering, and design (PED); real estate; construction and plantings; construction management; contingency; and monitoring and adaptive management (AM). PED would include such costs as field surveys and investigations, design, preparation of specifications and construction drawings; and the development, approval, and execution of the project partnership agreement.

Real estate costs cover lands, easements, rights-of-way, relocations, and disposal areas (LEERD's). The non-federal sponsor, the State of Virginia, owns all the land within the project area. Therefore, the non-federal sponsor would accrue no real estate costs. Real estate assumptions and estimates have been updated since this analysis and are defined in more detail in the Real Estate Appendix. There are no federally owned lands within the project area.

### 3.7 COST EFFECTIVENESS / INCREMENTAL COST ANALYSIS (CE/ICA)

A Cost Effectiveness Incremental Cost Analysis (CE/ICA) was conducted to compare the focused array of project alternatives and identify the best buy plan(s). The CE/ICA included

cost inputs (cost of labor, materials, Operations and Maintenance (O&M)), and inputs from the ecological models that were utilized to estimate the ecological benefits of the focused array of project alternatives.

To determine the ecological benefits of the focused array of project alternatives, the Oyster Habitat Equivalency Analysis Model, the Atlantic Ribbed Mussel Habitat Equivalency Analysis Model, the New England Saltmarsh Model, the Great Blue Heron Suitability Model, and an Ecological Connectivity Model were used to assess the environmental benefits of the focused array of project alternatives.

The Oyster Habitat Equivalency Analysis Model was developed by the National Oceanographic and Atmospheric Administration (2000) and was used to assess the productivity of benthic invertebrate fauna across various benthic habitats. This semi-quantitative tool was used to evaluate the net natural resource benefits of different site-specific restoration actions. This model is approved by the National Ecosystem Restoration Planning Center of Expertise (ECO-PCX) for U.S. Army Corps of Engineers (USACE) ecomodeling regional applications (although model approval is not required for Continuing Authorities Project ecomodeling analyses). For this model all values were scaled from 0-1 with 1 representing the maximum productivity value for the native oyster (*Crassostrea virginica*). For open water habitats without shellfish USACE assumed a benthic productivity value of 0.013. With full restoration we assumed an oyster benthic productivity value of 1.0.

Mussels, like oysters, are ecosystem engineers, an organism that creates, significantly modifies, maintains or destroys a habitat where they are found in dense aggregations (Gutierrez et al. 2003). Besides benefits such as their filter feeding, which improves water quality, and the secondary production they provide as an important part of the estuarine food web, their shells and byssus threads can act to stabilize shorelines when they are found at high densities. A synergistic relationship exists between the Atlantic ribbed mussel and the saltmarsh cordgrass in which the deposition of nutrient rich feces from the mussels enhances cordgrass production, helping to create natural levees along the marsh edge. Further, along the edges of salt marshes of the U.S. Atlantic Coast, Atlantic ribbed mussels (*Geukensia demissa*) and cordgrass (*Spartina alterniflora*) form an important mutualistic relationship. Cordgrass provides habitat and promotes settling of ribbed mussels, which, in turn, stabilize and fertilize the cordgrass and sediment (Bertness 1984). Ribbed mussels are found at much higher densities along the marsh edge, relative to the interior, typically over 10 times as dense (Lin 1989), and it is at such densities, which can range to well over 1,000 mussels/m<sup>2</sup> (Bertness and Grosholz 1985) where they can provide protection against coastal erosion along the marsh edge. They are attracted to various substrates involved in construction of living shorelines, including the coir logs or shell bags used to stabilize newly planted marsh grasses, providing additional benefits and stabilization to newly restored shorelines, as well as on the cordgrass itself, which is their primary substrate (Moody et al. 2020).

Atlantic ribbed mussels also provide similar ecosystem services as oysters, including water filtration, which reduces Total Suspended Solids (TSS) and lowers Chlorophyll A, improving water quality (Riigard 1988). Oysters and ribbed mussels have a similar filtration rate per gram of live tissue weight (Kreeger et al. 2018), due to this mussel beds can have a significant positive impact on water quality, similar to thriving oyster reefs. Mussels also stabilize

sediments and provide food and/or shelter for other estuarine life, similar to oysters. However, while they can produce a dense mat of low-relief shell structure when they form dense aggregations, they do not form true reefs as oysters can, and are typically found living among marsh plants fixed to the plant stems, each other and the sediments.

The Atlantic Ribbed Mussel Habitat Equivalency Analysis Model was developed by the USACE, Norfolk District, to assess benefits of Atlantic Ribbed Mussel restoration for the Belle Isle Aquatic Ecosystem Restoration Project. This model is structured with similar model rules and parameters to the Oyster Habitat Equivalency Analysis Model in that it assesses productivity of benthic invertebrate fauna; however, this model includes productivity rates for the Atlantic Ribbed Mussel based on findings on mussels (Bertness and Grosholz 1985, Galimany et al. 2013, Kreeger et al. 2018) as described above. For this model, all values were scaled from 0-1 with 1 representing the maximum productivity value for the native Atlantic ribbed mussel (*Geukensia demissa*). USACE utilized a Mussel Habitat Equivalency Analysis value of 0.4 at the existing wetland sites containing mussels. For open water habitats without shellfish USACE utilized a value of 0.013. With restoration USACE utilized a mussel benthic productivity value of 1.0.

Due to the similarity in benefits, oysters and mussels could be rated much the same. However, due to the expected difference in density over the area where they are found, they cannot be given the same ranking. The majority of a given marshland's population of ribbed mussels will be found at high densities only along the edge, with far fewer in the interior (Bertness 1984). An oyster reef will typically have a relatively uniform distribution of oysters over the entire reef area. Due to this, we estimate that a given area of mussel habitat, including both the marsh edge and interior, will produce approximately 1/3 as many ecological benefits when compared to a similar-sized area of oyster reef.

The New England Salt Marsh Model developed by Mckinney et al. (2009) is used to assess wildlife habitat value based on marsh characteristics and presence of habitat types. This model is approved for regional use by the ECO-PCX. Scoring was done in accordance with the definitions and values as provided in Mckinney et al. (2009).

The Great Blue Heron Suitability Model developed by the (USFWS 1985) which is used to assess suitability of great blue heron foraging and nesting habitat and assesses the quality of foraging habitat, disturbance, and size of foraging habitat and potential for nest suitability. For this model all values were scaled from 0-1 with 1 representing the maximum suitability value for the native great blue heron (*Ardea herodias*). The modeling analysis was limited to the foraging index component of the model as the project would not affect any great blue heron nesting habitat (the other model values were held as constants as a value of one). For the analysis USACE assumed a foraging index value of 0.4 for the NAA/FWO and a foraging index value of 0.5 for the FWO to discern the benefits of the shoreline habitat both with and without future restoration efforts.

Ecological connectivity of habitats is necessary to allow for sustainable habitat and associated wildlife communities that can forage, migrate, shelter, and breed (Sheaves 2009). Ecological connectivity affects broad-ranging functions in the ecosystem including food-webs and predator prey relationships (Sheaves 2009). Fragmented habitats can lead to reduced foraging,

migratory, and breeding habitats for wildlife and potentially even declines and loss of wildlife communities and populations. Connectivity between different types of habitats can be essential for species and communities that rely on multiple habitats. As wetland and beach shoreline habitats support a complex and interconnected food web, the loss of habitats and wildlife corridors can disrupt species and communities that rely on the habitats and connectivity of the habitats.

While the New England Salt Marsh Model, the Atlantic Ribbed Mussel Habitat Equivalency Analysis Model, and the Great Blue Heron Suitability Model capture the benefits of the tidal wetland and beach shoreline habitats themselves, these models do not fully assess the ecological connectivity of the tidal wetlands and beach shoreline habitats and how restoration of habitats can benefit wildlife habitats and corridors. Therefore, an Ecological Connectivity Index was developed by the USACE, Norfolk District to assess potential wildlife habitat benefits associated with restoring the connectivity of the tidal wetland and beach shoreline habitats.

At the Belle Isle State Park, the study area includes a beach shoreline habitat that connects two tidal wetland habitats. The habitats provide for important wildlife corridors for species utilizing both habitats such as the diamondback terrapin (*Malaclemys terrapin*) and a variety of native mammal species. The diamondback terrapin relies upon beach habitat for breeding and nesting habitat while relying upon tidal wetlands for foraging and shelter habitat. Therefore, the connectivity of these habitats as a viable wildlife corridor is essential for species such as the diamondback terrapin. In addition, a variety of mammal species utilize both habitats for foraging and shelter and the beach habitat provides an important corridor for mammals and other wildlife traversing between the tidal wetland habitats.

An index was created to assess ecological connectivity over time of the tidal wetland and beach shoreline habitats over time that considers simulated shoreline loss rates. A geospatial analysis was conducted in ArcGIS to determine the rate of shoreline loss of tidal wetland and beach shoreline habitats at the Belle Isle State Park Study Area from 1937 – 2017 based on aerial imagery over time. The habitat loss rate based on the geospatial analysis was an estimated 0.84 feet/year. Annual shoreline loss rates at the study site were then simulated throughout the project period of performance. Based on the shoreline loss rates over time, we then estimated the linear connectivity of the tidal marsh and beach shoreline habitats over the project period of performance based on the proportional relationship of the remaining tidal wetland/beach habitat connectivity as compared to the average linear width of the tidal wetland and marsh habitat. Because there would also be shoreline loss prior to the start of the project period of performance, this shoreline loss was incorporated into the calculations based on the estimated shoreline loss rate of 0.84 feet/year. For this model all values were scaled from 0-1 with 1 representing the maximum ecological connectivity value for tidal marsh and beach shoreline habitats. In summary, an annual index score for each year in the period of performance was generated that calculated the estimated linear connectivity of the tidal marsh and beach shoreline habitats over time with simulated shoreline loss rates and restoration benefits. For the With Project Conditions with enhancement or restoration of the tidal wetland and the beach shoreline habitat, an ecological connectivity value of 1.0 was assumed. Habitat unit benefit calculations were restricted to the wildlife (linear) corridor that extends from the beach shoreline habitat to the edge of each of the respective wetland habitats.

The CE/ICA requires comparison of costs and benefits in average annual terms. Accordingly, total investment costs, rehabilitation costs, and maintenance costs were annualized over a 50-year period of analysis, using a 2.50 percent discount rate, and October 2020 (FY 2021) price levels. Likewise, benefits were annualized over a 50-year period of analysis starting in 2022.

Restoration of wetlands should improve habitat within the first year following the completion of construction. Likewise, restoration of oyster habitat is expected to attain full benefit within a short period of time. Therefore, for the economic analysis, full benefits are assumed to be realized the first year following construction and remained constant throughout the period of analysis. More detailed information on the ecomodeling analysis and annualization of costs and benefits can be found in Appendix E, Economics Appendix. Average annual ecosystem restoration benefits input into the CE/ICA are based on the habitat units for each of the metrics described previously. The detailed ecomodeling input and details on the ecomodeling models and methodology is described in the Environmental Appendix, A-9, Ecomodeling Analysis: Methodology and Summary of Results. A separate index was determined for wetland restoration, mussel restoration, and reef habitat creation. Each index was considered for each year over the 50-year period of analysis, then multiplied by the appropriate acreage to determine the total average annual habitat units (AAHUs) for each of the alternatives. The CE/ICAs were then performed using the average annual benefits, total net AAHU derived from the Future With Project (FWP) and Future Without Project (FWOP) AAHUs and the average annual cost for each alternative plan to determine the most cost-effective and efficient (best-buy) alternatives.

### 3.7.1 Alternative Plan/Cost Analysis

The CE/ICA analysis determined the best buy plans out of the final array of alternatives. The best buy plans represent the most efficient means of achieving the given level of benefit among the identified cost-effective plans. Typically, there are several iterations of incremental analysis to determine the most efficient plans for varying levels of benefit. However, in this case, the best buy plan has the lowest incremental costs per benefit yet produces the highest possible benefits amongst all the plans under consideration. Alternative 6 and Alternative 2-3-6 are the best buy plans according to the CE/ICA analysis and Alternative 3-6 is cost effective (Figure 3-3).

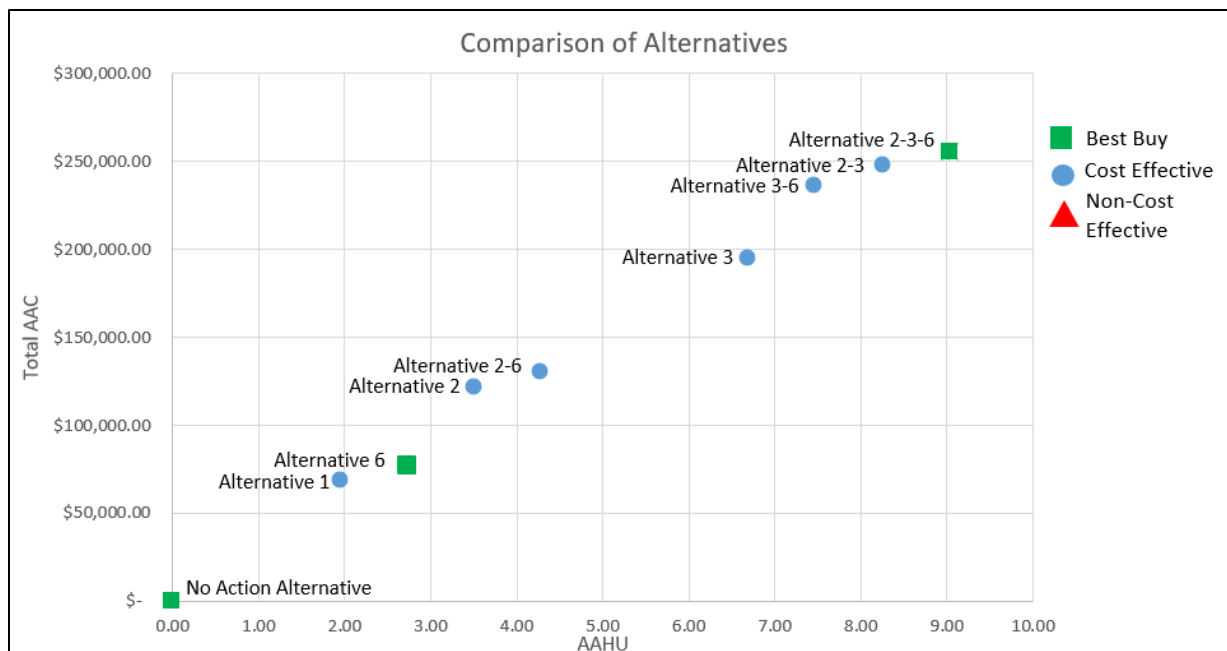


Figure 3-3. Comparison of Alternatives

Table 3-4 shows the calculations that are used to determine the average annualized cost for all alternatives. The first column shows the first costs, which are determined by the cost engineers, and include the costs of construction, design and implementation costs, construction management costs and monitoring and adaptive management costs. The second column is interest during construction (IDC), which assumes a 12-month construction period. The investment cost adds the first costs with the IDC. The average annual cost (AAC) assumes a 50-year project lifespan starting in year 2022 with a 2.50 discount rate. An O&M contingency is added to the AAC and is calculated using 1% of the construction costs. The O&M costs are then added to AAC to get a total AAC. These finalized costs are put into a USACE approved model called the IWR Planning Suite. The model provides the best buy alternatives, which are shaded green in Figure 3-3. Table 3-4 shows the relationship between cost and outputs for each alternative. It is worth noting the large gap between the lower four alternatives and the upper four alternatives.

Table 3-4 Comparison and Cost of Alternatives

Alternative	First Cost	IDC	Investment Cost	AAC	O&M	Total AAC
No Action	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Alternative 1	\$1,564,000	\$16,197	\$1,580,197	\$55,715	\$13,030	\$68,745
Alternative 2	\$2,790,000	\$28,893	\$2,818,893	\$99,389	\$22,310	\$121,699
Alternative 3	\$4,483,000	\$46,426	\$4,529,426	\$159,699	\$35,120	\$194,819

<b>Alternative 6</b>	<b>\$1,759,000</b>	<b>\$18,216</b>	<b>\$1,777,216</b>	<b>\$62,661</b>	<b>\$14,560</b>	<b>\$77,221</b>
<b>Alternative 2-3</b>	<b>\$5,709,000</b>	<b>\$59,122</b>	<b>\$5,768,122</b>	<b>\$203,373</b>	<b>\$44,400</b>	<b>\$247,773</b>
<b>Alternative 2-6</b>	<b>\$2,986,000</b>	<b>\$30,923</b>	<b>\$3,016,923</b>	<b>\$106,371</b>	<b>\$23,840</b>	<b>\$130,211</b>
<b>Alternative 3-6</b>	<b>\$5,603,000</b>	<b>\$58,024</b>	<b>\$5,661,024</b>	<b>\$199,597</b>	<b>\$36,660</b>	<b>\$236,257</b>
<b>Alternative 2-3-6</b>	<b>\$5,905,000</b>	<b>\$61,152</b>	<b>\$5,966,152</b>	<b>\$210,355</b>	<b>\$45,940</b>	<b>\$256,295</b>

Table 3-5 shows the incremental costs of the best buy alternatives. The incremental cost is the cost that would be required to add an additional habitat unit (HU) to the previous alternatives. For example, since the No Action/Future Without Project Alternative is the only alternative before Alternative 6, it requires \$28,391 to add an additional HU. That’s why the incremental cost for Alternative 6 is the same as its cost/AAHU. However, since Alternative 6 costs \$77,221 and has 2.72 HUs, it would require \$28,404, or the incremental cost of alternative 2-3-6, to add an additional HU.

**Table 3-5. Incremental Costs of Best Buy Alternatives**

<b><u>Measure</u></b>	<b><u>AAC</u></b>	<b><u>AAHU</u></b>	<b><u>Incremental AAC</u></b>	<b><u>Incremental AAHU</u></b>	<b><u>Incremental AAC per AAHU</u></b>
No Action	\$0	0	\$0	0	0
Alternative 6	\$77,221	2.72	\$77,221	2.72	\$28,391
Alternative 2-3-6	\$256,295	9.02	\$179,074	6.30	\$28,424

The reasoning behind the selection of a plan is discussed in the following section which describes the Recommended Plan. Please refer to the detailed economics analysis found in Appendix E, Economics for more information on the CE/ICA results and findings.

### 3.7.2 Alternative Plan Recommended

The alternative plans were evaluated for effectiveness, efficiency, completeness, and acceptability. The impacts of alternative plans were evaluated using the system of accounts framework (National Ecosystem Restoration, Environmental Quality, Regional Economic Development, and Other Social Effects).

The plan that reasonably maximizes NER and is consistent with the federal objective is identified as the NER Plan. Alternative 2-3-6 was selected as the NER/Recommended Plan because it provides the most AAHU and the incremental cost is only 13 dollars greater than Alternative 6, so more output is provided with a negligible increase in incremental cost. Additionally, Alternative 2-3-6 will provide mussel and wetland restoration, which Alternative 6 does not provide. These measures better complete the objectives of the project and cover all the necessary planning criteria. After completion of this analysis and selection of Alternative 2-

3-6 as the Recommended Plan, costs were further refined for this plan using MII software and incorporating results of an abbreviated risk analysis. The refined total project cost, when escalated to be fully funded over the life of the project, is below the \$10 million federal cost limit for CAP 206 projects.

## 4. RECOMMENDED PLAN

### 4.1 DESCRIPTION OF THE RECOMMENDED PLAN

The Recommended Plan (or Preferred Alternative) will restore substantive ecological resources that are currently degraded at Belle Isle State Park. Present day oyster populations in the Rappahannock River are a fraction of their historic records. There has been substantive tidal wetland and associated Atlantic ribbed mussel habitat and beach shoreline habitat loss at the study area. This project will provide an opportunity to restore this river to more historical conditions and substantively benefit fish and wildlife habitat. The Recommended Plan is Alternative 2-3-6, which consists of oyster reef restoration, Atlantic ribbed mussel restoration, wetland restoration and shoreline restoration. The Recommended Plan is a best buy plan. The ecological benefits associated with the Recommended Plan are estimated to include 9.02 habitat units for Alternative 2-3-6 and meet all project objectives. Therefore, the Recommended Plan is acceptable, efficient, effective, and complete.

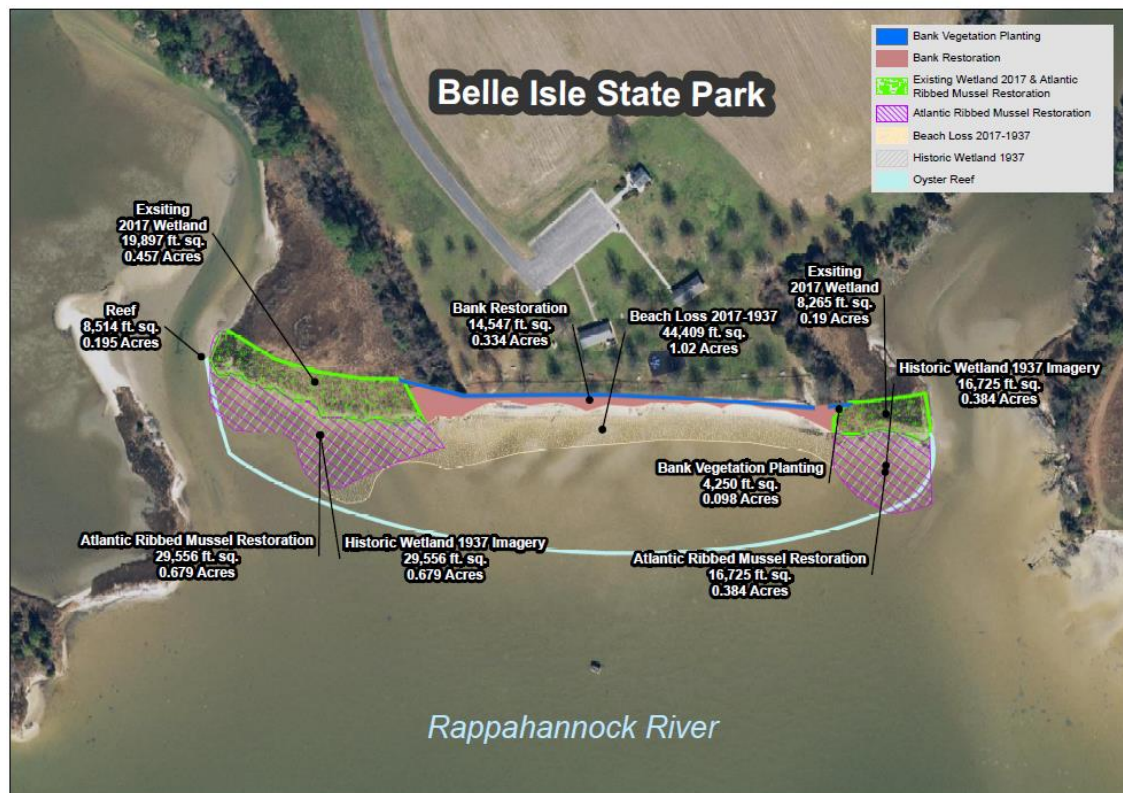


Figure 4-1. Location of the Recommended Plan

### 4.2 PROJECT COMPONENTS

The oyster restoration will consist of the placement of approximately 670 three-dimensional artificial reef structures in the subtidal to intertidal zone in two layers of arcs around the beach area of 0.2 acres. Each reef structure will be approximately 2 feet in height and 3 feet in diameter. The Rappahannock River provides conditions suitable for oysters, and there are

historical oyster grounds (Baylor grounds), private oyster leases, and public oyster harvest reefs in the study area vicinity. Prior to the initial oyster reef placement, a topographic survey would be conducted to establish and measure reference wetland elevations and to identify the exact locations and specifications of the oyster reefs.

Atlantic ribbed mussel restoration would consist of propagation of mussels from an existing native population on native cordgrass plugs that would then be planted in the existing wetland habitat. Atlantic ribbed mussels are commonly found within cordgrass-dominated salt marshes throughout the Chesapeake Bay, including the project site where they were observed in large quantities. The mussels improve water quality as a result of their water filtration capacity. They also serve as a valuable food source for shorebirds and other foraging species such as blue crabs (*Callinectes sapidus*). The mussels naturally attach to the roots of the native grasses and will assist in anchoring the wetland plants and will add to the overall ecosystem services that the habitat provides.

The shoreline restoration would consist of placement of coir logs at the bank/shoreline interface and then planting native plants adjacent and along the coir logs. The coir logs would be made of biodegradable material that would be staked in place.

The assumed project lifecycle is approximately 50 years. The project construction is anticipated to begin in year 2022. The average annual cost (AAC) associated with the Recommended Plan (Alternative 2-3-6) is estimated to be \$261,355. The ecological benefits are estimated to be 9.02 AAHU, as determined by the New England Salt Marsh model for Alternative 2-3-6.

Table 4-1. Annual Average Habitat Units

Alternative	Net AAHU	Total AAC	AAC/AAHU	Total First Cost (FY21)
Alternative 2-3-6	9.02	\$261,355	\$28,976	\$5,905,000

The Total Fully Funded Cost, with escalation through the midpoint of each construction element is estimated at \$6,161,000, with the 65% federal cost share \$4,004,650 and 35% non-federal cost share \$2,156,350. A breakdown of the project costs, as well as average annual costs and average annual benefits of the Recommended Plan are provided in Table 4-2.

Table 4-2. Recommended Plan Costs and Benefits

Project Costs	Recommended Plan
	Alternative 2-3-6
<b>a. Project First cost</b>	
1. Contractors Earnings + Contingencies	\$5,076,000
2. Engineering and Design	\$305,000
3. Supervision and Administration	\$152,000
4. Lands and Damages	\$372,000
<b>Total First Cost</b>	\$5,905,000
<b>b. Investment Costs</b>	
1. Total First Costs (Incremental Costs)	\$5,905,000
2. Interest During Construction	\$67,972
<b>Total Investment Costs</b>	\$5,972,972
<b>c. Average Annual Costs</b>	
Average Annual Investment Costs	\$210,595
OMRR&R	\$50,760
<b>Total Average Annual Costs</b>	\$261,355
<b>II. Benefits</b>	
a. Ecosystem Restoration Benefits (AAHU)	9.02
b. Average Cost per Unit of Habitat	\$28,976

OMRR&R = Operations, Maintenance, Repair, Replacement, and Rehabilitation

### 4.3 PROJECT SPONSOR COSTS

The apportionment of the construction costs for the Recommended Plan (Alternative 2-3-6) of federal and non-federal costs is presented below for the project. As shown in Table 4-3, the non-federal sponsor would be responsible for providing a total of approximately \$1,846,350 in

cash and/or work-in-kind and real estate.

Table 4-3. Apportionment of Federal and Non-Federal Construction Costs

	Federal Share	Non-Federal Share	Total
<b>Design &amp; Implementation</b>			
Design	\$202,800	\$109,200	\$312,000
Implementation	\$3,554,850	\$1,914,150	\$5,469,000
LERRDs	\$247,000	\$133,000	\$380,000
<b>Total Project Cost</b>	<b>\$4,004,650</b>	<b>\$2,156,350</b>	<b>\$6,161,000</b>
LERRD Credit		(\$310,000)	
<b>Cash Contribution</b>	<b>\$4,004,650</b>	<b>\$1,846,350</b>	<b>\$5,851,000</b>

#### 4.4 PLAN IMPLEMENTATION

##### 4.4.1 Adaptive Management and Monitoring

The Environmental Appendix provides an Adaptive Management and Monitoring Plan for the project. Monitoring and maintenance will occur for approximately five years post construction for the wetland and shoreline restoration features. Oyster and mussel reefs will be evaluated for success for six years post construction. This plan serves as the overall guide for how to monitor the wetland and bank enhancement actions as well as oyster and mussel reefs planned with implementation of Alternative 2-3-6. This plan describes adaptive management for the project (if needed) and provides metrics for evaluating success. This plan is not intended to be a static document, but rather, a dynamic document that will be updated as necessary to reflect the science-based restoration goals and strategies for the project. Any changes to the adaptive management plan after construction will be coordinated with USACE Headquarters Chief of Planning.

##### 4.4.2 Monitoring and Maintenance

Once the monitoring and maintenance period has been completed (5 years for wetlands/bank, 6 years for oysters/mussels), the operations, maintenance, repair, replacement, and rehabilitation shall be the primary responsibility of the non-federal sponsor.

#### 4.5 REAL ESTATE CONSIDERATIONS

The Real Estate Plan (Appendix B) is presented in support of the Belle Isle, Section 206 feasibility study, and describes the real estate required to implement the project. The purpose of the Real Estate Plan is (1) to identify the lands, easements, right-of-way, relocations, and disposal sites (LEERD) necessary to support construction, operation, and maintenance of the proposed project elements described in the IFR/EA (2) to outline the costs and real estate considerations associated with project implementations; and (3) to assess the non-federal sponsor’s capability for LEERD acquisition.

There are no federally owned lands within the project area. The non-federal sponsor, the Commonwealth of Virginia, owns all the land within the project area. This project will require use of 1.8 acres of the State Park Lands. The 1.8 acres of park equates to \$310,000 in LERRD crediting based on assessor data. No other existing federal projects are within the required LERRD for this project.

#### 4.6 RISK AND UNCERTAINTY

One potential risk to the project is the underestimation of the projected relative sea level rise or change. This could result in future inundation of the wetland and bank restoration sites especially during major storm events. The intermediate sea level change curve currently best approximates the existing field data for the nearest gauge data and was used for plan formulation and evaluation. However, to assess potential risks and uncertainties, the USACE low and high sea level change scenarios were also considered in this analysis to assess how potential project benefits and costs could be affected under these scenarios. For every estimated 0.3 feet increase in sea level rise, USACE assumed that wetland maintenance would be required over the project period of performance. These adaptive management actions would consist of placing additional sand material on the wetland system and potentially additional cordgrass (*Spartina alterniflora*) to maintain the proper elevations and native vegetation species for a cordgrass dominated marsh. The Adaptive Management and Monitoring Plan in the Environmental Appendix explains in detail how USACE plans to adapt to rising sea levels and shoreline loss.

The Rappahannock River is a highly productive system for oysters, whether on public or private grounds. However, for there to be a high amount of recruitment on the oyster reef structures, there needs to be a sufficient quantity of oyster larvae. Regional weather patterns significantly influence oyster recruitment on an annual and even seasonal basis, as does standing stocks (including their location and density) of adult oysters in the river. As with any restoration efforts of reef habitat, the risk of illegal harvest or poaching is always a consideration. However, USACE has minimized this risk by utilizing artificial reef structures where poaching would be highly unlikely (as the reef structures would damage oyster harvesting equipment). Predation of the oysters at various age classes and disease can also cause extensive mortality.

The USACE has not previously done mussel propagation projects, therefore, there is some uncertainty how successful this measure will be for this project. However, the USACE has consulted with other mussel propagation experts as well as the Virginia Institute of Marine Science during the feasibility study to better understand the feasibility of this measure. Also, the USACE would utilize monitoring and adaptive management to help assess restoration progress and modify restoration methodologies as needed. Therefore, this risk has been minimized to the extent practical.

There are three low rated risks associated with the cost comparison and incremental cost analysis of the alternatives. First, the weighting used for each environmental model favors the oyster reef model over the other models. This could favor a specific alternative, when, the alternative may not produce the most habitat units. Finally, the O&M costs added to AAC is a

contingency added to count for any unexpected maintenance after construction is completed. Because the O&M costs are currently unknown, there is a chance that the chosen alternative will have greater maintenance requirements than originally expected.

#### 4.7 BEST MANAGEMENT PRACTICES

Impact evaluations conducted during preparation of this IFR/EA have determined that no significant impacts would result from implementation of the Recommended 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 (Table 4-4) that would be implemented with the Recommended Plan, to the maximum practical extent, for impact avoidance and minimization.

Table 4-4. Best Management Practices

Stage/Step	Best Management Practices for On Land Activities	Best Management Practices for In Water Activities
Mobilization/ Demobilization/ Site Preparation	<ul style="list-style-type: none"> <li>- Avoid placing staging areas or structural measures in established wildlife habitat, use the same pathway to transport supplies and materials for bank and wetland planting to minimize impacts.</li> <li>- Geese fencing will be placed around the newly planted wetlands/bank to ensure the plants get established and prevent geese predation.</li> <li>- Ensure any tracks on grass from equipment are minimized and filled prior to construction completion.</li> <li>- No unnecessary idling of trucks or other equipment shall occur when not in use during construction.</li> <li>- Avoid placing staging areas or structural measures on wetlands.</li> <li>- No use of heavy equipment to crush any resources on the bank.</li> <li>- Use the coarsest, cleanest sand possible to prevent loss.</li> <li>- Use high density coir logs.</li> <li>- Avoid placing staging areas or structural measures along the bank near cultural resources.</li> <li>- One pathway to and from the beach to the wetland planting locations to avoid</li> </ul>	<ul style="list-style-type: none"> <li>- No unnecessary idling of vessels or other on water equipment shall occur when not in use during construction.</li> <li>- Avoid placing staging areas or structural measures in the water.</li> <li>- Construction equipment would be properly maintained to minimize the effects of the noise and to reduce any associated noise impacts.</li> <li>- Construction areas and equipment would be properly marked and fenced so any Park visitors wouldn't be at risk of injury.</li> <li>- Avoid placing staging areas or structural measures in areas used for recreational purposes, i.e. parks, walkways, boating facilities, etc.</li> <li>- Oyster reef has signage installed to warn boaters, and other recreational water activities.</li> </ul>

	<p>multiple trails across and near cultural resource sites.</p> <ul style="list-style-type: none"> <li>- Use synthetic mats on wetland areas to avoid damages.</li> <li>- Material staging areas would be restricted to uplands.</li> <li>- Avoid placing equipment in areas of recreation for the park during construction; such as the picnic, playground and beach areas when appropriate.</li> <li>- Flag or mark all non-impacted surface waters within the project or right-of-way limits that are within 50 feet of any clearing, grading or filling activities for the life of the construction activity within that area.</li> </ul>	<ul style="list-style-type: none"> <li>- Lay reef design out on land or on the barge prior to installation to ensure design placement is understood.</li> <li>- Prepare and implement a Spill Prevention Plan; employ measures to prevent spills of fuels or lubricants into state lands and waters.</li> </ul>
<p>General</p>	<ul style="list-style-type: none"> <li>- Park officials should have a continuous outreach and education plan in place for park guests to understand the types of flooding, flood mitigation activities, living shorelines and erosion control.</li> <li>- If HRTW materials or underground storage tanks are found, the project specifications would include procedures that require that they be handled and disposed of in a lawful manner.</li> <li>- The project specifications would include a spill prevention and control plan for vehicles and equipment.</li> <li>- Coordination prior to inland construction activities beginning would be conducted to ensure compliance with all local regulations regarding noise and vibration levels.</li> <li>- Coordination with all applicable emergency service agencies, local, state, and federal regulatory agencies, and the general public would be conducted to ensure that safety concerns are all addressed, to include those specific to evacuation measures.</li> <li>- Coordination with all applicable emergency service agencies, local, state, and federal regulatory agencies, and the general public would be</li> </ul>	<ul style="list-style-type: none"> <li>- An Accident Prevention Plan would be strictly adhered to during construction.</li> <li>- Coordination with all applicable emergency service agencies, local, state, and federal regulatory agencies, and the general public would be conducted to ensure that safety concerns are all addressed, to include those specific to evacuation measures.</li> <li>- Hard hats, steel toed boots and other safety equipment would be used during reef placement.</li> <li>- A spill prevention and control plan would be implemented to reduce any potential exposure of hazardous materials to workers.</li> <li>- Barge will be operated at approximately 10 knots or less to reduce any potential interactions with marine mammals and sea turtles.</li> </ul>

	<p>conducted to ensure that safety concerns are all addressed, to include those specific to evacuation measures.</p> <ul style="list-style-type: none"> <li>- An Accident Prevention Plan would be strictly adhered to during construction.</li> </ul>	
<p>Construction</p>	<ul style="list-style-type: none"> <li>- Minimize the use of obtrusive signs on or near the wetland plantings.</li> <li>- Fugitive dust must be kept to a minimum. Dust minimization measures would be implemented as needed.</li> <li>- For wetland restoration, utilize fill with soils of similar grade and composition</li> <li>- Bank vegetation and wetland restoration construction would follow a timeline to not close the area for longer than needed, impacting visitor incentive to the Belle Isle State Park.</li> <li>- Existing wetland plants and bank vegetation will be replaced if damaged during restoration.</li> <li>- All new wetlands and plants will be marked with appropriate signs to avoid visitor impacts.</li> <li>- Planting native vegetative seed mixes on disturbed land after construction is complete.</li> <li>- Shoreline plantings and construction will consider time of year to avoid impacts to nesting diamondback terrapins or their already established nests (late spring-early fall).</li> <li>- Preserve top 12 inches of material removed from wetlands for use as wetland seed and rootstock in the excavated areas.</li> <li>- Erosion and sedimentation controls designed in accordance with the Virginia Erosion and Sediment Control Handbook.</li> </ul>	<ul style="list-style-type: none"> <li>- Incorporate three-dimensional reef structures into existing viewshed as seamlessly as possible.</li> <li>- Minimize the use of obtrusive signs on or near the oyster reef.</li> <li>- Use of silt/turbidity curtains (or other equivalent methods) to reduce sedimentation due to construction activities.</li> <li>- Artificial reef placement would be in an arched shape to mirror the natural shoreline and local hydrology.</li> <li>- Placement of artificial reef structures would be within the months of natural oyster recruitment (April-September) to reduce the risk of sedimentation on the reef prior to spat set.</li> <li>- Placement of the reef should be on hard bottom (where possible) to reduce sinking and reduce any potential TSS and turbidity in the water column.</li> <li>- For the reef restoration design, ensure to allow enough spacing for boaters to traverse the reef to the beach habitat.</li> <li>- If shell bags are used for additional stabilization and habitat, use biodegradable bags.</li> <li>- During construction, do not impede vessel ingress/egress through navigation channels adjacent to proposed structural measures to the maximum extent practicable.</li> <li>- If stone is placed in or near the water, ensure it is clean stone free from dirt and debris.</li> </ul>

		<ul style="list-style-type: none"><li>- Appropriate curing of reef material (at least 30 days) to ensure material is dry prior to being placed in the water.</li></ul>
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## 5. ENVIRONMENTAL CONSEQUENCES

This chapter describes the existing and projected future conditions for each of the resources that reasonably could be expected to be impacted by the project. These conditions are described without implementation of the Recommended Plan and with implementation of the Recommended Plan (Alternative 2-3-6). The comparison of the No Action/Future Without Project Alternative provides a baseline for comparison to evaluate the action alternatives (Alternative 1, Alternative 3-6 & Alternative 2-3-6).

Potential cumulative effects to each resource area are also described in this section. Cumulative effects are those potential effects that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable actions. Cumulative effects will consider the potential effects of climate change and the VDOT shoreline stabilization project on the adjacent Belle Isle State park shoreline.

Guidelines established by the CEQ (40 CFR 1508.27) specify that the significance of an impact should be determined in relationship to both context and intensity (severity). The assessment of potential impacts and the determination of their significance are based on the requirements of 40 CFR 1508.27. Three levels of impact can be identified:

- No impact – No impact is predicted;
- Less than significant impact – An impact is predicted, but the impact does not meet the intensity/context significance criteria for the specific resource;
- Significant impact – An impact is predicted that meets the intensity/context significance criteria for the specific resource.

Impacts are defined in general terms and are qualified as adverse or beneficial and as temporary or permanent. Beneficial impacts provide desirable situations or outcomes; whereas adverse impacts may negatively impact a resource area. Temporary impacts will result from construction during the project, whereas permanent impacts are long-term effects following construction of the project. Negligible impacts are localized and are generally not measurable. Minor impacts are localized and slight but detectable; moderate impacts are readily apparent and appreciable, and major impacts are severely adverse or highly noticeable and considered to be significant.

Moderate impacts may not meet the criteria to be classified as significant, but the degree of change is noticeable and has the potential to become significant if not effectively mitigated. Additionally, CEQ regulations (at 40 CFR § 1508.20) further define mitigation in the following five ways, in order of preference:

1. Avoiding the impact altogether by not taking a certain action or parts of an action.
2. Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
3. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
4. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
5. Compensating for the impact by replacing or providing substitute resources or

environments.

The means for reducing adverse environmental impacts, including the use of BMPs, are also discussed for each resource area where appropriate.

## 5.1 AESTHETICS

### 5.1.1 No Action /Future Without Project Alternative

Implementation of the No Action/Future Without Project Alternative would change the visual landscape within the ROI as the shoreline continues to erode. The landward retreat of the existing tidal marshes would decrease habitat availability and biodiversity of foraging marsh species, such as wading birds and waterfowl. The adjacent upland areas would continue to be subject to further erosion, potentially threatening the long-term survival of trees within the existing riparian buffer and overall viewscape. The absence of shoreline protection coupled with the existing site conditions, including the large fetch, would continue to leave the site vulnerable during coastal storms. Land subsidence and wetland loss is anticipated to increase in response to sea level rise placing the tidal wetland marsh interface on the north bank of the Rappahannock River in Belle Isle State Park at risk of continued degradation, and ultimately loss of the beach area. Loss of the beach area would affect the aesthetics of the beach area looking outward toward the Rappahannock River. Continued erosion would also require the repositioning of the adjacent picnic and playground area on the Park property.

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. It would result in predicted permanent, minor, adverse changes of loss to the visual resources within the ROI.

### 5.1.2 Alternative 1: OYSTER REEF RESTORATION

Within the ROI, 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.

Oysters have evolved to live in both subtidal and intertidal conditions. Alternative 1 proposes to place alternative substrates for oysters to attach at a subtidal to intertidal site. Temporary aesthetics of the river viewshed will be impacted with the presence of the barge and other construction equipment. Once construction is completed, all equipment would leave the area and depending on where the reef is placed, will determine if the reef is visible during tidal cycles. Reef structures would potentially be visible from the shoreline during certain tidal conditions. Belle Isle State Park could use this visual reef as an education tool for its visitors, to explain the many benefits of oysters and how they are helping protect the shoreline through wave attenuation. Depending on the viewpoint of the person in the landscape, the view of the oyster structures could potentially be adverse. Staging areas and placement of the reef structures in the water and potentially maintenance activities would recreate an adverse, minor, and temporary impact in the visual landscape. A piling with necessary signage would be placed to ensure the safety of all recreational and commercial water activities. Therefore, the installation of oyster reefs in Alternative 1 are temporary to permanent, beneficial to adverse

and minor.

Climate change impacts such as increased temperatures, sea level rise, and changes in currents and weather patterns are predicted to continue in the future. Alternative oyster reef structures would assist in minimizing wave impacts, reducing the continued erosion during major weather events. Climate change impacts have the potential to influence the topography of the estuarine ecosystem and the land within the ROI. Implementation of the Project Alternative 1 is not predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.1.3 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Alternative 3-6 would restore the eroding and fragmenting wetlands by planting native, tidal grasses and Atlantic ribbed mussels as well as building the alternative structure oyster reef as described in Alternative 1. The eroding marshes look patchy, bare and undercut in some areas, with small pools of open water where marshes used to be. Implementation of this alternative would alleviate these fragmented areas, providing more lush grasses teaming with wildlife. The construction equipment to plant the vegetation would only be temporary, with long term visual benefits. The steep slope of the bank from the fast rate of erosion is causing trees to fall over into the marsh and nearby recreational beach. Planting along the bank and the use of coir logs would enhance the visual appearance of the shoreline, and maintain a sandy, recreational beach for visitors. The aesthetic impacts of Alternative 3-6 are temporary during construction to permanent post construction, adverse to beneficial and minor. Implementation of the Project Alternative 3-6 is not predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.1.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Oyster reef, wetland restoration, and mussel restoration aesthetic impacts would be similar to those described in Alternative 3-6. Permanent, adverse to beneficial, temporary to permanent impacts would result from this alternative, with minor changes to the viewshed. Implementation of the Project Alternative 2-3-6 is not predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.1.5 Best Management Practices

Best Management Practices to ensure that visual resources and aesthetics of the area are impacted to a lesser extent are:

- Incorporate three-dimensional reef structures into the existing viewshed as seamlessly as possible;
- Minimize the use of obtrusive signs on or near the oyster reef and wetland plantings, and
- Ensure any tracks on grass from equipment is minimized and filled prior to construction completion.

### 5.1.6 Cumulative Impacts

The future shoreline restoration project planned by VDOT would likely have temporary, minor adverse impacts to the viewshed in the ROI during construction; however, cumulative, long-term effects to the viewshed would be expected to be beneficial due to the shoreline restoration at both sites. Although the long-term effects of climate change have the potential to adversely impact shorelines in the ROI, implementation of any of the above action project alternatives would not be anticipated to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

## 5.2 AIR QUALITY

### 5.2.1 No Action/Future Without Project Alternative

With the No Action Alternative/Future Without Project Alternative, the proposed action would not occur and there would be no change to baseline air quality conditions. Implementation of the No Action/Future Without Project Alternative would not be predicted to result in cumulative impacts to air quality.

### 5.2.2 Alternative 1: OYSTER REEF RESTORATION

Minor and temporary adverse effects to air quality would occur from implementation of Alternative 1. These effects would result from the combustion of fossil fuels during construction of the proposed oyster reef. The reefs could be potentially be placed by a boat and/or barge with a crane or mechanical bucket. The temporary actions associated with construction would not be anticipated to result in measurable changes to regional air quality.

Therefore, minor impacts to air quality would occur as a result of implementation of Alternative 1. Implementation of the No Action/Future Without Project alternative would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.2.3 Alternative 3-6: OYSTER REEFS + WETLAND RESTORATION + SHORELINE RESTORATION

The most aggressive restoration efforts planned for the wetland and bank restoration sites would require the use of an excavator, a bulldozer, and dump trucks.

Adverse, temporary and minor impacts caused by air pollution would be primarily caused by increased temporary emissions of carbon monoxide, hydrocarbons, and nitrous oxides from the operation of the necessary equipment. Short-term health impacts that have been reported caused by air pollution include irritation to the eyes, nose, and through and upper respiratory infections such as bronchitis and pneumonia. Headaches, nausea, and allergic reactions can also result from short-term exposure. Additionally, short-term air pollution can aggravate the medical conditions of individuals with asthma and emphysema.

Implementation of this alternative is not predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects. It would result in temporary, minor, adverse changes to air quality within the ROI.

#### 5.2.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts for this alternative would be similar to those described for Alternative 3-6. There would be a minor increase in air emissions associated with the additional mussel restoration activity. This would require additional vehicle/equipment and potentially boat, and barge operations as compared to Alternative 3-6. These temporary, minor increases in emissions would not be predicted to result in measurable changes to the regional air quality.

The addition of the mussel reefs will enhance the health of the wetlands and improved nutrient cycling will occur. Atmospheric carbon in the soil will be fixed and sequestered due to the enhanced productivity from nitrogen uptake within the wetland community (PDE 2015).

Alternative 2-3-6, would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.2.5 Best Management Practices

For any potential final alignments, avoidance and minimization practices will be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to air quality during temporary construction conditions:

- No unnecessary idling of trucks, vessels or other equipment shall occur when not in use during construction.
- Fugitive dust must be kept to a minimum. Dust minimization measures would be implemented as needed such as the installation and use of hoods, fans and fabric filters to enclose and vent the handling of dusty materials, covering open equipment conveying materials, and the prompt removal of spilled or tracked dirt or other materials/sediments.

#### 5.2.6 Cumulative Impacts

Cumulative effects to air quality resulting from VDOT's future shoreline restoration project VDOT at the adjacent Belle Isle property in conjunction with the implementation of any of the above alternatives would be considered minor. Similar construction equipment to the current proposed project would be expected to be used resulting in temporary and localized impacts to air quality. Implementation of the alternatives are not predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects. The cumulative impacts to air quality would be minor and would not result in measurable changes to regional air quality.

### 5.3 BATHYMETRY, HYDROLOGY, AND TIDAL PROCESSES

#### 5.3.1 No Action/Future Without Project Alternative

With the No Action Alternative/Future Without Project Alternative, baseline bathymetric conditions and tidal processes would continue to persist in the short-term. Over time, however, the loss of existing tidal marsh habitat coupled with rising sea levels could potentially influence localized hydrology and bathymetry.

Climate 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 nature and character of the estuarine ecosystem in the ROI. Sea level rise would increase water levels in the ROI.

The No Action/Future Without Project Alternative would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects; adverse impacts would be temporary and negligible to minor.

### 5.3.2 Alternative 1: OYSTER REEF RESTORATION

During construction of the oyster reef, turbidity would increase along with Total Suspended Solids (TSS) in the water column during placement of the reef materials on the subaqueous bottom. However, suspended solids would settle out of the water column following the placement of reef materials and the site would quickly return to ambient conditions. Reef construction would alter the physical bottom type in the construction area from an open water sandy habitat to one containing oyster structures made of alternative substrate. This would encourage more tidal mixing and primary production. The oyster reef structures would permanently alter the bathymetry of the project site, restoring the bottom to a more historic topography when oyster reefs were present in this area.

Hydrologically, it has been shown that artificial reef structures, create more productive turbulence in the water column. The presence of a three-dimensional reef structure would supply more oxygen to the aquatic environment and assist in turning excess nutrients, such as nitrogen into gas form, so it can be diffused and removed from the ecosystem (Chesapeake Bay Foundation). See Figure 5-1 below. There would be beneficial, minor, permanent impacts to bathymetry, hydrology, and tidal processes from the oyster reefs.

The artificial reef structures would not be anticipated to have any adverse impacts on tidal processes in the area. Alternative 1 is would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

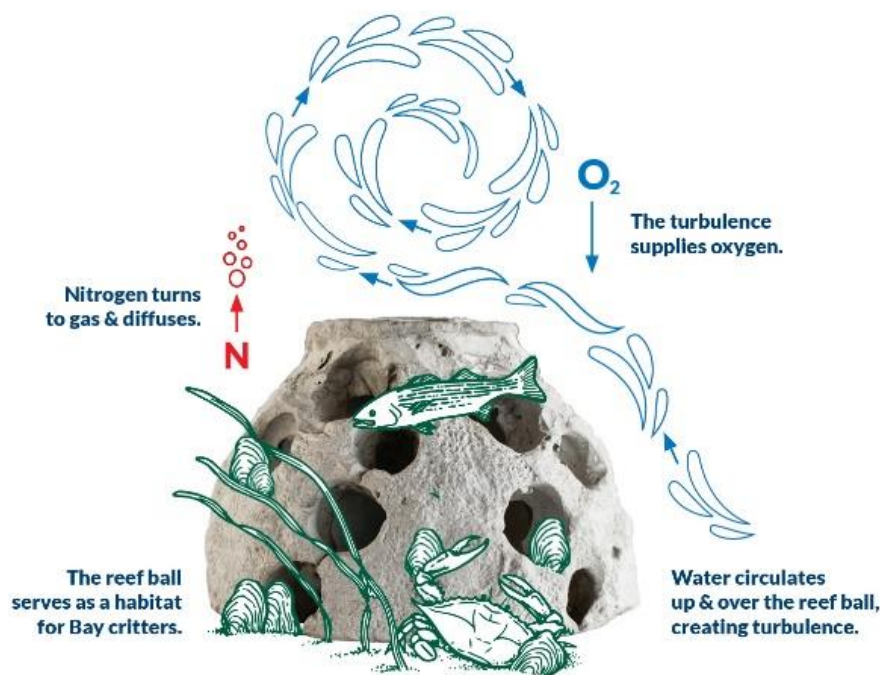


Figure 5-1. Example Reef Ball Structure (CBF 2020).

### 5.3.3 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

With Alternative 3-6, the oyster reef installation would be accompanied by wetland and shoreline restoration. Impacts from the oyster reef would be as those described in Alternative 1.

The wetland restoration would serve to further help restore the native topography, bathymetry, and overall tidal processes in the ROI.

This alternative would provide beneficial, permanent, and minor impacts to the bathymetry, hydrology, and tidal processes. Alternative 3-6 would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.3.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts from this alternative would be as those described for Alternative 3-6.

### 5.3.5 Best Management Practices

For of any of the action alternatives, avoidance and minimization practices would be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to bathymetry, hydrology and tidal processes include:

- Use of silt curtains (or other equivalent methods) to reduce sedimentation due to construction activities.

- Avoid placing staging areas or structural measures in wetlands.
- Artificial reef placement would be in an arched shape to mirror the natural shoreline and local hydrology

### 5.3.6 Cumulative Impacts

VDOT's project proposes to place multiple breakwaters within their site, which could influence the transport of sand and sediment within the ROI, altering the bathymetry and hydrology of the action area. These impacts would be permanent, adverse and minor in nature.

Climatic changes such as sea level rise and increasing global temperatures are predicted to continue over the next 50 years. Due to the synergistic effects from a combination of factors, accelerating relative sea level rise, and an increase in the frequency and strength of storms, the risk from coastal inundation will rise in the coming years for Lancaster County. Implementation would not be predicted to have cumulatively or synergistically interactions with climate change and/or effects from other actions in the ROI, with respect to bathymetry, hydrology and tidal processes.

## 5.4 BENTHIC FAUNA

### 5.4.1 No Action/Future Without Project Alternative

With the No Action Alternative/Future Without Project Alternative, the existing benthic community would continue to persist in the short-term. In the long-term, however, localized changes in benthic community composition of certain species may occur as a result of the anticipated effects of continued erosion, climate change and sea level rise. For example, the existing mussel population may gradually decrease as the cordgrass-dominated tidal marsh continues to erode and the shoreline retreats landward over time. The incremental loss of the marsh may decrease the availability of benthic resources and ultimately, habitat suitability for more commercially and recreationally important species.

Predicted climate change may also include changes in weather pattern and currents, and increased oceanic and estuarine surface temperatures, which may lead to long-term changes in the nature and character of the estuarine ecosystem in the ROI. The Chesapeake Bay system, in general, has demonstrated high sensitivity to climate variability, based on a synthesis of research. Although climate change impacts are likely to occur, Najjar et al. (2010) emphasizes that the severity of the impacts are directly related to human control. The No Action/Future Without Project Alternative would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects. Therefore, implementation of the No Action/Future Without Project Alternative would result in permanent, minor, and adverse impacts to benthic fauna.

### 5.4.2 Alternative 1: OYSTER REEF RESTORATION

During construction of the oyster reef, turbidity would increase along with Total Suspended Solids (TSS) in the water column while placing the reef materials on the subaqueous bottom. However, suspended solids would settle out of the water column following the placement of reef materials and the site would quickly return to ambient conditions. During placement of the reef materials, mobile species would relocate to avoid the disturbed area. Slower moving or

sedentary organisms may be directly affected due to displacement. Mortality may occur from burial, strike, or crushing during placement of reef structures. It is predicted that these losses will be replaced by alternate benthos, resulting in increased diversity and biomass (Wells 1957). Colonization of the hard reef structures will begin immediately after construction has been completed. In roughly three years a mature community will be established on the reef habitat (Burke 2010).

Existing oyster reefs in the Rappahannock River would have no adverse impacts from the implementation of Alternative 1, because these resources are located a minimum of three miles from the proposed project site. The proximity of these oyster reefs would, however, be beneficial for additional oyster recruitment. The proposed 670 alternative substrates for this alternative, making up approximately 0.2 acres, will provide additional habitat for new oysters to settle and as they spawn, their larvae will be transported to other reefs within the river. The three-dimensional structure of the reef structures would provide an increased surface area for all benthic organisms to inhabit, greater than the river bottom.

The implementation of Alternative 1 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects. Therefore, effects to the benthic community from implementation of the Action Alternative 1 would be predicted to be temporary minor adverse effects, and permanent, minor beneficial effects.

#### 5.4.3 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Benthic impacts from the oyster reef restoration would be as those described in Alternative 1.

The high level of erosion in the ROI has degraded historical wetland habitat, causing them to be open water areas. Continued erosion of the marsh will displace sediments into the water column, changing the depth of nearby habitat. To restore this area, native tidal plants and Atlantic Ribbed Mussels will be placed in the existing wetland areas. Shell bags would also be staked as needed along the fringes of the wetland restoration sites. During construction and planting, mobile species would relocate to avoid the disturbed area. Slower moving or sedentary organisms, will be directly affected due to compaction, crushing and burial during plantings. Adjoining areas to the project site may experience a slight decrease in water quality due to an increase in turbidity, concentration of suspended solids and dissolved nutrients. These impacts will only last during the construction phase and conditions will return after completion and shouldn't influence future light-dependent processes such as photosynthesis in the long-term (Johnson & Guinness 1975).

According to Burke (2010), wetland community reestablishments can occur within three years post construction. Once the wetland has been restored, the ecosystem will have direct beneficial impacts as many benthic invertebrates perform the physical breakdown of plant detritus, accelerating decomposition and nutrient cycling (Cooper et al. 2009).

During the bank vegetation plantings, coir logs will be used to protect new native vegetation as well as the restored wetland plants along the shore. There may be a slight decrease in water quality if runoff occurs during the plantings, increasing water turbidity and suspended solids. However, pre-construction conditions will occur, and the additional vegetation will prevent future

sediments from impacting the benthic environment. The benthic invertebrates present in the wetland and along the bank are food sources for larger animals, linking primary production to higher trophic levels. As the bank is stabilized, the habitat value and ecosystem services that a restored area will provide will benefit the entire area.

Overall, impacts to the benthic community from the implementation of Alternative 3-6 would be temporary, minor adverse effects, and permanent, minor beneficial effects.

The implementation of Alternative 3-6 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.4.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Oyster reefs, wetland restoration and shoreline restoration impacts would be as described in Alternative 3-6.

In addition, this alternative is to expand the restoration area for the Atlantic ribbed mussels. Disturbances during deployment of the mussels would be similar to the wetland plantings in Alternative 3-6. Mussels would be grown with the cordgrass and planted in the existing wetland areas. The organisms in the ROI would be buried under the placement of additional mussels and grasses, however, the more robust population of benthic organisms would result from their placement. Turbidity would temporarily increase because of the TSS in the water column due to construction and maintenance disturbances; however, suspended solids would settle out of the water column and the site will quickly return to ambient conditions. The mussel restoration would provide more productive benthic habitat for other aquatic organisms, increasing biodiversity, and the health of the ecosystem. The implementation of Alternative 2-3-6 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects. Therefore, the installation of project alternative 2-3-6 would have adverse to beneficial, temporary to permanent and minor impacts to the benthic community.

#### 5.4.5 Best Management Practices

For of any of the action alternatives, avoidance and minimization practices would be employed to the maximum extent practicable for all potential benthic impacts. Specific examples of best management practices to avoid and minimize impacts to local benthic fauna and habitat include:

- Use of turbidity curtains and other sediment control methods to reduce sedimentation due to construction activities.
- Avoid placing staging areas or structural measures in the water.
- Placement of artificial reef structures would be within the months of natural oyster recruitment (April-September) to reduce the risk of sedimentation on the reef prior to spat set.

#### 5.4.6 Cumulative Impacts

There is one present and foreseeable future project within the study area being installed by the VDOT. Independent of the implementation of the above referenced alternatives, various local, state, and federal projects and studies would continue related to sea level rise and climate

change. Resiliency efforts which include construction of breakwaters near the ROI by VDOT would temporarily contribute to a decrease in water quality for the benthic environment. However, these impacts would be minor, temporary to permanent and phased across years.

Climatic changes such as sea level rise and increasing global temperatures are forecast to continue over the next 50 years. Due to the synergistic effects from a combination of factors, accelerating relative sea level rise, and an increase in the frequency and strength of storms, the risk from further shoreline erosion would continue and potentially accelerate. However, implementation of Alternatives 1, 3-6 or 2-3-6 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or effects from other actions in the ROI, with respect to benthic resources.

## 5.5 CLIMATE CHANGE

### 5.5.1 No Action/Future Without Project Alternative

With the No Action Alternative/Future Without Project Alternative, there would be no change to baseline conditions in the short-term and existing activities in the ROI that produce greenhouse gases would be expected to continue. The cumulative effects of erosion and relative sea level rise are likely to accelerate the rate of shoreline erosion over time along the banks of the Rappahannock River. In the absence of shoreline enhancements and/or protection, the site would remain vulnerable to increasing frequency and strength of coastal storms and associated damaging storm surges that are the result of climate change.

Climate change would be predicted to increase global atmospheric carbon dioxide, causing ecological effects from nitrogen imports and exports. Salt marshes have the ability to export nitrogen from the system, increasing primary productivity of algae, which according to PDE (2015) has been linked to a decrease in biological diversity. Global climate change will bring about more intense storms, higher sea levels, flooding and changes in temperatures throughout the world. Therefore, implementation of the No Action Alternative/Future Without Project Alternative would not contribute to climate change, however, the impacts of climate change would likely be observed onsite in the future.

### 5.5.2 Alternative 1: OYSTER REEF RESTORATION

Impacts to air quality and related greenhouse gas emissions would be as those described in the Air Quality Section.

The oyster reef would provide wave attenuation and protect the wetland and shoreline habitats from further erosion. As sea level rises, the depth of the hard reef structures would increase; however, the fish and invertebrates within the basin would continue to utilize the structures. The changes in sea level may limit the amount of algae that depends on light transmission using the reef habitat, therefore changing some of the biodiversity on the reefs and causing those light dependent organisms to transition into shallower waters. Oysters have evolved to live both subtidally and intertidally, therefore, as sea levels rise, they would adapt to their new conditions on the reef.

The Rappahannock River is a productive waterbody for the commercial oyster industry. By adding this oyster reef into the project ROI, it would also expand the broodstock oysters

available for spawning within the system. The more oysters that are able to be harvested, to serve as sources for human protein, the less greenhouse gases would be released. According to Ray et al. (2019), if humans replaced 10% of the protein, they eat from land-based sources, to protein from oysters, the greenhouse gas savings would be equivalent to 10.8 million fewer cars on the road.

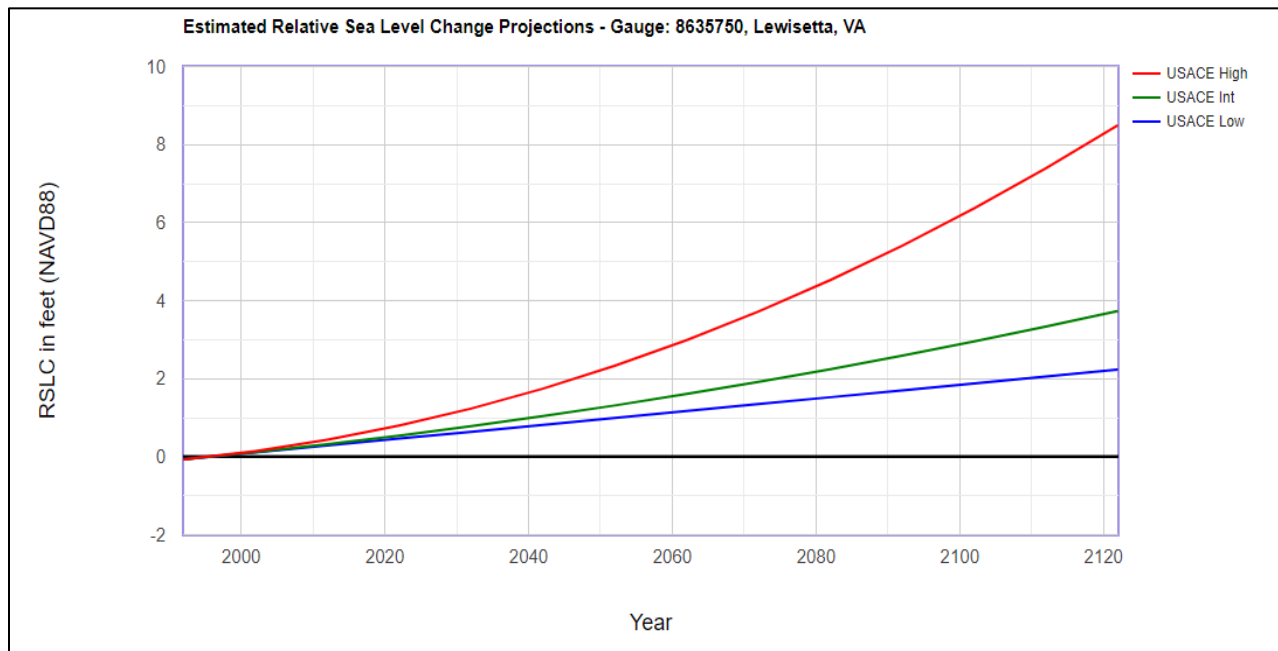
The addition of the oyster reef would have beneficial, permanent, minor impacts in regard to climate change, greenhouse gas emissions and relative sea level change. Alternative 1 would have temporary minor adverse effects, and permanent minor beneficial effects. Impacts would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.5.3 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts to air quality and related greenhouse gas emissions would be as those described in the Air Quality Section.

The wetlands would serve to provide some benefits to the effects of climate change by providing permanent, minor benefits in that they would serve to sequester carbon.

As required by USACE policy (EC 1165-2-212 -Sea Level Change Considerations in Civil Works Programs) increases in sea level were calculated for three different accelerating eustatic SLC scenarios - low, intermediate and high (Figure 5-2). Sea level is projected to rise by 2.23 feet within 100 years if the rate of increase remains consistent with historic trends as described in the low scenario. The intermediate scenario predicted a 3.73-foot increase in the sea level, while the high scenario forecasted that sea level will increase 8.5 feet over the 100-year life span of the project.



## Figure 5-2. Relative Sea Level Rise Curves from USACE Calculator.

Implementation of Alternative 3-6 would produce temporary minor adverse effects, and permanent, minor beneficial effects to climate change. Impacts would not be anticipated to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.5.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts to air quality and related greenhouse gas emissions would be as those described in the Air Quality Section.

Climate change effects that are occurring within the ROI would be predicted to continue throughout the installation of Alternative 2-3-6, which includes an oyster reef, and wetland and bank restoration as described in Alternative 3-6. This alternative would address additional erosion control and salt marsh preservation by building mussel reefs on either side of the project site. Consistent with ongoing trends, relative sea level change would be predicted to continue to rise, water temperatures would be predicted to slightly increase, and the pH would similarly decrease as ocean acidification progresses. For every estimated 0.3 feet increase in sea level rise the USACE assumed that wetland maintenance would be required over the project period of performance. These adaptive management actions would consist of placing additional sand material on the wetland system and potentially additional cordgrass (*Spartina alterniflora*) to maintain the proper elevations and native vegetation species for a cordgrass dominated marsh. These temporary increases on CO<sub>2</sub> emissions from implementing the Action Project Alternative would not be predicted to result in measurable changes in the rate of climate change or local relative sea level change. The addition of the mussel reef to the overall project will help to create a well-balanced ecosystem for absorbing greenhouse gases, allowing this alternative to have permanent, beneficial impacts.

### 5.5.5 Best Management Practices

For of any of the action alternatives, avoidance and minimization practices would be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to climate change, greenhouse gases and sea level rise include:

- No unnecessary idling of trucks, vessels or other equipment shall occur when not in use during construction.
- Fugitive dust must be kept to a minimum. Dust minimization measures would be implemented as needed.

### 5.5.6 Cumulative Impacts

As storms intensify, temperatures rise and flooding becomes a regular occurrence, the environment would have to adapt. Shoreline restoration similar to the above alternatives would aid in the transition into this new realm, continue to provide and enhance ecosystem services and protect the beach, wetland, and shoreline habitats.

Coastal management would play an important role in controlling the amount of wetland acreage ultimately lost to sea level rise. If soft structural stabilization and living shoreline approaches are supported over hard structures, losses of wetlands may be reduced. The future use and management of the remaining undeveloped land in the Basin would also be important for the preservation of wetlands. Setting aside open areas would provide a corridor that would allow wetland migration in the future.

The addition of this reef habitat within the ROI would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

## 5.6 CULTURAL RESOURCES

### 5.6.1 No Action/Future Without Project Alternative

With the No Action Alternative/Future Without Project Alternative, there would be continued beach and shoreline erosion at the estimated rate of 0.84 ft/yr. The cumulative effects of erosion and relative sea level rise are likely to accelerate the rate of shoreline erosion over time along the banks of the Rappahannock River. In the absence of shoreline enhancements and/or protection, the site would remain vulnerable to increasing frequency and strength of coastal storms and associated damaging storm surges that are the result of climate change. Cultural resources found within the property, specifically the bank, are at risk of damage or loss without shoreline protection measures.

Therefore, implementation of the No Action Alternative/Future Without Project Alternative would be adverse, permanent and minor to moderate for cultural resources. Cultural resources within the ROI would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.6.2 Alternative 1: OYSTER REEF RESTORATION

Due to the proposed project location of the oyster reef approximately 30 feet offshore, there would be no adverse impacts to cultural resources. Permanent, beneficial, minor impacts are predicted due to the ability for the offshore oyster reefs to absorb wave action and prevent further erosion. Impacts to cultural resources would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.6.3 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Implementation of Alternative 3-6 would result in placement of an oyster reef, a restored wetland habitat, and bank stabilization through the planting of native vegetation. Cultural resource impacts for the oyster reef would be as those described for Alternative 1.

There were no cultural resources found within the wetland area, so they would not be adversely impacted. Wetland restoration would beneficially affect cultural resources by providing more shoreline stabilization from continued erosion and undercutting.

The coir logs and native plantings would assist in sediment accretion. There would not be any grading of the bank or major bulldozing to impact cultural resources. The two cultural resource sites would be better protected from further exposure and degradation.

Alternative 3-6 would be anticipated to have permanent, beneficial, minor impacts on cultural resources. Impacts would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.6.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Oyster reef restoration, wetland restoration and shoreline restoration impacts would be as described in Alternative 3-6.

Alternative 2-3-6 would add the placement of mussels on cordgrass in the existing wetland. This would help to minimize the impacts of erosion in the existing wetlands. The VDHR has concurred that there would be no adverse impacts to cultural resources from the placement of additional mussels within the project area due to their location in the intertidal zone.

Therefore, Alternative 2-3-6 would be predicted to have minor, beneficial, minor impacts to cultural resources. Impacts would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.6.5 Best Management Practices

For any of the action alternatives, avoidance and minimization practices would be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to cultural resources include:

- No use of heavy equipment to crush any resources on the bank
- Avoid placing staging areas or structural measures along the bank near cultural resources
- One pathway to and from the beach to the wetland planting locations to avoid multiple trails across and near cultural resource sites

#### 5.6.6 Cumulative Impacts

The location of the VDOT project on the adjacent beach area, also has a few cultural resources that may be impacted upon their proposed construction efforts. However, none of the USACE project alternatives would adversely impact cultural resources in the vicinity of their project. No direct impacts from the VDOT project would impact this project.

Climatic changes such as sea level rise and increasing global temperatures would be predicted to continue over the next 50 years. Due to the synergistic effects from a combination of factors, accelerating relative sea level rise, and an increase in the frequency and strength of storms, the risk from coastal inundation will rise in the coming years for Lancaster County. Implementation of Alternatives 1, 3-6, or 2-3-6 would not be predicted to have cumulatively or synergistically interactions with climate change and/or effects from other actions in the ROI.

### 5.7 FISHERY RESOURCES

#### 5.7.1 No Action/Future Without Project Alternative

With the No Action/Future Without Project Alternative, the shoreline wetlands, beach area and vegetated bank is at risk of further erosion, fragmentation, and ultimately, loss. Further wetland

loss would be anticipated to increase in response to sea level rise, increased storm events and climate change. The eroding bank would cause a decrease in water quality due to the influx of nutrients and sediments entering the water column. Accretion may occur downstream at the mouth of Deep Creek. This would impact surface, pelagic and benthic fishery resources and essential fish habitat.

Overall impacts resulting from implementation of the No Action/Future Without Project Alternative would be permanent, adverse, and minor. Implementation of the No Action/Future Without Project Alternative would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.7.2 Alternative 1: OYSTER REEF RESTORATION

During placement of the oyster artificial substrates, there would be a potential to both directly and indirectly affect the EFH occurring throughout the water column, from benthic to surface waters.

Turbidity would increase along with TSS in the water column while placing the reef materials on the subaqueous bottom. However, suspended solids would settle out of the water column following the placement of reef materials and the site would quickly return to ambient conditions. The composition of benthic substrates would affect EFH for managed species; some EFH consists of areas composed of soft muddy and/or sandy substrates, while other benthic EFH may be composed of reefs or other shelter providing structures. Within the action area, the benthic substrate adjacent to Belle Isle State Park is characterized mostly by sand, and a mixture of sand and mud.

The oyster reef restoration would serve to improve local water quality by removing sediments from the water column and improving tidal mixing providing a beneficial, minor impact to EFH and fishery resources.

These effects would vary depending upon species tolerance, exposure rate, duration of the exposure, and life stage. This EFH is generally used by the egg and larval life stages of many fish species with surface currents aiding in the distribution of planktonic fishes throughout a given habitat range. Suspended sediments may impact fish eggs and larvae through deposition, abrasion, or smothering, especially in the placement areas (Wilbur and Clarke 2001). Once construction is complete, the area will return to ambient conditions and the habitat value will be greater than before, allowing the fish to recolonize. The table below lists fish species and the specific life stage that might be impacted by the proposed project (NOAA 2010).

Table 5-1. NMFS Listed Fish Species with Essential Fish Habitat within the Rappahannock River.

Common Name	Scientific Name	Egg	Larvae	Juveniles	Adult
Windowpane flounder	<i>Scopthalmus aquosus</i>			X	

Bluefish	<i>Pomatomus saltatrix</i>			X	X
Summer flounder	<i>Paralichthys dentatus</i>		X	X	X
Atlantic sea herring	<i>Clupea harengus</i>				X
Red hake	<i>Urophycis chuss</i>	X	X	X	X
Winter skate	<i>Leucoraja ocellata</i>				X
Little skate	<i>Leucoraja erinacea</i>				X
Clearnose skate	<i>Raja eglanteria</i>			X	X

There would be no impact to existing commercial oyster reefs in the Rappahannock River from implementation of Alternative 1. These resources are located a minimum of three miles from the proposed project site. Additional fish habitat would be created upon the deployment of the alternative reef structures, allowing biodiversity and populations the ability to increase. Implementation of Alternative 1 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

Impacts to anadromous fish and fish habitat likewise would be similar to those impacts described for EFH. There would be a temporary, minor impact to water quality resulting from the increased TSS and turbidity which may cause anadromous fish to temporarily flush from the construction areas. However, the improved water quality from the reef habitats would have a minor, beneficial effect on anadromous fish.

Therefore, effects to the fishery resources and essential fish habitat from implementation of the Action Alternative 1 would be predicted to be temporary, minor adverse effects and permanent minor, beneficial effects.

### 5.7.3 Alternative 3-6: OYSTER REEFS + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts for the oyster reef restoration would be as those described in Alternative 1.

Wetlands are resources that combine shallow water, high levels of nutrients, and primary productivity together to form an ideal environment for the development of organisms that form the base of the food web. Wetlands also provide foraging sites for fish, amphibians, shellfish and insects. Dead plant leaves and stems break down in the water to form detritus, which feeds many small aquatic insects, shellfish and small fish that are food for larger predatory fish, reptiles, amphibians, birds and mammals. Many species of birds and mammals rely on wetlands for food, water, and shelter, especially during migration and breeding. The high level of erosion in the ROI has degraded the historical wetland habitat, causing them to be open water areas.

To restore this area, native tidal plants and Atlantic ribbed mussels would be placed in the existing wetland areas. Staked shell bags would also be placed along the fringes of the wetland

sites as needed. Reef and wetland construction would temporarily increase turbidity, concentration of suspended solids and dissolved nutrients during construction. Impacts to EFH when planting tidal plants and mussels may include compaction, burial and mortality in some plants and wetland organisms. According to Burke (2010), wetland communities can reestablish within three years post-construction.

With the shoreline restoration, coir logs and native vegetation planting would serve to help restore the river shoreline shallow, tidal open water habitat. Coir logs would assist in accreting the eroding sediments from the banks, rather than them ending up in the water column and accreting around the mouth of Deep Creek.

Overall, this alternative would provide permanent, minor, beneficial effects on EFH and fishery resources, as this would provide additional fish shelter and foraging habitat and also serve to enhance water quality. Adverse effects would be temporary and minor.

The implementation of Alternative 3-6 is not predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.7.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Oyster reefs, wetland restoration and shoreline restoration impacts would be as those described for Alternative 3-6.

Water quality disturbances during deployment of the mussel plugs with the cordgrass would be similar to the wetland plantings in Alternative 3-6. Additional mussels would aid in the improvement of water quality, provide beneficial habitat, stabilize the wetlands and prevent further erosion. According to the Partnership for the Delaware Estuary (2015), Atlantic ribbed mussels are responsible for a substantial amount of pelagic-benthic coupling as the suspended materials they filter get transferred to the sediment surface as feces and pseudofeces.

The USACE submitted an EFH Assessment to NMFS for this alternative on September 23, 2020. The USACE's findings were that implementation of the Recommended Plan is anticipated to result in minor to negligible impacts to EFH, managed species, and their prey. Adverse effects would largely be temporary, and in time, permanent, beneficial impacts would result. No substantial adverse impacts to EFH or managed species are anticipated, and best management practices will aide in reducing potential impacts to essential habitats utilized by managed species in the Action Area. The NMFS provided its concurrence on December 11, 2020.

The implementation of Alternative 2-3-6 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.7.5 Best Management Practices

For of any of the action alternatives, avoidance and minimization practices would be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to local fish and fishery resources include:

- Use of turbidity curtains and other sediment control methods to reduce sedimentation due to construction activities.
- Avoid placing staging areas or structural measures in the water.
- Placement of the oyster reef would be within the months of natural oyster recruitment (April-September) where practicable to reduce the risk of sedimentation on the structures prior to spat set

### 5.7.6 Cumulative 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. The implementation of any of the action project alternatives would not be anticipated to substantially contribute cumulatively to injuries and/or mortalities resulting from these impacts.

Sea level rise and climate change has the potential to adversely affect fishery resources and EFH in the ROI due to continued erosion. Implementation of the action project alternatives would not be predicted to substantially cumulatively interact with climate change, sea level rise, or other possible cumulative effects. No substantial adverse impacts to fish resources would be anticipated and no impacts to the population level of any fish species or any associated prey species would be anticipated.

## 5.8 FLOOD PLAINS

### 5.8.1 No Action/Future Without Project Alternative

The No Action/Future Without Project Alternative would involve no action from USACE to enhance, expand, and protect the Belle Isle State Park shoreline ecosystem. Without implementation of an action alternative, there would continue to be degradation of a diverse aquatic estuarine ecosystem, including tidal wetlands, river-shoreline interface, and oyster reef habitats. As noted in Chapter 1, beach, wetland, and shoreline loss have been documented going back to 1937. Over time, continued sea level rise, subsidence, and erosion could possibly impact the Park's buildings and parking area. Implementation of the No Action/Future Without Project Alternative would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.8.2 Alternatives 1, 3-6, 2-3-6

Implementation of Alternatives 1, 3-6 or 2-3-6 would not cause any adverse impacts to floodplains and flooding. All alternatives would offer positive benefits to the State Park's shoreline and ecosystem. While the proposed alternatives focus on ecosystem restoration within the normal daily tidal zone, they will also provide some benefits to stabilize and protect the shoreline against continued erosion.

No adverse impacts to the flood plain are anticipated. Coordination was conducted with federal,

state, and local authorities. The intent of the project is to restore and preserve natural and beneficial flood plain values through aquatic ecosystem restoration. The proposed project meets the floodplain management requirements of EO 11988.

Impacts to flood plains would be permanent, beneficial, and minor.

Implementation of any of the above alternatives are not predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.8.3 Best Management Practices

Specific examples of best management practices to avoid and minimize impacts on floodplains include:

- Park officials should have a continuous outreach and education plan in place for park guests to understand the types of flooding, flood mitigation activities, living shorelines and erosion control.

## 5.9 GEOLOGY, PHYSIOGRAPHY & TOPOGRAPHY

### 5.9.1 No Action/Future Without Project Alternative

With the No Action/Future Without Project Alternative, there would be no impacts to geology, physiography, and topography of the site and existing conditions would continue to persist in the short-term.

In the absence of shoreline stabilization measures, the shoreline and tidal marshes would continue to erode and remain vulnerable during significant storm events consequently leading to minimal, adverse impacts on these resources over time. A habitat shift would be seen as the upland areas shift into intertidal, and small pools from consistent erosion will be created. 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 the geology, physiography, and topography from implementation of the No Action/Future Without Project Alternative are predicted to be adverse, and negligible to minor.

### 5.9.2 Alternative 1: OYSTER REEF RESTORATION

Alternative 1 proposes the installation of an intertidal to subtidal oyster reef using artificial substrates. Placement of the artificial substrates would not have an impact on geology or physiography. However, the vertical relief that the reefs provide will have negligible to minor beneficial impacts with respect to the topography, by increasing the flow speeds across the area, reducing the rate of sedimentation, and area where the sediment ultimately deposits. Alternative 1 would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.9.3 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts from the oyster reef would be as those described for Alternative 1.

There would be a minor, beneficial, and permanent alteration to the marsh geology and

topography, as sediment would be added to bring the wetland restoration area to the appropriate elevation for a cordgrass-dominated wetland. Topography would be permanently and beneficially impacted over time, as the shoreline becomes stabilized and sediments erosion into the riverbank is reduced.

Adding coir logs at the base of the eroding bank would assist in trapping sediments from entering the water column. This would allow plants to take hold and stabilize the shoreline. Implementing the Action Project Alternative 3-6 there will be minor topographic increases in elevation over the 50-year project cycle. Impacts overall would be beneficial, permanent, and minor. Alternative 3-6 would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.9.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts from the implementation of the oyster reef, wetland restoration plantings and shoreline restoration would be as those described in Alternative 3-6.

With the mussel restoration, there would be additional impacts to help retain the restored topography as well as benefits to geology, as the mussels filter in suspended particles and deposit them within the benthos. Over time, the composition of the benthic floor could be changed due to the increase in these deposits. Mussel reefs would not impact physiography within the project ROI. Overall impacts would be anticipated to be beneficial, permanent, and minor.

Alternative 3-6 would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.9.5 Best Management Practices

Best management practices would be to reduce ground disturbance to the extent practicable.

- For wetland restoration, utilize fill with soils of similar grade and composition
- Placement of the reef should be on hard bottom (where possible) to reduce sinking and reduce any potential TSS and turbidity in the water column

#### 5.9.6 Cumulative Impacts

VDOT's project proposes to place multiple breakwaters within their site, which could influence the transport of sand and sediment within the ROI, altering the geology and topography of the action area. Physiography may be impacted over time, as climate change impacts become more evident. These impacts would be permanent, adverse and negligible to minor.

Climatic changes such as sea level rise and increasing global temperatures are predicted to continue over the next 50 years. Due to the synergistic effects from a combination of factors, accelerating relative sea level rise, and an increase in the frequency and strength of storms, the risk from coastal inundation will rise in the coming years for Lancaster County. Implementation of Alternatives 1, 3-6, or 2-3-6 would not be predicted to cumulatively or synergistically interact with climate change and/or effects from other actions in the ROI.

## 5.10 HAZARDOUS, TOXIC & RADIOACTIVE WASTE

### 5.10.1 No Action /Future Without Project Alternative

Within the ROI (three-mile radius surrounding the project site), there are no documented hazardous, toxic, or radioactive waste spills according to records obtained from the state and federal spill database searches described in Section 4.5. The No Action/Future Without Project Alternative would not be anticipated to result in any release of petroleum, hazardous, toxic, or radioactive release within the ROI, and therefore, would have no adverse effects on hazardous, toxic, and radioactive waste (HTRW). Implementation of the No Action/Future Without Project Alternative would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.10.2 Alternative 1: OYSTER REEF RESTORATION

The geographic extent of impacts is dependent upon factors such as the type of equipment used and environmental conditions such as wind and currents (USACE 1983). A potential for fuel and petroleum spills exists with vessel and construction equipment in the area, but accident and spill prevention plans specified in the contract specifications should prevent most spills. The construction contract would include requirements to properly manage, store, and dispose of all fuels and materials generated by or used for the project. Implementation of this alternative would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects. No adverse effects on HTRW would be anticipated to occur.

### 5.10.3 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

The potential for HTRW impacts for the oyster reef would be as those described in Alternative 1.

There is no evidence that HTRW will be found within the wetland sites when sediment is disturbed during restoration plantings. Only clean fill free of any regulated contaminants would be placed at the wetland restoration sites. Best management practices will be employed during construction at the wetland sites to avoid the suspension of sediment and the release of any contamination into the water column. An erosion control plan will be created and implemented to control the entry of sediments into the tidal streams and their migration downstream of the work area.

No impacts to HTRW would be anticipated to occur. Implementation of this alternative would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.10.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Potential impacts to HTRW for the oyster reef restoration, wetland restoration, mussel restoration, and shoreline restoration would be as described in Alternative 3-6.

### 5.10.5 Best Management Practices

For any of the action alternatives, avoidance and minimization practices would be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to HRTW include:

- Use of turbidity curtains and other sediment control methods to reduce sedimentation due to construction activities
- If HRTW materials or underground storage tanks are found, the project specifications would include procedures that require that they be handled and disposed of in a lawful manner.
- The project specifications would include a spill prevention and control plan for vehicles, vessels, and equipment.

### 5.10.6 Cumulative Impacts

Because there is no current evidence of environmental contamination at either project site, there would be no anticipated releases of petroleum, hazardous, toxic, or radioactive waste with implementation of any of the alternatives in conjunction with VDOT's project. There would be no anticipated cumulative or synergistic impacts.

## 5.11 LAND USE AND INDUCED DEVELOPMENT

### 5.11.1 No Action/Future Without Project Alternative

With the No Action/Future Without Project Alternative, land erosion would continue. Land subsidence and wetland loss would be anticipated to increase in response to sea level rise, decreasing the area within the ROI for recreation and agricultural opportunities.

The No Action/Future Without Project Alternative would cause minimal, permanent, adverse impacts to Land Use and Induced Development. Implementation of the No Action/Future Without Project Alternative would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.11.2 Alternative 1: OYSTER REEF RESTORATION

The reef restoration would result in no effect upon adjacent land use in the agricultural lands that surround the majority of Belle Isle State Park. Waterfront use adjacent to the ROI is predominantly fishing and recreational, which upon the addition of the oyster reef, may become more productive fishing grounds as the reefs attract more aquatic life. The oyster reef may provide a minor benefit to land use by serving to help protect the existing recreational beach areas from further erosion. There may be some minor temporary, adverse impacts to upland sites used as temporary staging areas during construction and maintenance.

Effects to the land use from implementation of Action Alternative 1 would be predicted to be adverse to beneficial, permanent, and negligible to minor in nature. The implementation of Alternative 1 is not predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.11.3 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts to land use from the oyster reef restoration would be as those described for Alternative 1.

Restoration of the shoreline would assist in the protection of the beach area serving to help maintain recreational beach uses. The stabilization measures that will take place by planting native vegetation and placing coir logs at the base of the bank will benefit the current landscape. There may be some adverse, temporary, minor impacts to uplands sites used as temporary staging areas during construction and maintenance. Impacts to land use would be temporary adverse, and permanent beneficial effects would be negligible to minor. Impacts would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.11.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts from oyster reef restoration, wetland restoration and bank restoration would be as described in Alternative 3-6.

### 5.11.5 Best Management Practices

For of any of the action alternatives, avoidance and minimization practices would be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to land use:

- Avoid placing equipment in areas of recreation for the park during construction; such as the picnic, playground and beach areas when appropriate.
- Material staging areas would be restricted to uplands.
- For the reef restoration design, ensure to allow enough spacing for boaters to traverse the reef to the beach habitat.

### 5.11.6 Cumulative Impacts

There is one present and foreseeable future project within the ROI being installed by the VDOT. Independent of the implementation of the above referenced alternatives, various local, state, and federal projects and studies will continue related to sea level rise and climate change. Resiliency efforts which include construction of breakwaters, beach nourishment, and vegetative plantings on the adjacent shoreline by VDOT would contribute to land use impacts within the ROI as a whole.

Climatic changes such as sea level rise and increasing global temperatures are forecast to continue over the next 50 years. Due to the synergistic effects from a combination of factors, accelerating relative sea level rise, and an increase in the frequency and strength of storms, the risk from further shoreline erosion will continue and potentially accelerate. Minor direct permanent beneficial impacts are expected with the addition of beach width at the VDOT site, and minor, temporary, adverse effects are expected due to other aspects of the proposed construction. However, implementation of any of the above project alternatives, in conjunction

with the VDOT project, is not predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

## 5.12 NOISE & VIBRATION

### 5.12.1 No Action /Future Without Project Alternative

With the No Action/Future Without Project Alternative, there would be new impacts to noise and existing ambient noise conditions, such as the intermittent occurrence of commercial and recreational fishing vessels in the ROI, would continue. 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.

### 5.12.2 Alternative 1: OYSTER REEF RESTORATION

The primary source of noise from the reef restoration would be from the vessels required to complete the project. Typical noise levels generated by this equipment ranges from 80 to 88 decibels at 50 ft from the source (USDOT 1995). Noise from this equipment will be intermittent and of short-term duration. Assuming that noise from the equipment radiates equally in all directions, sound intensity will diminish inversely as the square of the distance from the source. Therefore, in a free field (no reflections of sound), the sound pressure level decreases 6 decibels with each doubling of the distance from the source. Under most conditions, reflected sound will reduce in attenuation because of distance (American National Standards Institute, 1983).

The area surrounding the project site is composed of water, farmland or wooded areas and the state park, no residential areas including any sensitive receptors would be impacted by the noise. Hull vibrations caused by vessel engines can cause acoustic re-emission and the operating machinery, such as the vessel cranes during artificial reef deployment can cause excessive noise (Bernardini 2019). Noise and vibration effects would be temporary, adverse and minor in nature. There would be no permanent noise effects. Implementation of the No Action/Future Without Project alternative would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.12.3 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Noise impacts for the oyster reef restoration would be as those described in Alternative 1.

Construction equipment used for the wetland restoration and bank vegetation plantings would cause minimal noise impacts to the surrounding area. The rural setting of Belle Isle State Park reduces any residential effects during installation. All machinery would be used intermittently during the day and only during normal operating hours. Therefore, noise impacts within the ROI would be temporary, adverse and minor. There would be no permanent effects.

Implementation of the No Action/Future Without Project alternative would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.12.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Noise impacts for the oyster reef, wetland, and shoreline restoration would be as described in Alternative 3-6. The only additional effect from the project alternative would be a longer timeline for completion of the project due to the installation of cordgrass plugs containing the mussels. No additional noise-generating equipment would be required, however, depending on how the mussels would be deployed, it would likely require additional workdays for the crew to complete. Therefore, noise impacts within the ROI would be slightly higher than Alternative 2-3 due to additional operation of vehicles but impacts would still remain at a temporary, adverse and minor level. There would be no permanent effects.

Implementation of the No Action/Future Without Project alternative would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.12.5 Best Management Practices

For any potential final alignments, avoidance and minimization practices will be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to noise and vibration levels during temporary construction conditions:

- No unnecessary idling of trucks or other construction equipment shall occur when not in use during construction.
- Construction equipment would be properly maintained to minimize the effects of the noise and to reduce any associated noise impacts.
- Coordination prior to inland construction activities beginning would be conducted to ensure compliance with all local regulations regarding noise and vibration levels.

#### 5.12.6 Cumulative Impacts

There is another resiliency project taking place within the project ROI, on the adjacent shoreline by VDOT. This resiliency project includes construction of breakwaters, installation of high and low marshes and beach nourishment. The combination of the USACE project and the VDOT project will cause longer term noise and vibration impacts depending on when both projects go to construction. Timelines may overlap, or they may not, so exact noise levels during the actual construction of the project is relatively uncertain. However, all noise effects would be temporary, adverse and minor to the surrounding environment. Implementation of the No Action/Future Without Project alternative would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.13 OCCUPATIONAL HEALTH & SAFETY

#### 5.13.1 No Action /Future Without Project Alternative

With the No Action/Future Without Project Alternative, there would be no impacts to occupational health and safety beyond existing baseline conditions. If any potential safety hazards occurred as the result of storm damage or excessive erosion in the future, Belle Isle

State Park Rangers would immediately correct (or prohibit access to) the hazards to avoid exposing the general public to a safety hazard.

The No Action/Future Without Project Alternative would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.13.2 Alternative 1: OYSTER REEF

Alternative 1 proposes the installation of an intertidal to subtidal oyster reef using artificial reef structures. During construction of the oyster reef, all safety risks would be for any workers operating the heavy machinery such as cranes to deploy the reef structures. Proper PPE should be worn, including hard hats, gloves, life jackets and steel toed boots. While working in and around the water, drowning is always a safety risk, therefore, all vessels should be equipped with flotation devices and first aid equipment. These risks would be temporary, minor and adverse to occupational health and safety. All risks would be mitigated to the extent practical.

Post construction, as the reef structures remain in place, they would pose an additional health and safety issue to any recreational visitors within the project action area. Proper signage should be used to clearly mark the oyster reef, since it could cause serious injury if a vessel or person was to run into it. Injuries that could result from minor cuts and scrapes in an aquatic environment could pose additional threats from water borne illnesses such as Vibrio. These risks will be permanent, minor and adverse with respect to occupational health and safety.

Alternative 1 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.13.3 Alternative 3-6: OYSTER REEF + WETLAND RESTORATION + BANK RESTORATION

Impacts to occupational health and safety from the oyster reef restoration would be as those described in Alternative 1.

Wetland restoration would include filling, grading, and planting native marsh vegetation to assist in shoreline stabilization and further loss. Heavy machinery may be used to assist in transporting vegetation to the project site for planting. Any equipment being used, and contractors using the equipment need to uphold their prepared Accident Prevention Plan. Post construction, all of these risks will be removed and risks to human health or safety would be negligible along the wetland because of the planting.

During the installation of the coir logs and native plantings for the shoreline restoration, similar considerations would need to be met as were with the wetland planting. The existing stability of the shoreline would be cause for concern and should be considered when operating machinery and planting new vegetation, for the chance of further collapse. Coir logs can be heavy and proper maneuvering of these materials should be taken into consideration. Post construction, they can still pose as a tripping hazard if small children are left unattended to play on. These risks would be permanent, adverse and negligible to minor in regard to human health and safety.

Alternative 3-6 would not be predicted to substantially, cumulatively or synergistically interact

with climate change and/or other cumulative effects.

#### 5.13.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts from the oyster reef restoration, wetland restoration, and shoreline restoration would be as described in Alternative 3-6. Potential occupational health and safety impacts from the mussel restoration would be similar to those for the wetland restoration and at the same threshold level of impact.

In the long term, the beneficial impacts on human health due to the water filtration capacity served by the mussels will help to remove bacteria from the water, allowing for improved local water quality. Overall impacts would be adverse to beneficial, negligible to minor and temporary to permanent in regard to human health and safety.

Alternative 2-3-6 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.13.5 Best Management Practices

As the design and engineering of the alignments advance, minor alignment shifts, and detailed coordination could be evaluated to avoid and minimize potential impacts to safety. These considerations could be undertaken during the PED phase and coordinated with applicable agency partners during the associated permit application process. For any potential final alignments, avoidance and minimization practices will be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts on safety include:

- An Accident Prevention Plan would be strictly adhered to during construction.
- Coordination with all applicable emergency service agencies, local, state, and federal regulatory agencies, and the general public would be conducted to ensure that safety concerns are all addressed, to include those specific to evacuation measures.
- Construction areas and equipment would be properly marked and fenced so any Park visitors wouldn't be at risk of injury
- Hard hats, steel toed boots and other safety equipment will be used during reef placement
- A spill prevention and control plan would be implemented to reduce any potential exposure of hazardous materials to workers.

#### 5.13.6 Cumulative Impacts

The VDOT's project on the adjacent shoreline proposes to place multiple breakwaters within their site, grade the existing beach to create low/high marshes, and plant vegetation to assist with shoreline stabilization. There would be no anticipated cumulative impacts to human health and safety in conjunction with our project.

Implementation of Alternatives 1, 3-6, or 2-3-6 in conjunction with the VDOT project or other future projects would not be predicted to have cumulatively or synergistically interactions.

## 5.14 RECREATION

### 5.14.1 No Action/Future Without Project Alternative

The No Action/Future Without Project Alternative would continue to affect erosion and recreation in the beach area. Currently, the beach area has substantively degraded (in terms of beach width) from erosion. Land subsidence and wetland loss is anticipated to increase in response to sea level rise placing the tidal wetland marsh interface at risk for fragmentation and complete loss. This would change the habitat diversity within each tidal and subtidal environment, altering the recreational fishing opportunities. With implementation of the No Action/Future Without Project Alternative, impacts to recreation would be permanent, minor and adverse. Implementation of the No Action/Future Without Project Alternative would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.14.2 Alternative 1: OYSTER REEF RESTORATION

The placement of reef structures would be anticipated to enhance the recreational fishery as fishing stocks would improve from the increased habitat. While implementing these features would have some minor short-term increases in turbidity, caused by bottom disturbances during construction, the long-term effect on recreational fishing would be positive. Once the reef structures are placed, sessile organisms would attach and begin to colonize, attracting smaller reef fish which ultimately bring the larger, recreational fish to the local area.

Recreational boaters from the surrounding areas use the Rappahannock River and adjacent creeks. Some boaters pull their boats up to the beach that is within the project area to enjoy and utilize the shoreline. The reef would be marked with signs and spacing would be provided to allow boater access to the Belle Isle State Park public beach to avoid potential adverse impacts entering the beach area. There would be temporary, minor, adverse effects during construction, however, once the reef is placed, permanent impacts would influence the areas where boats could enter the beach area. Waterfowl hunting is permitted within the ROI. Hunters utilize the duck blind located in the project area and the adjacent marshes and creeks. Waterfowl would be expected to vacate the area during construction due to the presence of construction equipment, however, this would be temporary and post-construction they would be expected to return to the area.

Overall, there would be temporary, minor adverse effects, and to permanent, beneficial and minor effects. Implementation would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.14.3 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impact to recreation from oyster reef restoration would be as those described in Alternative 1. Some of the recreational activities with the ROI would have to be prohibited while construction activities are taking place to restore the wetland community. Due to the equipment being used, it would pose a danger to have people in the surrounding areas during installation. However, once construction is complete, the area could then be reopened for bird watching, playing on

the nearby playground, picnics, education and hiking.

During the shoreline restoration, a portion of the recreational beach would be lost from the installation of the coir logs. However, the majority of the beach would remain intact for continued use. Construction efforts would cause some birds and other mobile animals to vacate the area until completion of the project. The addition of native vegetation along the banks would provide a food source and habitat for migratory and resident birds, which would increase the bird diversity for bird watchers. The coir logs and native vegetation plantings would help prevent further erosion along the shoreline.

There would be temporary, minor adverse effects, and permanent minor beneficial effects to recreation. Implementation of this alternative would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.14.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts for the oyster reef restoration, wetland restoration, and shoreline restoration would be as those described for Alternative 3-6. The impacts for the mussel restoration would be similar to the impacts for the wetland restoration and at the same impact threshold level. Otherwise, the presence of the mussels would have permanent impacts as they will aid in improved water quality, ecosystem services and habitat for other wildlife, making the experience for Park guests more enjoyable. There would be adverse, temporary and minor impacts to recreation during construction activities with equipment in the project area. Beneficial impacts to recreation include a stabilized beach and habitat areas for birding, fishing, and exploring. Implementation of this alternative would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.14.5 Best Management Practices

For any of the action alternatives, avoidance and minimization practices would be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to recreation include:

- The Park would be responsible for temporarily closing off construction areas for recreational use.
- During construction, do not impede vessel ingress/egress through navigation channels adjacent to proposed structural measures to the maximum extent practicable.
- Avoid placing staging areas or structural measures in areas used for recreational purposes, i.e. parks, walkways, boating facilities, etc.
- Oyster reef has signage installed to warn boaters, and other recreational water activities
- Boater safety is a priority and coordination with the Coast Guard is ongoing to ensure safety.

#### 5.14.6 Cumulative Impacts

In conjunction with the proposed VDOT project on the adjacent shoreline, it is predicted that the increase in wetland, and subtidal habitat would improve the health of the ecosystem, therefore, drawing in more recreationally fish species. Boaters, kayakers and other recreational activities

will need to be aware of the breakwaters built through the VDOT project along the shore, however, these will not impact recreation within ROI. It is not predicted that the VDOT project would substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

## 5.15 SOCIOECONOMICS

### 5.15.1 No Action/Future Without Project Alternative

With the No Action/Future Without Project Alternative, baseline conditions would be expected to continue and there would be no individual or cumulative impacts to demographic or socioeconomic community trends within the ROI.

#### Alternative 1: OYSTER REEF RESTORATION

In general, Alternative 1 would have relatively minor social impacts. There would be a temporary increase in employment with the creation and deployment of the artificial reef structures. The placement of oyster reef structures may enhance the recreational fishery as fishing stocks improve from the increased habitat. Implementation of Alternative 1 would enhance the ecosystem and therefore cause a potentially beneficial effect on tourism for the area. Overall, impacts would be beneficial, temporary to permanent, and negligible to minor. Benefits would be temporary and minor. Implementation of the Alternative 1 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.15.2 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts from installation of the oyster reef structures would be as those described as Alternative 1. The Rappahannock River and Belle Isle State Park are destinations for eco-tourists, with plenty of outdoor activities. Implementation of Alternative 3-6 would enhance the ecosystem and therefore potentially cause a beneficial effect on tourism for the area.

The plan would not have any adverse effects on population, land use, community cohesion, transportation, or income levels. It would not result in any population displacement or private property acquisition. There would be a temporary increase in employment with the implementation of the project. Overall, impacts would be beneficial, temporary to permanent, and negligible to minor. Implementation of Alternative 3-6 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.15.3 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts would be similar to those described for Alternative 3-6 although slightly higher with the additional mussel restoration. The impact threshold would be as that described for Alternative 3-6.

#### 5.15.4 Best Management Practices

For any of the action alternatives, avoidance and minimization practices would be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to socioeconomics include:

- Barges and construction vessels would not impede commercial fishing vessels during their hours of operation
- Bank vegetation and wetland restoration construction would follow a timeline to not close the area for longer than needed, impacting visitor incentive to the Belle Isle State Park

#### 5.15.5 Cumulative Impacts

In conjunction with the proposed VDOT project on the adjacent shoreline, it would be anticipated that the increase in wetland, and subtidal habitat could improve the health of the ecosystem. Both plans would not have any adverse effects on population, land use, community cohesion, transportation, or income levels. There would be no anticipated substantial cumulative or synergistic effects.

### 5.16 SPECIAL SPECIES STATUS

#### 5.16.1 No Action/Future Without Project Alternative

##### *Federally Threatened and Endangered Species and Designated Critical Habitat*

With the No Action/Future Without Project Alternative, baseline conditions would be expected to continue and there would be no individual or cumulative impacts to federally or state listed endangered and threatened species or any designated critical habitat.

##### *Marine Mammals*

With the No Action/Future Without Project Alternative, there would be no individual or cumulative impacts to marine mammals.

##### *Species Protected under the Migratory Bird Treaty Act of 1918 and Executive Order 13186 and Other State Listed Bird Species*

With the No Action/Future Without Project Alternative, there would be no impacts to migratory birds in the short-term. However, the shoreline and adjacent marshes would continue to erode over time and may decrease the habitat quality of migratory birds and their associated prey resulting in temporary, minor to moderate impacts. Continued loss of the shoreline would be anticipated to adversely affect migratory bird foraging habitat including wading bird foraging habitat. Impacts would be adverse, permanent and minor to moderate. Substantial cumulative or synergistic impacts associated with climate change would not be anticipated with implementation of the No Action/Future Without Project Alternative.

#### 5.16.2 Alternative 1: OYSTER REEF RESTORATION

##### *Federally Threatened and Endangered Species and Designated Critical Habitat*

The ROI is not located in the habitat of the northern long-eared bat, therefore, there would be no effect to the northern-long eared bat or its habitat.

The oyster reef would not be constructed in the preferred habitat of sea turtles, Atlantic sturgeon or shortnose sturgeon as these species prefer more offshore habitats. Their presence in the ROI would be highly unlikely and any impacts to these species and their habitats would be discountable.

Because the reef would be placed in an intertidal-subtidal area where sturgeon would not be anticipated to breed or forage, there would be no anticipated adverse modification of critical habitat.

Implementation of Alternative 1 would have no effect to the northern long-eared bat under the jurisdiction of the USFWS. There would be no adverse modification of critical habitat under the jurisdiction of the USFWS.

Implementation of Alternative 1 may affect but would not adversely affect listed species (sea turtles, Atlantic sturgeon, and shortnose sturgeon) under the jurisdiction of NMFS in the ROI. Alternative 1 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### *Marine Mammals*

Bottlenose dolphins prefer further offshore habitat than the oyster reef location. Therefore, their presence in the ROI would be highly unlikely. Temporary construction impacts would generate some limited underwater noise which could potentially flush away bottlenose dolphins temporarily in the ROI should they be present. The reef structures would help to permanently increase the local fish community serving to increase potential prey items to the bottlenose dolphin. Any potential impacts would be adverse to beneficial, temporary to permanent, and negligible.

#### *State Listed Species, Migratory Birds, and Eagle Conclusion*

The oyster reef would not be constructed in the preferred habitat of the diamondback terrapin or the spotted turtle. These species prefer more nearshore environments with aquatic vegetation. Their presence in the ROI would be highly unlikely. With Alternative 1 there would be no anticipated impacts to the diamondback terrapin or the spotted turtle.

No anticipated impacts to bald eagle nesting sites or their associated primary or secondary buffers would be anticipated. No high, intermittent sound impacts associated with construction are anticipated to occur within 2,640 feet of any reported eagle nests. During the site visit, there were not any nests found in the action area. Therefore, bald eagle nesting is not likely to be disturbed by this project and no Bald Eagle Permit is anticipated to be required.

During construction, the noise and disturbance effects have the potential to flush birds from the ROI resulting in a minor and temporary impact. The creation of the reef habitat has the potential to permanently increase the prey forage base for migratory birds utilizing the wetlands and shoreline habitats for foraging. Overall impacts to migratory birds including state listed avian species would be adverse to beneficial, temporary to permanent, and minor to moderate.

### 5.16.3 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

#### *Federally Threatened and Endangered Species and Designated Critical Habitat*

The ROI is not located in the habitat of the northern long-eared bat, therefore, there would be no effect to the northern-long eared bat or its habitat.

Impacts with the oyster reef restoration would be as those described in Alternative 1.

The wetland and shoreline restoration would not be constructed in the preferred habitat of sea turtles, Atlantic sturgeon or shortnose sturgeon as these species prefer more offshore habitats. Their presence in the ROI would be highly unlikely and discountable.

Because the reef would be placed in an intertidal-subtidal area where sturgeon would not be anticipated to breed or forage, there would be no anticipated adverse modification of critical habitat.

Implementation of Alternative 1 would have no effect to the northern long-eared bat under the jurisdiction of the USFWS. There would be no adverse modification of critical habitat under the jurisdiction of the USFWS.

Implementation of Alternative 1 may affect but would not adversely affect listed species (sea turtles, Atlantic sturgeon, and shortnose sturgeon) under the jurisdiction of NMFS in the ROI. Alternative 1 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### *Marine Mammals*

Bottlenose dolphins prefer further offshore habitat than the oyster or wetland reef restoration sites. Therefore, their presence in the ROI would be highly unlikely. Temporary construction impacts would generate some limited underwater noise which could potentially flush away bottlenose dolphins temporarily in the ROI should they be present. The reef structures would help to permanently increase the local fish community serving to increase potential prey items to the bottlenose dolphin. Any potential impacts would be adverse to beneficial, temporary to permanent, and negligible.

#### *State Listed Species, Migratory Birds, and Bald Eagle Conclusion*

Diamondback terrapins and spotted turtles have the potential to occur in the nearshore wetland and beach habitats, although their presence and behaviors in the ROI are uncertain. There could be temporary, minor disturbance effects to these species during construction. However, the wetland and shoreline restoration efforts overall would be largely beneficial serving to permanently improve their habitat. Impacts would be adverse to beneficial, temporary to permanent, and minor.

Migratory birds, including state listed birds, would temporarily flush from the ROI due to noise and other disturbance effects from construction, however, upon returning (post construction) the habitat would be of greater value for foraging and nesting grounds. One of the primary benefits of the wetland restoration project is the increase in secondary production, resulting in larger populations of prey items for sea turtles and shore bird species that utilize the project area.

Shore birds, blue crabs and mud crabs commonly prey upon Atlantic ribbed mussels, whose population would be increased during the wetland restoration.

No anticipated impacts to bald eagle nesting sites or their associated primary or secondary buffers would be anticipated. No high, intermittent sound impacts associated with construction are anticipated to occur within 2,640 feet of any reported eagle nests. During the site visit, there were not any nests found in the action area. Therefore, bald eagle nesting is not likely to be disturbed by this project and no Bald Eagle Permit is anticipated to be required.

Impacts would be adverse to beneficial, temporary to permanent, and minor to moderate for migratory birds. Although, increased climate change has the potential to adversely impact migratory birds in the ROI, implementation of the Alternative 3-6 is not anticipated to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.16.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

While the benefits to some migratory birds would be slightly higher due to improved foraging from the restored mussel habitat, impacts and impact findings would be as described in Alternative 3-6.

The USFWS concurred on December 1, 2020, that the Recommended Plan would not be likely to adversely affect the northern long-eared bat. The NMFS concurred on September 24, 2020, that the Recommended Plan may affect but is not likely to adversely affect federally listed species: the Atlantic sturgeon, shortnose sturgeon, green sea turtle, loggerhead sea turtle leatherback sea turtle or the Kemp's Ridley sea turtle. The Recommended Plan would not adversely modify critical habitat under the jurisdiction of the USFWS or NMFS.

Alternative 2-3-6 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.16.5 Best Management Practices

For any potential final alignments, avoidance and minimization practices will be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to special status species during temporary construction conditions:

- Barge will be operated at approximately 10 knots or less to reduce any potential interactions with marine mammals and sea turtles.
- Turbidity curtains or other equivalent measures will be used to reduce any potential impacts to water quality during construction.

#### 5.16.6 Cumulative Impacts

VDOT's project on the adjacent shoreline proposes to place multiple breakwaters within their site, grade the existing beach to create low/high marshes, and plant vegetation to assist with shoreline stabilization. If both projects go to construction at the same time, that will influence available habitat for any species trying to vacate the construction area. However, since Belle

Isle State Park has 733 acres and 7 miles of shoreline that is protected habitat along the Rappahannock, not to mention additional habitat within Lancaster County and along the Rappahannock River. Implementation of Alternatives 1, 3-6, or 2-3-6 in conjunction with the VDOT project or other future projects is not predicted to have cumulatively or synergistically interactions with climate change and/or effects from other actions in the ROI.

## 5.17 VEGETATION, WETLAND & SAV

### 5.17.1 No Action/Future Without Project Alternative

As the impacts of climate change become more evident, it is predicted that sea level rise, along with other stressors would lead to 25-75% loss of salt marshes in some Atlantic estuaries by 2100 (PDE 2015). In the absence of shoreline stabilization measures from the No Action/Future Without Project Alternative, the existing shoreline and adjacent tidal marshes would continue to erode, especially vulnerable during significant storm events. Shoreline loss would continue at an approximate rate of 0.84 feet per year and there would be a conversion of existing intertidal habitat to subtidal habitat. Shoreline retreat would continue to threaten the survival of trees in the riparian buffer due to root exposure and eventual collapse into the Rappahannock River. The gradual loss of existing marsh and nearshore sandy habitat over time would degrade the habitat value and reduce biodiversity among vegetation and animal life. The No Action/Future Without Project Alternative would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects. Therefore, effects to the vegetation from implementation of the No Action/Future Without Project Alternative would be predicted to be permanent, adverse, and moderate.

### 5.17.2 Alternative 1: OYSTER REEF RESTORATION

Installation of the proposed oyster reef would be offshore in a subtidal to intertidal area. It would not directly impact wetland or upland vegetation, however, indirectly may have some minor negative impacts during construction. During placement of the oyster structures, any nearby boat activity may cause unusual wakes, increasing erosion potential and stability along the shoreline vegetation, however, this would be negligible to wetlands. Once the structures are in place, they would provide beneficial wave attenuation from future impacts to the shoreline from boat wake or coastal storms. No wetland mitigation would be required.

The oyster reef would reduce the effects of surge and therefore, reduce overall erosion impacts on the existing and restored wetland and shoreline habitat, serving to protect the habitat and native vegetation. This would provide a permanent and beneficial effect to wetlands and upland vegetation.

Submerged Aquatic Vegetation (SAV) is a valuable resource found throughout areas of the Chesapeake Bay and its tidal tributaries. There is currently no presence of SAV within the proposed project area or within the ROI. Photointerpretation of historical imagery prior to 1971 indicates that SAV was not present in nearshore areas adjacent to Belle Isle State Park. Since 1999, annual SAV monitoring and reporting conducted by the Virginia Institute of Marine Science indicates that SAV is not present in the ROI or in the nearby vicinity of the ROI. Implementation of the proposed alternative would have no effect on SAV in the ROI.

Alternative 1 would have negligible temporary or permanent impacts to wetland and vegetation within the ROI. The No Action/Future Without Project Alternative is not predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.17.3 Alternative 3-6: OYSTER REEF + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts to vegetation, wetlands, the shoreline, and SAV from the oyster reef would be as those described for Alternative 1.

The majority of the project site is composed of intertidal and subtidal habitat in regard to the wetland restoration. These tidal marshes, located at either end of the project site, have been experiencing high levels of erosion and undercutting. The native marsh vegetation in the low marsh at this site is cordgrass and at the high marsh is dominated by salt meadow hay. Approximately 1.1 acres of wetland habitat would be restored at the project site. During wetland plantings, there would be temporary, adverse impacts to the existing vegetation from machinery and human impacts while walking around and planting in the existing area. Operations would be managed to minimize these impacts where possible to not highly impact the existing wetland habitat. However, once the planting is complete, vegetation would rebound and impacts from the planting will then become beneficial.

In conjunction with marsh planting, this alternative also aims to increase the Atlantic ribbed mussel population within the constructed wetland area (approximately 1.1 acres). This would have beneficial impacts to the vegetation since mussels live in mutualism with cordgrass marshes. The mussel feces and pseudofeces act as a fertilizer for the marsh plants and the presence of mussels has been shown to produce taller and denser marsh plants (DPE 2015).

As the marsh transitions to the bank, the existing vegetation includes marsh elder (*Iva frutescens*), and groundsel tree (*Baccharis hamifolia*). This alternative would increase shoreline stabilization efforts by planting more of these native species in the action area. During implementation, there would be temporary, adverse impacts to the existing vegetation if they need to be relocated or removed for construction access.

Overall, there would be temporary, minor, adverse effects, and permanent, minor to moderate, and beneficial effects. The No Action/Future Without Project Alternative would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.17.4 Alternative 2-3-6: OYSTER REEF RESTORATION+ MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts for the oyster reef, wetland and shoreline restoration would be those described in Alternative 3-6.

This alternative 2-3-6 would increase the population of Atlantic Ribbed Mussels even further, by building reefs on either end of the ROI. Equipment used to deploy the mussels could impact the existing vegetation on a minor scale. However, the benefits of adding more mussels to the ecosystem outweigh the temporary impacts to the current vegetation, because this alternative

includes the restoration efforts within the marsh and bank. In addition to the mussels placed on the 1.1 acres of created wetland habitat from Alternative 3-6, this alternative will place additional mussels on 0.6 acres of existing wetland habitat.

Overall, there would be temporary, minor adverse effects, and permanent, minor to moderate, beneficial effects. This Alternative would not be predicted to substantially cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.17.5 Best Management Practices

As the design and engineering of the alignments advance, minor alignment shifts could be evaluated to avoid and minimize potential impacts to wetland vegetation. These considerations could be undertaken during the PED phase and coordinated with applicable agency partners during the associated permit application process. For any of these potential final alignments, avoidance and minimization practices will be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to existing wetlands and vegetation during temporary construction conditions:

- Strict erosion and sediment control measures will be employed during construction.
- Existing wetland plants and bank vegetation will be replaced if damaged during restoration
- All new wetlands and plants will be marked with appropriate signs to avoid visitor impacts

#### 5.17.6 Cumulative Impacts

Cumulative effects to vegetation within the ROI from VDOT's future shoreline restoration project would be considered negligible. VDOT will be constructing a similar project with wetland restoration and the installation of breakwaters along the adjacent shoreline. Both projects would increase wetland habitat within the ROI and therefore increasing biodiversity, however, impacts of both projects would work independently of one another. Although increased climate change has the potential to adversely impact vegetation in the ROI, implementation of any of the Action Project Alternatives would not be anticipated to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.18 WATER QUALITY

#### 5.18.1 No Action/Future Without Project Alternative

With the No Action/Future Without Project Alternative, there would be no change to water quality in the ROI in the short-term. Water quality would continue to be a function of existing environmental conditions, including wind and tidal currents, sedimentation and runoff, and freshwater inputs/nutrient loading during spring months and storm events throughout the year.

Climatic changes such as sea level rise and increasing global temperatures would be 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. Climate change is anticipated to potentially increase winter and spring nutrient loading into the Chesapeake Bay (Najjar et al. 2010). The higher temperatures, lower dissolved oxygen levels,

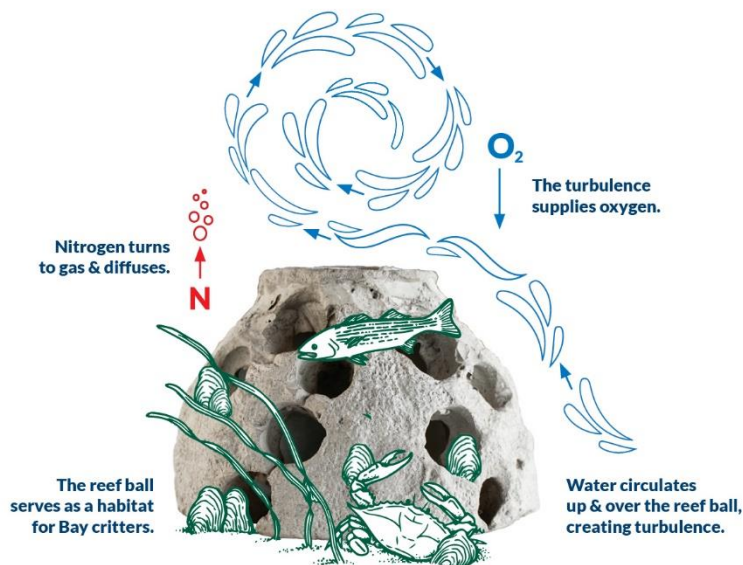
and increased phytoplankton productivity may result in more frequent hypoxic conditions (low dissolved oxygen conditions) in the water column. The anticipated higher temperatures and carbon dioxide levels in the Chesapeake Bay may result in increases in harmful algal blooms (Najjar et al. 2010). As wetlands retreat and benthic organisms, such as Atlantic ribbed mussels are removed from the system, water quality would decline, allowing for a higher concentration of particles that can be nutrient-laden and pathogenic to humans (PDE 2015). The implementation of the No Action/Future Without Project Alternative would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

Therefore, implementation of the No Action/Future Without Project Alternative would result in minor, adverse impacts to water quality.

### 5.18.2 Alternative 1: OYSTER REEF RESTORATION

Implementation of Alternative 1 would result in minor, temporary impacts to water quality in the ROI. During construction of the oyster reef, turbidity would increase along with TSS in the water column during placement of the reef materials on the subaqueous bottom. However, suspended solids would settle out of the water column following the placement of reef materials and the site would quickly return to ambient conditions.

Once the oyster reef is established, it would improve water quality due to the filter feeding capabilities of the oysters and habitat it will provide for other Bay critters. Each oyster has the potential to filter up to 50 gallons of water per day, removing suspended solids from the water column, decreasing turbidity, reducing TSS levels, and increasing water clarity. It has been shown that artificial reefs such as dome-like reef structures, create more productive turbulence in the water column. The proposed oyster reef will be approximately 0.2 acres, made from an estimated 670 alternative substrates. The presence of the reef will supply more oxygen to the aquatic environment and assist in turning excess nutrients, such as Nitrogen into gas form, so it can be diffused and removed from the ecosystem (Chesapeake Bay Foundation). See Figure 5-3 below.



### Figure 5-3. Example Reef Ball Structure (CBF 2020).

The implementation of Alternative 1 would not predicted be to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects. Therefore, effects to the water quality from implementation of the Alternative 1 would be temporary, adverse, and minor, and permanent, beneficial and minor.

#### 5.18.3 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts to water quality from the installation of the artificial oyster reef, would be as those described in Alternative 1. During wetland restoration, sediment from the salt marsh sites would be exposed during the plantings and could enter the water column. Increased turbidity has the potential to lower Dissolved Oxygen, however these impacts are limited to the time of construction and conditions will return to pre-construction levels. Best management practices would be implemented while wetland sites are being restored, eliminating adverse water quality impacts. The additional mussels that will be planted within the wetland area may cause initial damages to the existing wetland plants and mussel population through compaction or burial. However, these additional mussels would aid in the improvement of water quality, stabilize the wetlands and prevent further erosion. According to the Partnership for the Delaware Estuary (2015), Atlantic ribbed mussels are responsible for a substantial amount of pelagic-benthic coupling as the suspended materials they filter get transferred to the sediment surface as feces and pseudofeces.

Operating machinery on site for the vegetation plantings along the bank may cause loose sediment to erode into the water, impacting local water quality. While these effects are temporary and localized, they would be minimized and prevented upon the addition of the native plants and coir logs. Coir logs have the ability to host plants as well as trap sediment from entering into the water.

Overall, implementation of Alternative 3-6 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects. Therefore, effects to the water quality from implementation of this Alternative temporary, adverse, and minor, to permanent, beneficial and minor.

#### 5.18.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Impacts from the installation of the oyster reef, wetland and bank restoration would be as those described in Alternative 3-6. According to the Partnership for the Delaware Estuary (2015), “in estuaries with lots of mussel-rich salt marshes, mussel populations might help sustain water quality at the watershed scale.” Initial impacts to water quality during construction would occur from an increase in suspended particles upon placement of the mussels. The ecosystem services that the additional mussels would enhance the local ecosystem and assist in returning any local water quality issues to ambient conditions. As the sediments resettle and conditions return to pre-construction, the increased population of mussels would stem erosion by binding

tightly together and planting roots, therefore, retaining any further influx of sediments into the water column, reducing eutrophication and enhancing water quality (PDE 2015).

Overall, implementation of Alternative 2-3-6 would not substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects. This Alternative would have temporary, adverse, and minor effects, and permanent, beneficial and minor effects on water quality.

#### 5.18.5 Best Management Practices

For any of the action alternatives, avoidance and minimization practices would be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to local water quality include:

- Use of turbidity curtains and other sediment control methods to reduce sedimentation due to construction activities.
- Avoid placing staging areas or structural measures in the water.
- If stone is placed in or near the water, ensure it is clean stone free from dirt and debris.
- Appropriate curing of reef material (at least 30 days) to ensure material is dry prior to being placed in the water

#### 5.18.6 Cumulative Impacts

With the onset of sea level rise, and global climate change, wetland fragmentation and ultimate loss are inevitable, as they are drowning and becoming subtidal environments. The quality of the surface waters in the ROI is dependent upon the water quality of the tributaries draining into the watershed. Implementation of the alternatives are not predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

Cumulative effects to water quality resulting from VDOT's future shoreline restoration project VDOT at the adjacent Belle Isle property in conjunction with the implementation of any of the above alternatives would be considered negligible. Similar construction equipment to the current proposed project would be expected to be used resulting in temporary and localized impacts to water quality. The cumulative impacts to water quality would be negligible and would not result in measurable changes to regional water quality.

### 5.19 WILDLIFE

#### 5.19.1 No Action/Future Without Project Alternative

In the absence of shoreline stabilization measures, erosion would continue to result in shoreline loss at an approximate rate of 0.84 feet per year and the conversion of existing intertidal habitat to subtidal habitat. Shoreline retreat would continue to threaten the survival of trees in the riparian buffer due to root exposure and eventual collapse into the Rappahannock River. The gradual loss of existing marsh and nearshore sandy habitat over time would result in the decrease of abundance and biodiversity of certain types of prey species in the ROI. In turn, this may have further implications at high trophic levels for species, such as shore and marsh-dwelling birds, who depend upon abundant food sources for their survival.

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, sea level rise, and changes in currents and weather patterns have the potential to influence the nature and character of the estuarine ecosystem and the abundance of wildlife in the ROI. Shifts in salinity, temperature, and sea level all have the potential to result in shifts in prey species availability with minimal, adverse impacts to wildlife.

The No Action/Future Without Project Alternative is not predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects, including the future VDOT shoreline restoration project to the east of the project site. Therefore, with implementation of the No Action/Future Without Project Alternative, impacts on wildlife are adverse permanent, and negligible to minor.

### 5.19.2 Alternative 1: OYSTER REEF RESTORATION

During construction activities of the subtidal to intertidal oyster reef, some wildlife would be temporarily displaced from the action area and certain species, such as shore-dwelling birds would likely avoid the area until all construction activities are complete and ambient conditions are restored. Increased turbidity during in-water construction of the oyster reef may temporarily disrupt foraging abilities of wildlife. However, once the barge and construction equipment complete the project, all wildlife will return and to an enhanced ecosystem. Overall, there would be temporary, adverse, negligible to minor effects, and permanent, beneficial minor effects to wildlife during implementation of Alternative 1.

Implementation of the Project Alternative 1 would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

### 5.19.3 Alternative 3-6: OYSTER REEF RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Oyster restoration impacts would be as those described in Alternative 1.

The activities involving the wetland sites may have some temporary adverse effects on terrestrial and avian resources. For example, while the wetland sites are being replanted, the heavy equipment used in the process may flush away avian and terrestrial wildlife. Mammals that would typically occur in the area include the gray squirrel, eastern chipmunk, otter, eastern cottontail, porcupine, skunks, Virginia opossum, whitetail deer, red fox, and raccoon. Some common amphibian and reptiles include bull frogs, snapping turtles, and salamanders. Normal behaviors would be disturbed briefly but would return to normal once the initial activity has been completed. Impacts on current mussel populations would be negligible during restoration, as more will be placed on site during construction. Long term impacts of wetland restoration on the terrestrial resources of the Belle Isle project site will be primarily positive in nature.

The Chesapeake Bay region of the Atlantic Flyway has a diverse population of songbirds, shorebirds, water birds, raptors, and waterfowl species. Wetland complexes, forest stands, open fields, and shallow waters of the Chesapeake Bay, including tributaries such as the Rappahannock River, provide benefits year-round for resident and migratory birds to feed and nest. There are six species of migratory birds within the ROI, and all species listed in Table 5-2 except the bald eagle are considered Birds of Conservation Concern throughout their range in the continental United States and Alaska. According to the Center for Conservation and

Biological Diversity, no known active bald eagle nests have been reported in the ROI.

Table 5-2. Birds of Conservation Concern

Bald eagle	<i>Haliaeetus leucocephalus</i>	Breeds Dec 15 to June30
Bobolink	<i>Dolichonyx oryzivorus</i>	Breeds May 20 to Jul 31
Kentucky warbler	<i>Oporornis formosus</i>	Breeds Apr 20 to Aug 20
Prairie warbler	<i>Dendroica discolor</i>	Breeds May 1 to Jul 31
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	May 10 to Sep 10
Wood thrush	<i>Hylocichla mustelin</i>	May 10 to Aug 31

Some areas of the beach, including the exposed bank, can provide important habitat for birds, reptiles, and other animal species. During restoration of the exposed bank through coir log placement and native vegetation planting, some terrestrial and avian wildlife may be temporarily disrupted and displaced. The diamondback terrapin (*Malaclemys terrapin*), a state threatened species, typically nests on bare or sparsely vegetated beaches. According to Park personnel, diamondback terrapins are commonly observed in this area. Terrapins mate and lay eggs on beaches in late spring, to be hatched in late summer, early fall (Chesapeake Bay Program 2020). The time of year for construction may impact terrapin nesting either through compaction, burial or displacement of nesting females. Upon completion of this project, the habitat connectivity will reduce fragmentation and provide additional foraging and nesting habitat for terrapins. The horseshoe crab (*Limulus polyphemus*) also inhabits beach habitat within the intertidal zone during the egg-laying period. Spawning areas are difficult to document since egg deposits occur at night (Butowski 1994). A variety of birds (e.g., shorebirds, gulls, and fish crows) utilize beach habitat for foraging. Other avian species such as belted kingfisher (*Ceryle alcyon*), bank swallow (*Riparia riparia*), and rough-winged swallow (*Stelgidopteryx serripennis*) utilize exposed banks to create nesting cavities. Initial site visits did not see any evidence of nesting cavities, however, at time of construction there may be impacts to ones that have since developed a nesting ground. Vegetation plantings may reduce or eliminate the use of the exposed bank for those avian species; however, they will open a new habitat for other bird species to inhabit.

Although some initial impacts may take place, expanding the habitat diversity and shoreline stability will increase the biodiversity of wildlife which use the sites. Overall, there would be temporary, adverse, negligible to minor effects, and permanent, beneficial minor effects to wildlife during implementation of Alternative 3-6. Implementation of Project Alternative 3-6 would not predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects, including the future VDOT shoreline restoration project.

#### 5.19.4 Alternative 2-3-6: OYSTER REEF RESTORATION + MUSSEL RESTORATION + WETLAND RESTORATION + SHORELINE RESTORATION

Alternative 2-3-6 adds additional mussel restoration pieces to the project area in conjunction to what was described in Alternative 3-6. Wildlife effects would be similar to those for Alternative 3-6, except perhaps slightly more beneficial. Overall, there would be temporary, adverse, negligible to minor effects, and permanent, beneficial minor effects to wildlife during implementation of Alternative 2-3-6. Increasing the mussel population would not be predicted to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

#### 5.19.5 Best Management Practices

For any of the action alternatives, avoidance and minimization practices would be employed to the maximum extent practicable for all potential impacts. Specific examples of best management practices to avoid and minimize impacts to terrestrial wildlife and habitat include:

- Planting native vegetative seed mixes on disturbed land after construction is complete.
- Avoid placing staging areas or structural measures in established wildlife habitat, use the same pathway to transport supplies and materials for bank and wetland planting to minimize impacts.
- Time of year for construction and equipment pathways along the beach will be evaluated to avoid impacts to nesting diamondback terrapins in early spring, or hatchlings in late summer, early fall.

## **6. CUMULATIVE IMPACTS**

The future shoreline restoration project planned by VDOT would likely have temporary, minor adverse impacts to wildlife in the ROI during construction; however, cumulative, long-term effects to wildlife would be expected to be beneficial due to the restoration of ecosystem benefits and services that would occur as a result of the shoreline restoration work at both sites and the oyster reef proposed as part of the Action Alternative 1. Although the long-term effects of climate change have the potential to adversely impact wildlife in the ROI, implementation of the any of the above Action Project Alternatives would not be anticipated to substantially, cumulatively or synergistically interact with climate change and/or other cumulative effects.

## 7. COMPLIANCE

Compliance with the following environmental laws (and implementing regulations) and Executive Orders (EOs) is required for the project alternatives under consideration (note: this is not necessarily an exhaustive list of all applicable environmental requirements). This project is anticipated to be in full compliance with all environmental laws and EOs. See Table 7-1 for the Table of Environmental Compliance.

Table 7-1. Table of Environmental Compliance

<b>Title of Law</b>	<b>U.S. Code</b>	<b>Compliance Status</b>
Abandoned Shipwreck Act of 1987	43 United States Code (U.S.C.) 2101	N/A-no shipwrecks within project ROI
American Bald and Golden Eagle Protection Act of 1962, as amended	16 U.S.C. 668	Full Compliance
Anadromous Fish Conservation Act of 1965	16 U.S.C. 757 et seq	Full Compliance
Clean Air Act of 1972, as amended	42 U.S.C. 7401 et seq	Full Compliance
Clean Water Act of 1972, as amended	33 U.S.C. 1251 et seq	Full Compliance
Coastal Zone Management Act of 1972, as amended	16 U.S.C. 1451 et seq	Full Compliance
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	N/A
Emergency Wetlands Resources Act	16 U.S.C. 3901-3932	N/A
Endangered Species Act of 1973	16 U.S.C. 1531	Full Compliance. Coordination completed; concurrence received from USFWS and NMFS
Estuary Protection Act of 1968	16 U.S.C. 1221 et seq	Full Compliance

Title of Law	U.S. Code	Compliance Status
Fish and Wildlife Coordination Act of 1958, as amended	16 U.S.C. 661	Full Compliance
Flood Control Act of 1970	33 U.S.C. 549	N/A
Land and Water Conservation Act	16 U.S.C. 460	Full Compliance
Magnuson-Stevens Fishery Conservation and Management Act	16 U.S.C. 1801	Full Compliance (for this phase) Coordination completed; concurrence received December 1, 2020.
Marine Mammal Protection Act of 1972, as amended	16 U.S.C. 1361	Full Compliance
Marine Protection, Research, and Sanctuaries Act of 1972	33 U.S.C. 1401	N/A
Migratory Bird Conservation Act of 1928, as amended	16 U.S.C. 715	Full Compliance
Migratory Bird Treaty Act of 1918, as amended	16 U.S.C. 703	Full Compliance
National Environmental Policy Act of 1969, as amended	42 U.S.C. 4321 et seq	Full compliance is anticipated following the signing of the Finding of No Significant Impact.
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

<b>Title of Law</b>	<b>U.S. Code</b>	<b>Compliance Status</b>
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 7-2. Executive Orders

<b>Title of Executive Order</b>	<b>Executive Order Number</b>	<b>Compliance Status</b>
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	N/A
Federal Compliance with Right-to-Know Laws and Pollution Prevention	12856	N/A
Federal Actions to Address Environmental Justice and Minority and Low-income Populations	12898	N/A
Protection of Children from Environmental Health Risks and Safety Risks	13045	Full Compliance
Invasive Species	13112	Full Compliance
Marine Protected Areas	13158	N/A

<b>Title of Executive Order</b>	<b>Executive Order Number</b>	<b>Compliance Status</b>
Consultation and Coordination with Indian Tribal Governments	13175	Full Compliance
Responsibilities of Federal Agencies to Protect Migratory Birds	13186	Full Compliance.
Facilitation of Cooperative Conservation	13352	N/A
Planning for Federal Sustainability in the Next Decade (2015)	13693	Full Compliance

Table 7-3. Environmental Permitting Requirements

<b>Law</b>	<b>Agency Responsible</b>	<b>Permit, Agreement, Authorization, or Notification Required</b>
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 required
Comprehensive Environmental Responses, Compensation and Liability Act of 1980, as amended	USEPA	N/A
Clean Water Act, Section 401	VDEQ	401 Water Quality Certification to be obtained during the Pre-construction, Engineering and Design phase
CZMA	VDEQ	Concurrence determination received from VDEQ February 9, 2021
Coastal Barrier Resources Act (CBRA)	USFWS	N/A
Endangered Species Act of 1973	NMFS	“No effect” and “Not likely to Adversely Affect” concurrence determinations

Law	Agency Responsible	Permit, Agreement, Authorization, or Notification Required
		from NMFS provided September 21, 2020; concurrence determination from USFWS provided December 1, 2020.
Fish and Wildlife Coordination Act (FWCA)	USFWS	Final FWCA Report provided December 1, 2020.
Magnuson-Stevens Fishery Conservation and Management Act	NMFS	Concurrence determination from NMFS provided December 11, 2020.
Marine Mammal Protection Act of 1972, as amended	NMFS	N/A; no authorization required
Marine Protection, Research, and Sanctuaries Act of 1972*	USEPA	N/A
Migratory Bird Treaty Act of 1918, as amended	USFWS	No take permit required
National Historic Preservation Act of 1966, as amended	Advisory Council on Historic Preservation, Virginia Department of Historic Resources	Concurrence determination provided November 20, 2020.
Noise Control Act of 1972	USEPA	Full Compliance
Resource Conservation and Recovery Act of 1976	USEPA, VDEQ	Full Compliance

**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 EIS for any major federal action that could have a significant impact on quality of the human environment and the preparation of an 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 IFR/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 Section 1.8, National Environmental Policy Act, Scoping and Public, Resource Agency, and Tribal Coordination. The Draft IFR/EA will undergo a 30-day agency, tribal, and public review period. All comments will be addressed in the Final IFR/EA, and responses to comments received will be provided in Environmental Appendix. The Final IFR/EA, including all appendices and supporting documentation accompanied by the signed Finding of No Significant Impact fulfills requirements of the NEPA.

### **Clean Water Act**

This IFR/EA contains sufficient information to demonstrate that the Recommended Plan is in compliance with the Clean Water Act. The Clean Water Act, 404(b)(1) Report provided in the Environmental Appendix documents this project is in full compliance with Section 404 of the Clean Water Act.

Section 404 of the Clean Water Act 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. This project will benefit tidal wetlands and no direct, permanent adverse impacts to jurisdictional wetlands are anticipated with implementation of this project. No wetland mitigation is required for this project.

The State Water Control Board issued conditional §401 Water Quality Certification for Nationwide Permit (NWP) 27 Aquatic Habitat Restoration, Enhancement, and Establishment Activities (effective date 19 March 2017) as meeting the requirements of the Virginia Water Protection Permit Regulation. A copy of the NWP 27 including terms and conditions is provided in the Integrated Report/Environmental Assessment Appendix A, Environmental Appendix. The Recommended Plan appears to meet the requirements of the NWP 27 and its associated Water Quality Certification, pending confirmation based on information to be developed during the Design and Implementation Phase. Therefore, this provides reasonable assurance that a Water Quality Certification pursuant to Section 401 of the Clean Water Act could be issued for the Recommended Plan from the VDEQ. A Water Quality Certification pursuant to Section 401 of the Clean Water Act would be obtained from the VDEQ prior to construction. All conditions of the Water Quality Certification would be implemented in order to minimize adverse impacts to water quality.

### **Federal Coastal Zone Management Act, 16 U.S.C. 1451 et seq.**

The federal 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, 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 VDEQ 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 project would be carried out in a manner that is fully consistent with the enforceable policies of the Virginia CMP. Coordination with the VDEQ is ongoing, and the Federal Consistency Determination submitted to VDEQ is provided in the Environmental Appendix. Concurrence was obtained on February 09, 2021.

#### **Clean Air Act, as amended, 42U.S.C. 7401 et seq.**

There will be negligible to minor, temporary increases in air emissions from operation of construction equipment during construction and maintenance operations. These emissions will be below *de minimis* levels. 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.

#### **U.S. Fish and Wildlife Coordination Act, 16 U.S.C.661-666(c)**

The Final Fish and Wildlife Coordination Act Report was received on December 1, 2020, indicating full compliance with the Fish and Wildlife Coordination Act.

#### **Endangered Species Act**

Coordination with the USFWS pursuant to Section 7 of the ESA for the species and their effect determination are provided in Table 7-4.

Coordination with the USFWS pursuant to Section 7 of the ESA was completed on December 1, 2020 in full compliance. Coordination with the NMFS pursuant to Section 7 of the ESA was completed on September 21, 2020. This documentation is provided in the Environmental Appendix.

Table 7-4. Federally Listed Species Known or With the Potential to Occur in the Action Area

<b>Taxonomic Category/Common Name</b>	<b>Scientific Name</b>	<b>Status</b>	<b>Critical Habitat</b>	<b>Affect Determination</b>
<b><i>Fish</i></b>				
Atlantic Sturgeon	<i>Acipenser oxyrinchus oxyrinchus</i>	E	Y*	May Affect, Not Likely to Adversely Affect
Shortnose Sturgeon	<i>Acipenser brevirostrum</i>	E	N	May Affect, Not Likely to Adversely Affect
Kemp's Ridley Sea Turtle	<i>Lepidochelys kempii</i>	E	N	May Affect, Not Likely to Adversely Affect
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	E	N	May Affect, Not Likely to Adversely Affect
Green Sea Turtle	<i>Chelonia mydas</i>	E	N	May Affect, Not Likely to Adversely Affect
Loggerhead Sea Turtle	<i>Caretta caretta</i>	T	N	May Affect, Not Likely to Adversely Affect
<b><i>Mammal</i></b>				
Northern long-eared bat	<i>Myotis septentrionalis</i>	T	N	No Affect

T = Threatened; E = Endangered; Y = Yes; N = No; ^Species status is reported as it pertains to the DPS/Action; \*Critical Habitat not located in Action Area.

**Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. 1801 et seq.**

This Act requires federal action agencies to consult with the NMFS if a proposed action may affect EFH. The USACE evaluated potential project impacts on NMFS-managed fish species on EFH; this determination is found in the Environmental Appendix. Negligible to minor, adverse impacts to some EFH is anticipated, however no impacts are anticipated to substantively impact EFH. There will also be permanent, negligible to minor beneficial impacts to EFH fish due to the placement of alternative reef structures. Relevant correspondence is provided in the Environmental Appendix, concurrence received on December 11, 2020.

**Anadromous Fish Conservation Act, 16 U.S.C. 757, et seq.**

The project considered habitat impacts to the anadromous fish. Adverse, temporary, negligible to minor impacts are anticipated due to increased potential of Total Suspended Solids and turbidity in the water column during reef and wetland planting placement operations. NMFS concurred with this finding.

### **Marine Mammal Protection Act, 16 U.S.C. 1631 et seq.**

The Marine Mammal Protection Act prohibits the take of marine mammals including the West Indian manatee, and all cetaceans found in the ROI. There would be no anticipated impacts to marine mammals with implementation of the Recommended Plan.

### **Section 106 and 110(f) of the National Historic Preservation Act, 16 U.S.C. 470 et seq.**

The NHPA applies to properties listed in or eligible for listing in the 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, 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 and determined there would be no adverse to historic resources. Section 106 consultation concluded when VDHR provided written concurrence that there would be no adverse effects to historic resources with implementation of the project on November 20, 2020. The concurrence determination from VDHR is provided in the Environmental Appendix.

### **Resource Conservation and Recovery Act, as amended, 42 U.S.C. 6901 et seq.**

The RCRA controls the management and disposal of hazardous waste. “Hazardous and/or toxic wastes,” classified by the 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 are no RCRA sites or generators in the vicinity of the project area.

### **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 is no evidence or history of contamination at the project site under the CERCLA.

### **Executive Order 11988, Floodplain Management**

Federal agencies should avoid, to the extent possible, the long-and short-term adverse impacts associated with the occupancy and modification of the Base Floodplain (1% annual chance floodplain as defined by FEMA, and the avoidance of direct and indirect support of development in the Base Floodplain wherever there is a practicable alternative. Under the EO, USACE is

required to provide leadership and take action to: 1) Avoid development in the Base Floodplain unless it is the only practicable alternative; 2) Reduce the hazard and risk associated with floods; 3) Minimize the impact of floods on human safety, health and welfare; and 4) Restore and preserve the natural and beneficial values of the Base Floodplain. For critical facilities, the 0.2% annual chance floodplain should be evaluated.

From USACE ER 1165-2-26, in accordance with EO 11988, USACE uses the eight-step process below to address floodplain management, with project-specific responses:

1. **Determine if the proposed action is in the Base Floodplain.** Due to location, type, and nature of the proposed project, restoration and/or enhancements of tidal shoreline wetlands, river-shoreline interface, and oyster reef habitats, all alternatives are located in the Base Floodplain.
2. **If the action is in the Base Floodplain, identify and evaluate practicable alternatives to the action or to location of the action in the Base Floodplain.** With ecosystem restoration including tidal wetlands, river-shoreline interface, and oyster reef habitats, all alternatives would be located in the Base Floodplain. Chapter 2 discusses the process of considering, screening, and comparing alternatives. Before screening, 16 potential alternatives were initially developed and considered.
3. **If the action must be in the floodplain, advise the general public in the affected area and obtain their views and comments.** Due to the limited scope of the proposed project, it was decided that an initial public scoping meeting was not necessary, but there would be an opportunity for the general public to review and provide comments with the Draft Continuing Authorities Program, Section 206, Aquatic Ecosystem Restoration Project, Belle Isle State Park, Lancaster, Virginia Draft IFR/EA.
4. **Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial floodplain values. Where actions proposed to be located outside the Base Floodplain will affect the Base Floodplain, impacts resulting from these actions should also be identified.** No alternatives will be located outside the Base Floodplain. No adverse impacts are expected; any impacts would be negligible and temporary. As an ecosystem restoration project, all alternatives would be beneficial to natural and beneficial floodplain values, no losses expected.
5. **If the action is likely to induce development in the Base Floodplain, determine if a practicable non-floodplain alternative for the development exists.** Due to location and scale of the project, none of the alternatives would be likely to induce development. The project is mainly focused within the normal/daily tidal zone.
6. **As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action including any likely induced development for which there is no practicable alternative and methods to restore and preserve the natural and beneficial floodplain values. This should include reevaluation of the "no action" alternative.** None of the alternatives would be expected to cause adverse impacts or induce development. The goal of the project would be to restore and preserve the natural and beneficial floodplain values.
7. **If the final determination is made that no practicable alternative exists to locating the action in the Base Floodplain, advise the general public in the affected area of**

**the findings.** A 30-day public review comment period of the Draft Continuing Authorities Program, Section 206, Aquatic Ecosystem Restoration Project, Belle Isle State Park, Lancaster, Virginia Draft FR/EA was conducted.

8. **Recommend the plan most responsive to the planning objectives established by the study and consistent with the requirements of the Executive Order.** The Recommended Plan is the most responsive to the planning objectives and consistent with the EO.

The Recommended Plan would have temporary, negligible to minor impacts to the Base Floodplain and is fully compliant with EO 11988.

#### **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. The Recommended Plan would enhance wetland functions and values and is in full compliance with this EO.

#### **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. The Recommended Plan is in full compliance with this EO.

#### **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. The Recommended Plan does not affect any minority or low-income communities. It is in full compliance with this EO.

#### **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. This project is in full compliance with this EO.

#### **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 impacts to migratory birds would range from adverse to beneficial effects that would range from a negligible to a minor level of impact.

## 8. LIST OF PREPARERS

Table 8-1. List of Preparers

Name	Contribution/Education	Years of Experience
Jennifer Shunfenthal	Plan Formulator/ Geography/BA, Environmental Management MS	5
Gerard Walter	Economics/ BS, Economics	10
John Haynes, RPA	Cultural Resources/MA, Anthropology	30
David Schulte	Environmental Analysis/MS, Marine Science	20
Alicia Logalbo	Environmental Analysis/MS, Biology	20
Paul Moye, P.E., CFM	Floodplain Management/BS, Civil Engineering	32
Heather Lockwood	Environmental Analysis/MS, Environmental Science & Policy	9
Tammy Knecht	GIS Mapping/BS, Environmental Biology	12
Leah Weaver	Water Resources/MS, Civil Engineering/BS	8
Bryan Adkins	Cost Engineering/BSE	5
Alicia Barrette	Real Estate/ BS, Ecological Studies	32

## 9. LISTING OF PERSONS AND AGENCIES CONSULTED

Table 9-1. Listing of Persons and Agencies Consulted

Name	Agencies/Governments
Russ Burke	Christopher Newport University
Christine Vaccaro	NOAA Fisheries
Ronald Grayson	VDHR
Marc Holma	VDHR
Kim Penrod	Delaware Nation
Chief Robert Grey	Pamunkey Indian Tribe
Chief Anne Richardson	Rappahannock Inc.
Andrew Button	VMRC
Brian Hopper	NOAA Fisheries
David O'Brien	NOAA Fisheries
Joseph Wood	Chesapeake Bay Foundation
Danielle Kreeger	Partnership for the Delaware Estuary
Josh Moody	Partnership for the Delaware Estuary
Julia Wellman	VDEQ
Craig Koppie	USFWS
Carrie Traver	USEPA

## 10. RECOMMENDATION

I concur with the findings of the Norfolk District Project Delivery Team (PDT) and advise that the Recommended Plan, as fully detailed in this Integrated Feasibility Study and Environmental Assessment, be authorized for construction as a federal project.

Potential impacts to the human environment have been fully evaluated and there are no significant impacts identified with implementation of the Recommended Plan. Impacts evaluated included environmental, cultural, social, and economic effects that are anticipated from the implementation of the Recommended Plan.

The Recommended Plan of the Norfolk District is Alternative 2-3-6; this alternative would restore approximately 0.2 acres of oyster reef habitat, 1.1 acres of wetland habitat (including mussel restoration), 0.6 acres of Atlantic ribbed mussel habitat in existing wetland habitat, and restoration of 0.3 acres of avian shoreline habitat . The Recommended Plan is the NER Plan and includes:

- Construction of oyster reef structures using artificial reef structures approximately 30 feet offshore from the existing shoreline;
- Restoration of historic wetland habitat by regrading and planting native cordgrass containing native Atlantic ribbed mussels;
- Restoration of the shoreline by placing coir logs and planting native plant species; and
- Enhancing wetlands and restoring native Atlantic ribbed mussel habitat by planting additional cordgrass with Atlantic ribbed mussels.

The Recommended Plan will cost approximately \$6,161,000 (Total Project Cost Fully Funded), with the 65% federal cost share of \$4,004,650 and 35% non-federal cost share of \$2,156,350. The non-federal sponsor is required to provide the non-federal cost share during project construction and all lands, easements, and rights-of-way necessary for the construction, operation, and maintenance of the project.

I also confirm that the IFR/EA, and FONSI complies with all applicable policies

BY: \_\_\_\_\_

DATE: \_\_\_\_\_

BRIAN P. HALLBERG, PMP  
COL, EN  
Commanding

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